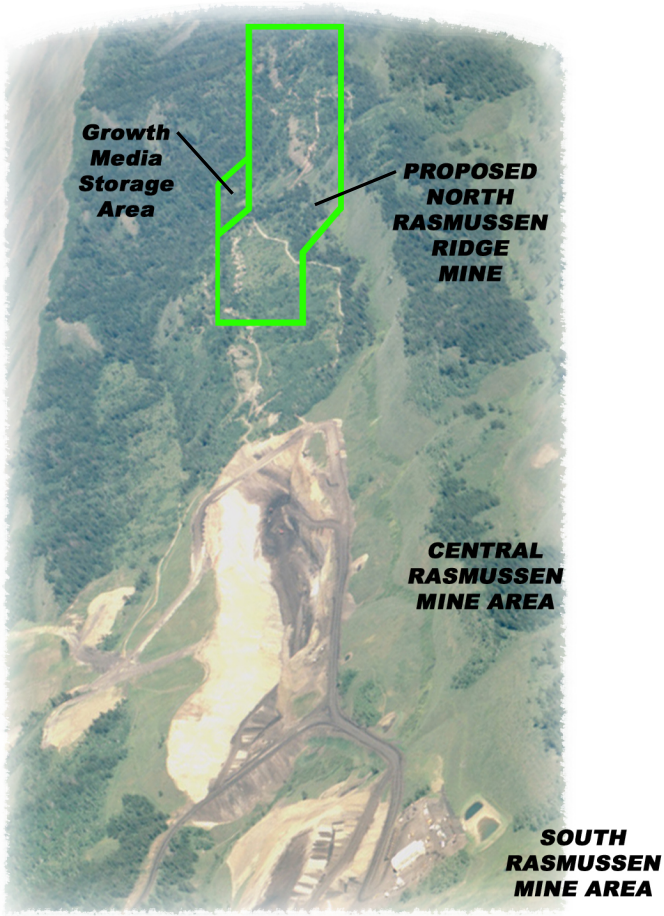
Draft

Environmental Impact Statement
North Rasmussen Ridge Mine

Agrium Conda Phosphate Operations
Caribou County, Idaho

Lead Agency:

U.S. Department of Interior
Bureau of Land Management
Upper Snake River District
Pocatello Field Office



Cooperating Agencies:

Idaho Department of Lands

U.S. Department of Agriculture
Forest Service
Caribou-Targhee National Forest

March 2003

Dear Reader:

Enclosed for your review and comment is the Draft Environmental Impact Statement (DEIS) for Agrium Conda Phosphate Operation's North Rasmussen Ridge Mine. The DEIS serves to analyze the effect of continuing mining operations for eight years beyond the current permit. The North Rasmussen Ridge Mine consists of two open pits and a haul road extension that are located approximately 19 miles northeast of Soda Springs in Caribou County, Idaho.

This DEIS addresses those concerns identified by the BLM or raised during public scoping from May 18 through June 5, 2001. The BLM, in conjunction with all interested parties, will propose mitigation measures to address incremental impacts which are over and above what was approved for the existing South and Central Rasmussen Ridge Mines.

Following the 60-day public review and comment period, a Final EIS will be prepared. It will include mitigation measures that address both predicted direct impacts from Agrium's proposed mining operations, as well as for predicted cumulative impacts from other activities in the area.

Public comments on the DEIS will be accepted during a 60-day comment period. Comments on the DEIS should be submitted to: Bureau of Land Management, Pocatello Field Office, Attention: Wendell Johnson, EIS Project Manager, 1111 North 8th Avenue, Pocatello, ID 83201, e-mail address: ID_NRasmussen_EIS@blm.gov.

The Final EIS may be published in an abbreviated format, so please retain this draft document for future reference. Your interest in the management of public lands is appreciated.

Sincerely,

K. Lynn Bennett
Idaho State Director

DRAFT ENVIRONMENTAL IMPACT STATEMENT
NORTH RASMUSSEN RIDGE MINE

LEAD AGENCY:	U.S. Department of Interior Bureau of Land Management Upper Snake River Districts Pocatello Field Office
COOPERATING AGENCIES:	U.S. Department of Agriculture Forest Service Caribou-Targhee National Forest Idaho Department of Lands
PROJECT LOCATION:	Caribou County, Idaho
DATE DRAFT EIS FILED WITH EPA:	March 7, 2003
DATE COMMENT PERIOD ENDS	May 6, 2003
MAILING ADDRESS FOR SUBMITTAL OF COMMENTS ON DRAFT EIS:	Mr. Wendell Johnson EIS Project Manager BLM Pocatello Field Office 1111 N. 8th Avenue Pocatello, ID 83201 (208) 478-6353 ID_NRasmussen_EIS@blm.gov

ABSTRACT

This Draft Environmental Impact Statement analyzes impacts related to the expansion of mining at Agrium's North Rasmussen Ridge Mine in southeast Idaho. The Proposed Action includes developing two mine pits and a haul road. Use of existing support and transportation systems would continue. Existing operations at the Central Rasmussen Ridge Mine are approved in a 1997 Mine Plan Approval. This environmental analysis reviews potential impacts from selenium and updates the previous impact analyses for other resources. Alternatives to the Proposed Action are also analyzed and site specific mitigation measures developed. The BLM Preferred Alternative is the Proposed Action because it disturbs the least acreage of the action alternatives and all waste material is returned back to the pits.

The BLM and USFS believe, at this early stage, it is important to give reviewers notice of several court rulings, related to public participation in the environmental review process. First, reviewers of draft environmental impact statements must structure their participation in the environmental review of the proposal so that it is meaningful and alerts an agency to reviewer's position and contentions. Vermont Yankee Nuclear Power Corp. v. NRDC, 435 U.S. 519,553 (1978). Also, environmental objections that could be raised at the draft EIS stage but that are not raised until after completion of the final EIS may be waived or dismissed by the courts. City of Angoon v. Hodel, 803 F. 2d 1016, 1022 (9th Cir. 1986) and Wisconsin Heritages, Inc. v. Harris, 490 F. Supp. 1334, 1338 (E.D. Wis. 1980). Because of these court rulings, it is very important that those interested in this proposed action participate by the close of the 60-day comment period for the draft EIS so that substantive comments and objections are made available to the BLM and USFS at a time when they can meaningfully consider and respond to them in the final EIS.

RESPONSIBLE OFFICIAL FOR DEIS:	Mr. K. Lynn Bennett Idaho State Director Bureau of Land Management
EIS NUMBER:	ID-075-2001-0016

ACRONYMS

AAQS	Ambient Air Quality Standards
ABA	Acid Base Accounting
AGP	Acid-Generating Potential
amsl	Above Mean Sea Level
ANP	Acid-Neutralizing Potential
ARD	Acid Rock Drainage
AUM	Animal Unit Month
BA	Biological Assessment
bcy	Bank Cubic Yard
BE	Biological Evaluation
BLM	Bureau of Land Management
BMP	Best Management Practices
CEQ	Council on Environmental Quality
cfs	Cubic Feet Per Second
CFR	Code of Federal Regulations
COPC	Constitutes of Potential Concern
CWA	Clean Water Act
°C	Degrees Celsius
°F	Degrees Fahrenheit
DEIS	Draft Environmental Impact Statement
EA	Environmental Assessment
EC	Electrical Conductivity
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act of 1972
FEIS	Final Environmental Impact Statement
FLPMA	Federal Land Policy and Management Act
gpm	Gallons Per Minute
HDPE	High-Density Polyethylene
HUC	Hydrologic Unit Code
IDAPA	Idaho Administrative Procedures Act
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Department of Fish and Game
IDL	Idaho Department of Lands
IDWR	Idaho Department of Water Resources
IMA	Idaho Mining Association
INFISH	Inland Native Fish Strategy
K factor	Hydraulic Conductivity
lcy	Loose Cubic Yard
LRMP	Land and Resource Management Plan
Maxim	Maxim Technologies, Inc.
MCL	Maximum Contaminant Level
$\mu g/m^3$	Micrograms Per Cubic Meter
meq/1	Milliequivalent Per Liter
mg/L	Milligrams Per Liter
mg/kg	Milligrams Per Kilogram
mm	Millimeters
mgpd	Million Gallons Per Day
mph	Miles Per Hour
mmhos/cm	millimhos of electrical current
MSHA	Mine Safety and Health Administration
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
ppm	Parts Per Million
PSD	Prevention of Significant Deterioration Air Quality Program
RCRA	Resource Conservation and Recovery Act
RHCA	Riparian Habitat Conservation Area
ROD	Record of Decision
ROS	Recreation Opportunity Spectrum
SAR	Sodium Adsorption Ratio
SHPO	State Historic Preservation Office
SIO	Scenic Integrity Objective
SPCC	Spill Prevention Control and Countermeasures Plan
SWPPP	Storm Water Pollution Prevention Plan
TCP	Traditional Cultural Property
TDS	Total Dissolved Solids
TES	Threatened, Endangered, or Sensitive Species
TMDL	Total Maximum Daily Load
tpy	Tons Per Year
USACE	United States Army Corps of Engineers
USDOT	United States Department of Transportation
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VMS	Visual Management System
VQO	Visual Quality Objective

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SUMMARY

SUMMARY

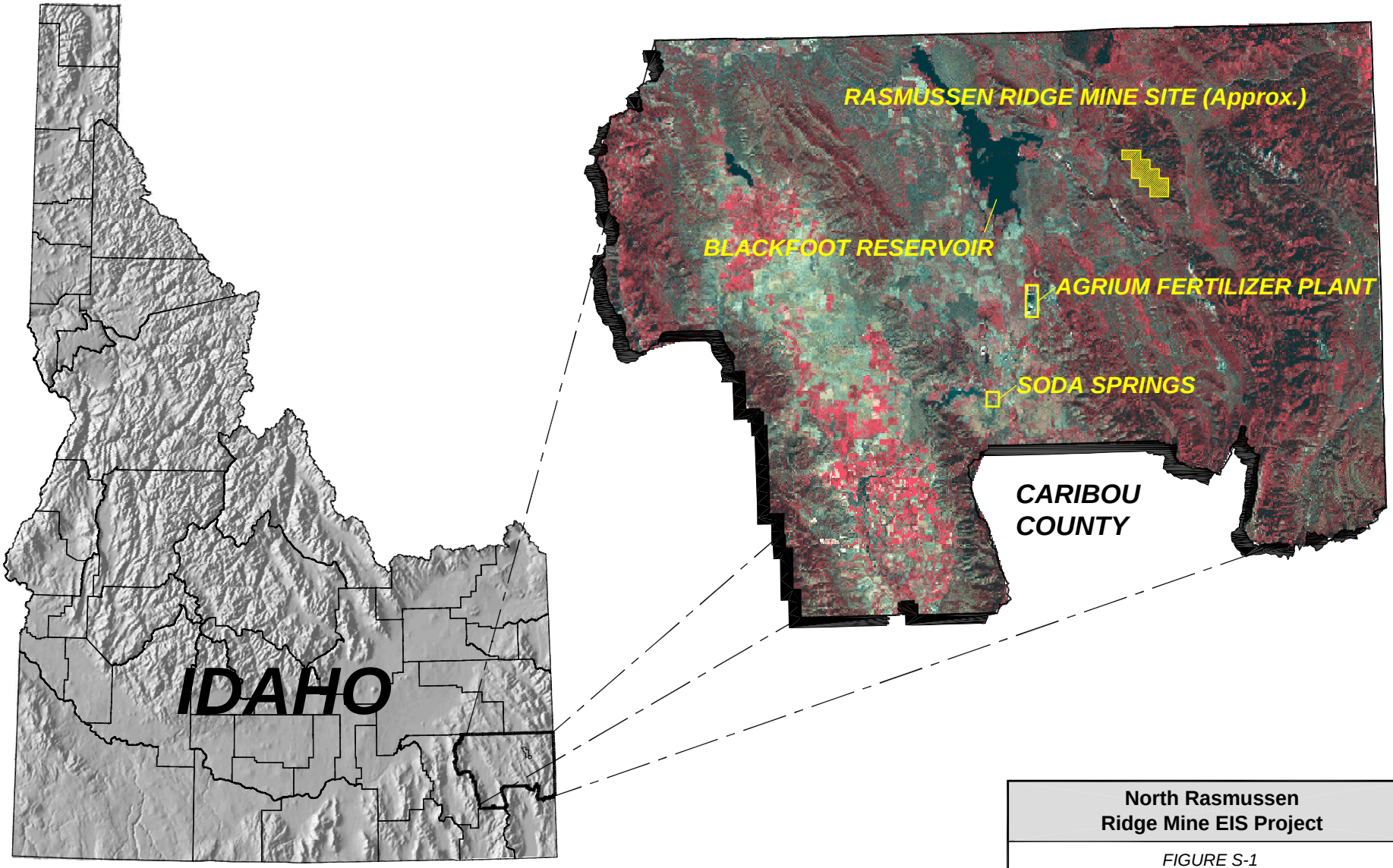
PROPOSED ACTION

Nu-West Industries, Inc., doing business as Agrium Conda Phosphate Operations (Agrium) has proposed to extend the existing mining operations at South and Central Rasmussen Ridge northward along the ridge onto lands administered by the U.S. Forest Service and Idaho Department of Lands. The project is located on public lands 19 miles northeast of Soda Springs in Caribou County, Idaho (**Figure S-1**). Mining would occur on Federal Phosphate Leases I-04375 and I-07619 within the Caribou-Targhee National Forest, and on State Lease I-9313, adjacent to the federal phosphate leases. Lease I-04375 contains 920 acres, and Lease I-07619 contains 437 acres. Lease I-04375 in its entirety and 200 acres of Lease I-07619 are located within the Caribou National Forest, and the remaining 240 acres of Lease I-07619 are on state land. The northeast corner of Section 16, T6S, R43E of the Boise Meridian contains Idaho mineral lease number I-7957, which is held by P_4 Production, LLC. A portion of the North Rasmussen ore body is located within that lease area. Agrium reached an agreement with P_4 (Agrium/P_4 Production Ore and Overburden Exchange Agreement) to acquire the mineral rights for this lease. IDL has reissued the lease as Agrium State Lease Number 9313. The proposed disturbance activities are shown by land ownership in Chapter 2, Table 2.2-2.

Disturbed lands that would result directly from the activities proposed would total 269 acres. The new pits would include 199 acres; the rest of the disturbed acreage would be for roads, ponds, and growth media stockpiles. All of the waste rock generated from the proposed pit would be placed as backfill in the Central and North Rasmussen pits after the ultimate pit depths have been achieved. Approximately 1,015,716 cubic yards of growth media would be salvaged and several hundred thousand cubic yards would be used immediately to cover disturbed areas. A storage area for the growth media would be developed to temporarily store up to 918,000 cubic yards of material. All available topsoil and alluvium from the pit would be directly applied to completed and re-sloped areas where possible or would be salvaged and held in the growth media storage area for future use. Approximately 197 acres of the proposed disturbance would be reclaimed. Most of the proposed open pits would be backfilled to approximate original contours, and one pit would be partially backfilled. Based on Agrium's current annual production rate, the life span of the proposed North Rasmussen Ridge Mine would be about 8 years.

ALTERNATIVES

Two alternatives to the Proposed Action were evaluated in the EIS: Alternative 1 – Proposed Action with Impermeable Capping of Backfilled Areas, and Alternative 2 – No Action. Alternative 1 is essentially the same as the Proposed Action except that Agrium would construct a layer of impermeable (low-permeability) material between the seleniferous waste and the applied growth media to minimize potential effects of water that could infiltrate into the backfill. This alternative would require a 26-acre external waste rock dump. Capping could be completed with clay material or a synthetic liner. If clay is used, a quarry of approximately 25 acres would be required. Total disturbance for Alternative 1 would be 320 acres. Under Alternative 2, No Action, no disturbance would occur at North Rasmussen Ridge, however, the 35-acre final pit would remain open at Central Rasmussen.



North Rasmussen Ridge Mine EIS Project	
FIGURE S-1 *GENERAL LOCATION MAP*	
ANALYSIS AREA: Caribou County, Idaho	
Date: 02.27.03	Drawing File: 1164 Loc.dwg
Scale: NTS	DRAWN BY: MTM

ENVIRONMENTAL IMPACTS

Proposed Action

Minerals, Topography, Geology, and Paleontology

Impacts associated with the Proposed Action would include: commitment of recoverable phosphate resources in the area of the Rasmussen Ridge to development; physical changes to topography and exposure of rocks; potential instability of disturbed slopes; potential damage to fossils; and potential exposure of earth materials that contain potentially harmful concentrations of selenium or other elements to weathering processes. If they are exposed, earth materials that contain selenium or other elements would increase the potential for release of these constituents into surface waters or soils. The release of unfavorable concentrations of selenium or other elements into the environment and subsequent uptake by plants or animals could have adverse effects on plant or animal life. Fossil resources, some with potential scientific significance, would be unavoidably destroyed by mining.

Air Resources

Standard environmental practices for evaluating impacts to air resources require consideration of the airshed [generally, the surrounding airshed within 100 kilometers (66 miles)] as well as to the immediate area. The North Rasmussen Ridge Mine is located in southeastern Idaho on Rasmussen Ridge between the Grays and Wooley mountain ranges.

The Proposed Action would create emissions of nitrogen oxides, carbon monoxide, volatile organic carbon, sulfur dioxide, and particulate matter with a 10-micron mean diameter. All these emissions would be within the NAAQS and would not be considered an impact to human health. The nearest residence is more than two miles northeast of the project site and the nearest sensitive area (Grays Lake National Wildlife Refuge) is over ten miles north of the site.

Water Resources

Direct and indirect impacts on water resources would result from the Proposed Action. These impacts were evaluated using models for infiltration and groundwater flow and transport.

Surface water impacts would result from surface disturbances related to the proposed mining activities within the Reese Canyon Creek, West Fork of Sheep Creek, and No Name Creek drainages. These disturbances would produce increased sediment loads which would be controlled by sediment collection basins, silt fences, sediment traps, concurrent reclamation of disturbed areas, and other Best Management Practices.

Overburden would be removed from the open pits and sequentially backfilled into the pits and covered with an engineered vegetative cover. The backfill would be subject to infiltration of precipitation and snowmelt. This infiltration of meteoric water would dissolve soluble chemical constituents from the overburden as it passes downward through the material. Column leach tests of the overburden have indicated that certain chemical constituents are likely to be leached

from the overburden in concentrations that are above the applicable groundwater or surface water standards. Based on geochemical testing, the constituents of potential concern (COPCs) in groundwater include total dissolved solids (TDS), sulfate, aluminum, antimony, cadmium, manganese, and selenium. COPCs in surface water include cadmium, nickel, selenium, and zinc. Selenium, aluminum, and cadmium would not exceed any groundwater standards outside the lease boundary.

The seepage would travel 400 feet through unsaturated rock from the bottom of the backfilled pit to the water table in the Wells Formation regional aquifer. As the seepage percolates downward through the unsaturated bedrock, attenuation reactions such as precipitation and adsorption, driven by changes in pH and lack of exposure to air would reduce the concentration of COPCs. The seepage would reach the water table where it would be diluted and possibly further attenuated by chemical reactions as it flows downgradient northwest in the Wells Formation aquifer.

Groundwater modeling of the impacts from seepage into the Wells Formation indicates that a groundwater mound would develop in the regional aquifer due to increased recharge from runoff into the partially backfilled pit. A manganese plume (within which concentration would exceed the applicable groundwater standard) would extend about 3,000 feet northwest of the lease boundary. Concentrations of antimony, sulfate, and TDS in groundwater would exceed Idaho groundwater standards inside the lease boundary, but would not exceed applicable standards outside the lease boundary. The Idaho groundwater standard for antimony is based on human health considerations. Groundwater standards for sulfate, TDS, and manganese are based on aesthetic qualities which do not impact human health. The Wells Formation aquifer does not appear to be connected to any surface springs or water bodies within the study area, and therefore the water quality impacts to the Wells Formation would not affect surface water quality. Two wells in the area (over 2 miles west of Rasmussen Ridge) provide domestic water. The manganese plume is not expected to affect those wells nor to pose an impact to human health.

Flow rates in surface streams, seeps, and springs would decrease during mining, as the open pits collect surface water runoff and shallow alluvial groundwater that would have reported to stream drainages. After mining, runoff from the fully backfilled pit areas would be restored, although the partially backfilled pit would continue to intercept surface runoff and shallow alluvial groundwater that would have reported to surface streams, seeps, and springs.

Watershed and Soils

The Proposed Action and alternatives would have direct and indirect impacts to the soil resources within the North Rasmussen Ridge Mine area. Soil resources outside the North Rasmussen Ridge Mine area would not be directly affected. The proposed mine expansion Panels A and B includes open-pit mining, overburden disposal as backfill, temporary storage areas for growth media, and storm water retention ponds. These facilities would result in 269 acres of disturbance, of which 197 acres would be reclaimed. The growth media storage area is expected to contain up to 918,000 cu yd of the 1,015,716 cu yd of salvaged growth media. The Proposed Action would place all overburden produced from mining processes in the unbackfilled

portions of the existing Central Rasmussen pit and the mined-out areas of the North Rasmussen pits as areas become available, eliminating the need for external waste rock dumps. Potential direct impacts on soil resources and watersheds in the project area include loss of soil during soil salvage and replacement, loss of sediment through erosion, exposure and mobilization of selenium, and reduced soil productivity. Indirect impacts on soil resources include degradation of water quality related to erosion or selenium in sediment and reduced success of vegetation related to soil fertility. Impacts from erosion are expected to be minimal as a result of the proposed BMPs and reclamation outlined in the North Rasmussen Ridge Supplemental Mine and Reclamation Plan. Loss of soil fertility within the project area could be reduced using BMPs by incorporating slash into the salvaged growth media to increase the organic matter content, mixing soils with few coarse fragments with soils that contain a higher content of coarse fragments to dilute the total percentage of coarse fragments, and timing salvage operations to optimize revegetation.

Existing watershed conditions would be modified by implementation of the Proposed Action because of the two stream diversions to prevent water from entering where portions of the pit would intercept natural flow during mining. The stream diversions would be temporary, and the culverts would be removed after mining and new stream channels would be constructed at the locations of the culverts. Impacts to the watersheds that result from the Proposed Action are expected to have minimal effects of sediment loss and erosion processes in the Blackfoot River Basin. Use of BMPs, water management, and concurrent reclamation of disturbed areas in accordance with the North Rasmussen Ridge Supplemental Mine and Reclamation Plan would control sediment yield to the six sub-watersheds.

Vegetation, Riparian Areas and Wetlands

Under the Proposed Action, 269 acres of vegetation would be altered, including 193 acres of conifer, 69 acres of mixed aspen/conifer, and 8 acres of sagebrush. No wetlands or riparian areas would be directly affected. All disturbed areas that are amenable to reclamation would be reclaimed. Of the 269 disturbed acres, 197 acres, or 73 percent of the disturbed area, would be reclaimed. Reclamation would include backfilling the pits with overburden, covering it with a minimum of 8 to 10 feet of non-seleniferous limestone and chert, and 2 to 3 feet of growth media. Reclamation would result in a shift in the plant community from aspen/conifer and sagebrush communities to a community initially dominated by grasses. With time and research, management may change and require other species mixes. Natural succession would also continue, so other species including trees and shrubs may invade the reclaimed area. Impacts to native and planted vegetation from uptake of selenium are not likely to be substantial because of the high toxicological thresholds and planned BMP actions.

The pits may intercept some groundwater flow in the shallow alluvium that may indirectly affect some wetland areas in upper Reese Canyon, No Name Creek and the West Fork of Sheep Creek during mining. After mining ends, the shallow alluvial flow would be restored by constructing channels of impervious material across the top of the backfilled pit to allow surface flows to reenter the drainages, however, groundwater flow in shallow alluvium may be altered to the northeast of the pit. Some wetlands may lose a portion of their water supply.

Noxious weeds may become established from ground disturbance under the Proposed Action, but existing monitoring and control programs would be maintained until reclamation is complete.

Terrestrial Wildlife

The Proposed Action would disturb wildlife habitat during construction and mine operations. Wildlife mortalities and injuries to ground and tree nesting species would occur during ground clearing and construction. Mortalities and injuries to wildlife may also occur during operations as a result of accidental collisions with vehicles. Potential effects to wildlife would also include loss of habitat and potential effects from exposure to selenium. The Proposed Action would affect 269 acres of wildlife habitat; the majority would be restored to habitat initially dominated by perennial grasses, with limited trees and shrubs, after mining operations end. It is planned to replant trees and shrubs during reclamation, some by bucket plantings and some as seedlings. Wildlife habitat would not be restored to its original condition within the proposed project disturbance footprint for many decades.

Long-term impacts to wildlife resources that would result from exposure to selenium are possible as the result of the Proposed Action. The use of at least 8 to 10 feet of non-seleniferous overburden material along with 2 to 3 feet of growth media is expected to limit the potential for uptake of selenium through the food chain once mineral extraction is completed.

Fisheries and Aquatic Resources

Potential impacts to aquatic wildlife and fisheries in the study area include changes in habitat quality and quantity and effects from exposure to selenium. There is also the potential for downstream aquatic habitat and fisheries to be affected by the Proposed Action. Selenium may affect fisheries through discharges to springs which have source areas intercepted by the pit. Potential direct impacts to aquatic life and associated habitat under the Proposed Action, including increased sedimentation, decreased water supply, and exposure to selenium, are expected to be limited. The Storm Water Pollution Prevention Plan has been developed to limit the potential for mine-related erosion and sedimentation.

Long-term impacts to aquatic resources resulting from exposure to selenium may occur as the result of the Proposed Action. Selective placement of seleniferous material and a cover of non-seleniferous materials, along with implementation of stormwater BMPs, are expected to limit the potential for selenium uptake through the food chain.

Threatened, Endangered and Special Status Species

Baseline studies indicated that the study area supports potential habitat for a number of threatened, endangered, and special status plant and wildlife species. However, the study area is occupied by only a few of these species. The potential direct and indirect impacts to these species are similar to the impacts to terrestrial wildlife and fisheries and aquatic resources that have already been discussed. Species that are higher on the food chains that are included in the list (such as the wolverine, cutthroat trout, and boreal owl) may be subject to adverse impacts from selenium via bioaccumulation and biomagnification from prey species with high

concentrations of bioaccumulated selenium. However, biotoxic levels of selenium are considered unlikely. These adverse impacts would occur only if the higher-level species feed within the study area or feed consistently on prey species with high concentrations of selenium. Additionally, two of the three plant species listed by the USFS as sensitive may occur within the study area. The study area was considered marginal habitat for the bald eagle, boreal owl, gray wolf, wolverine, and lynx.

Concentrations of selenium in the potentially affected water bodies in the area ranged from less than the practical detection limit of 0.001 to 0.004 mg/L, and were just below the state water quality standard for aquatic life of 0.005 mg/L. There is a potential for the concentrations of selenium to cause adverse direct impacts to various species of aquatic life. Potential adverse indirect impacts caused by bioaccumulation and biomagnification in the aquatic food chains may cause adverse direct impacts to waterbirds that feed in or raise young in these water bodies. Based on the historical trend of increased phosphate mining and elevated levels of selenium in the Blackfoot River, concentrations of selenium in the surface waters and sediment of the Blackfoot River watershed can be expected to increase and result in potentially adverse effects to aquatic life and possibly to waterfowl.

Impacts to terrestrial species may occur via uptake of selenium in plant forage and prey animals. Additionally, seeps, springs, and creeks that serve as sources of food and drinking water may become contaminated from surface water runoff and leaching of selenium to underlying groundwater. However, the use of at least 8 to 10 feet of non-seleniferous overburden material along with 2 to 3 feet of growth media is expected to limit the potential for exposure to selenium through the food chain.

Habitat loss would also play a role in the loss or change of the food chain cycle specific to this area. Raptors such as northern goshawk, flammulated owl, and the three-toed woodpecker may be lost in this area, due to the majority of the affected habitat under the Proposed Action being restored to a habitat type that would represent a change from conifer, mixed aspen/conifer, and sagebrush communities to habitat that would be initially dominated by perennial grasses.

Grazing Management

The Rasmussen Valley Cattle Allotment and the Sheep Creek Sheep Allotment would be affected by the development of phosphate minerals in North Rasmussen Ridge. The Proposed Action would result in the loss of existing vegetation by clearing areas that would be needed to support mining operations, although grazing has already been suspended on the mining leases. Reclamation would involve at least 8 to 10 feet of non-seleniferous overburden and 2 to 3 feet of growth media placed over the seleniferous waste rock. This reclamation plan would reduce the likelihood that selenium would accumulate in vegetation. Disturbed areas would be reclaimed using a seed mixture mainly composed of grasses with shallow roots that would also reduce the potential for accumulation of selenium. The potential exists for the spread of noxious weeds in new disturbance areas that could result in a decline in the quality of grazing allotments. The existing plan of monitoring and treating areas of weeds would continue and is expected to contain or reduce the infestations.

Recreation

The potential effect to recreation from the Proposed Action has two aspects: one is related to the amount of opportunity for recreation that would be created by the proposed project, and the second is the opportunity that is removed from recreational use. Local residents in Caribou County value forested land for recreation in part because of the proximity to their homes. The main issue is the potential change in access to recreational opportunities in the analysis area. Potential effects on existing recreational uses, primarily hunting, from any change in access opportunities on forest roads is expected to be minor, as there would be no additional road closures.

Visual Resources

For any of the alternatives, the adjacent hilly terrain would limit public views of the proposed visual modifications. Visitors to the area are low in number. Visual effects could include alteration of the physical setting and visual quality of the landscape and effects to the landscape as experienced from sensitive viewpoints, including travel routes and recreational use areas. These visual effects would occur at the North Rasmussen Ridge Mine under the Proposed Action. The proposed mining operations on National Forest lands would comply with the Caribou National Forest Land and Resource Management Plan (USFS 1985). The Visual Quality Objectives (VQOs) for USFS lands in the study area would be met by implementation of any of the alternatives. The VQOs for the study area are considered modification or maximum modification. These VQOs allow the greatest modification of the landscape, including management activities that dominate the original characteristic landscape. These VQOs would be appropriate for large-scale mining operations.

Land Use, Access and Transportation

No changes in surface or mineral ownership would be associated with any of the alternatives. Implementation of any of the alternatives would be consistent with the existing land use planning and management guidelines for federal- or state-administered mineral leases.

Implementation of the Proposed Action would result in a change of existing land uses by surface disturbances associated with expansion of the existing mining operations and temporary closure to public access in the North Rasmussen Ridge Mine area. Rangeland used for livestock grazing was the primary existing land use within the area of the proposed mine expansion, however, this area has been closed to grazing because of mining exploration activities. For the Proposed Action, most of the disturbed areas would be reclaimed, resulting in minimal long-term effects to land use. After the North Rasmussen Ridge Mine area has been reclaimed, vegetation and public access would be restored and land uses such as grazing would be reestablished.

For the Proposed Action, the potential effects to public access and traffic volume on existing transportation facilities would be unchanged from the current conditions for the existing Central Rasmussen Ridge Mine. Dust suppressants such as magnesium chloride would be used as needed on project-related roads. The potential effects of fugitive dust from project-related vehicular

traffic on roads and vehicular emissions associated with the Proposed Action would not substantially increase over the existing conditions.

Cultural Resources and Native American Concerns

The entire area of potential effect of the Proposed Action and the alternatives has been inventoried for cultural resources. No eligible cultural resources have been found in the project area. The North Rasmussen phosphate occurs in the Meade Peak Member of the Phosphoria Formation, which is overlain by the Rex Chert Member of the same formation. Chert and porcellanite facies of the Phosphoria Formation farther east in the Bighorn and Pryor Mountains produce distinctive cherts and porcellanites that were highly valued by prehistoric populations as raw material for manufacture of stone tools. Cultural resource inventories in the project area have not identified any culturally modified Phosphoria chert or porcellanite. Evidently, the chert and porcellanite in these deposits that was reasonably accessible to primitive technology was not of adequate quality to be attractive.

Social and Economic Conditions

Agrium proposes to use the same size of work force to develop the North Rasmussen Ridge Mine to provide continuous production to its Conda fertilizer plant. The viability of Agrium's production plant depends on procuring a uniform, constant supply of ore that is of adequate quantity and quality. The most notable impact of the proposed mine expansion would be to extend existing employee needs for housing and services in the area another 8 or more years. Extension of the mine would also result in a continuous cash flow from mining into the southeast Idaho economy from payrolls, purchases, and contracting of services as well as royalties to the federal government that are returned to the state and county. In addition, government tax receipts generated from income, property, sales, mine license tax, and other taxes from the mine and employees to city, state, and county governments would continue during the additional 8 or more years that the mine would operate.

Environmental Justice

On February 11, 1994, Executive Order 12898, "Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations" was published in the *Federal Register* (59 FR 7629). The order requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. The Proposed Action is an expansion of an existing facility that is surrounded by National Forest System lands and would not affect any area of low-income housing or low-income populations.

The U.S. Census identified 714 residents, or 9.6 percent of the total population, that lives below the poverty level in the urban areas of Caribou County. Residents who live below the poverty level were not identified for rural areas between Soda Springs and the Rasmussen Ridge mining area. The proposed project is on federal and state leases and is not located within the corporate limits of any urban community or in any populated rural area. The Proposed Action would not affect any area that contains populations who live under the poverty level.

The population of Caribou County is predominantly Caucasian (96 percent, according to the 2000 Census). The Hispanic population accounted for 4 percent. Other minority groups in Caribou County constitute a small percentage of the total population. No areas were identified in the county that consisted of predominantly minority populations. The Proposed Action therefore would not disproportionately affect minority populations.

Hazardous Materials

The annual use and handling of hazardous materials and wastes would be the same as existing operations at the Central Rasmussen Ridge Mine for any of the alternatives. However, the duration of the handling period for hazardous materials and wastes would be approximately 8 years longer for the Proposed Action than for Alternative 2 (No Action). The types of hazardous materials and wastes, storage locations, and estimated quantities to be used and stored for any of the alternatives are provided in **Table 2.2-6**. Hazardous materials and wastes would continue to be transported along the same route that is currently used for the existing Central Rasmussen Ridge Mine.

As discussed in Section 2.2.3.6, mining associated with any of the alternatives would comply with federal and state regulations for hazardous materials and wastes and with the existing approved Storm Water Pollution Prevention Plan (SWPPP, Agrium 2001). BMPs for the pollutants with the potential to be released from the site (sediment, storm water runoff, fuels, and oils), and the Spill Prevention Control and Countermeasures Plan (SPCC) for the mine are incorporated in the SWPPP document. No significant fuel spills or leaks have occurred during operation of the existing mine facilities (Agrium 2001).

For all alternatives, the types and quantity of wastes generated and the transportation and disposal procedures would be the same as are currently used at the Central Rasmussen Ridge Mine. The mine is currently considered a small-quantity generator because less than 100 kilograms of hazardous waste (solvents) are generated per month. Used engine oil is stored on site and then is sent to a recycling company located in Pocatello, Idaho.

Mining overburden and waste rock are exempted from hazardous waste regulations under the Bevill amendment to the Resource Conservation and Recovery Act of 1976.

Alternative 1 – Proposed Action with Impermeable Capping of Backfill Areas

Minerals, Topography, Geology and Paleontology

Potential effects from this alternative would be essentially the same as for the Proposed Action, but with the additional disturbance of 26 acres for the external waste rock dump and 25 acres for a clay source, if clay is used as a cap material.

Air Resources

Potential effects from this alternative essentially would be the same as for the Proposed Action, but with potentially greater amounts of fugitive dust from construction of an external waste dump and hauling materials to construct the impermeable cap. The additional fugitive dust would also be within NAAQS, as calculated with EPA standard emission factors.

Water Resources

Alternative 1 would result in impacts to water flow and quality similar to those described for the Proposed Action. However, the groundwater mound in the Wells Formation regional aquifer would be slightly smaller, because less infiltration would move through the fully backfilled panels. Since the partially backfilled pit would not be capped, the manganese plume for Alternative 1 would be almost identical to that of the Proposed Action. Concentrations of antimony, sulfate, and TDS in groundwater would exceed Idaho groundwater standards inside the lease boundary, but would not exceed applicable standards outside the lease boundary.

Flow rates in surface streams, seeps, and springs would decrease during mining, as the open pits collect surface water runoff and shallow alluvial groundwater that would have reported to stream drainages.

Watershed and Soils

Alternative 1 would result in an additional 26 to 51 disturbed acres of soil compared with the Proposed Action because of the decreased volume available in the Central Rasmussen backfill area that would result from the need to design the slopes at a shallower 4.0h:1.0v slope. Production of backfill would eventually equal mining production, which would require an external waste dump outside of the perimeter of the pit, in the Angus Creek sub-watershed.

The effects of Alternative 1 on watersheds would be similar to the Proposed Action, with the exception of a minor increase in local erosion from the additional disturbance and the presence of a waste rock dump and additional acreage associated with a clay pit for capping materials. Erosion would be slightly greater because of the external waste rock dump.

Vegetation, Riparian Areas and Wetlands

Potential impacts under Alternative 1 would be similar to the Proposed Action. Alternative 1 would involve construction of an impermeable cap between seleniferous waste and the non-seleniferous limestone and chert overburden. An impermeable cap would further reduce the potential for uptake of selenium by deep-rooted vegetation and the potential for water to infiltrate through seleniferous materials. A 4.0h:1.0v slope would be used to construct the cap under Alternative 1, which would in turn reduce the total storage capacity and increase the disturbance footprint of the open pit. Alternative 1 would require construction of a waste rock dump to compensate for the reduced storage capacity. The overall disturbance footprint of the open pit

under Alternative 1 would be increased by 26 acres. Additional disturbance would also be associated with construction of the waste rock dump and clay pit under Alternative 1.

Terrestrial Wildlife

Potential impacts to wildlife would be similar to the Proposed Action. An additional 26 acres of habitat and the area associated with the clay pit would be lost in the short term under this alternative.

Fisheries and Aquatic Resources

Potential impacts to aquatic resources would be similar to the Proposed Action.

Threatened, Endangered or Special Status Species

Alternative 1 would further reduce the potential for exposure to selenium by threatened, endangered, and sensitive plants and wildlife by installing an impermeable cap over the backfilled materials. Otherwise, potential impacts to these species would be similar to the Proposed Action.

Grazing Management

Alternative 1 would increase the acreage subject to accumulation of selenium in vegetation in the area of the external waste rock dump.

Recreation

Potential effects on recreation would be the same as were described for the Proposed Action with exception to the disturbance caused by the external waste rock dump and clay pit.

Visual Resources

Potential effects to visual resources for this alternative would be similar to the Proposed Action. Construction of a 26-acre external dump under this alternative would create a west-facing slope that would be an additional intrusion of line and color, but that would still comply with the VQOs for the area. Additional disturbance would be associated with the clay quarry and road.

Land Use, Access and Transportation

Potential effects to land use, access, and transportation for this alternative would be the same as for the Proposed Action with exception to the disturbance associated with the external waste rock dump and clay pit.

Cultural Resources and Native American Concerns

There would be no potential effects under this alternative, as was described for the Proposed Action.

Social and Economic Conditions

Potential effects on social and economic conditions of the study area essentially would be the same under this alternative as under the Proposed Action. Cost of the impermeable cap would be approximately $20.5 million more than the Proposed Action, and a clay cap would cost approximately $9.7 million more than the Proposed Action.

Environmental Justice

Factors that could affect Environmental Justice under Alternative 1 would be the same as for the Proposed Action.

Hazardous Materials

Potential effects from hazardous materials under Alternative 1 would be the same as under the Proposed Action.

Alternative 2 – No Action

Minerals, Topography, Geology and Paleontology

Three primary impacts are associated with Alternative 2 – No Action. First, recoverable phosphate resources in the North Rasmussen Ridge area would not be committed to development at this time. Second, without these phosphate resources, it would require additional mining elsewhere to supply the current demand. Third, reclamation plans for the Central Rasmussen Ridge Mine pit area would change. The pit would not be backfilled, resulting in a 35-acre pit with residual highwalls and exposing earth materials that contain concentrations of selenium and other elements to weathering processes. The exposure of materials containing selenium or other elements would increase the potential for release of these constituents into surface waters or soils. The release of selenium or other elements into the environment for subsequent uptake by plants or animals could have adverse effects on plant or animal life.

Air Resources

The No Action alternative would not create any impacts to air resources beyond the effects already analyzed for the Central Rasmussen Ridge Mine. These emissions were analyzed previously and approved (BLM and USFS 1997b).

Water Resources

The No Action alternative would result in no backfill of the last pit in the Central Rasmussen Ridge Mine area. This would allow infiltration of water through the pit bottom that would impact groundwater in a similar manner as that projected for North Rasmussen. No backfill of this area may result in a pit lake.

Watershed and Soils

The No Action Alternative would not result in any increase in disturbance in the North Rasmussen Ridge area beyond the level already permitted for the Central Rasmussen Ridge Mine; however, no action would render the economically recoverable mineral resource unusable and the Central Rasmussen Ridge pit would not be backfilled, resulting in the potential for a pit lake to form. Mining would continue in the Central Rasmussen Ridge Mine, resulting in 231 acres of disturbance, of which 196 acres would be reclaimed.

Vegetation, Riparian Areas and Wetlands

No additional impacts to vegetation communities would occur under the No Action Alternative beyond the effects already projected for the Central Rasmussen Ridge Mine. Infestations of noxious weeds would be expected to remain as at present or be reduced by the existing BMPs for monitoring and control.

Terrestrial Wildlife

No additional impacts to wildlife would occur under this alternative beyond the effects already described for the Central Rasmussen Ridge Mine.

Fisheries and Aquatic Resources

No additional impacts to fisheries and aquatic resources would occur under the No Action alternative beyond the effects described for the Central Rasmussen Ridge Mine. There is potential for a lake to form in the Central Rasmussen Ridge pit and alter the hydrologic regime in the local streams over the long term.

Threatened, Endangered or Special Status Species

No additional impacts to threatened, endangered or sensitive species would be expected under this alternative beyond the effects already evaluated for the Central Rasmussen Ridge Mine.

Grazing Management

The reduction in grazing lands projected by the Proposed Action and Alternative 1 would not occur under this alternative. There would be no additional loss of grazing areas beyond the level already described for the Central Rasmussen Ridge Mine.

Recreation

There would be no change in recreation opportunities under this alternative beyond the effects already described for the Central Rasmussen Ridge Mine.

Visual Resources

Potential impacts to visual resources were considered acceptable and in compliance with the VQOs for the Proposed Action and Alternative 1. Some minor effects to visual resources would still occur at the Central Rasmussen Ridge Mine under this alternative, but were previously analyzed and approved.

Land Use, Access and Transportation

The No Action alternative would not change land use or result in road closures or access, or change vehicular use of roads beyond the existing conditions.

Cultural Resources and Native American Concerns

There would be no effects on these resources under the No Action Alternative.

Social and Economic Conditions

If the No Action Alternative was selected, mining at Central Rasmussen Ridge Mine would cease in 2003, with an associated drop in employee numbers. The Mine currently employs 400 people. Some of the employees laid off might find employment with other mining companies in the area, but most would leave the community to search for work elsewhere. A reduction in population would have indirect effects on local needs for housing and services, local purchases, and property and sales taxes. The Mine would also reduce their payrolls, local purchases, and tax and royalty payments to local, state, and federal governments.

Environmental Justice

Factors that affect Environmental Justice under the No Action Alternative would be the same as for the Proposed Action.

Hazardous Materials

There would be no potential effects from hazardous materials under the No Action Alternative; however, potential effects would continue at the Central Rasmussen Mine until mining ceases in 2003 or 2004.

CHAPTER 1 - PURPOSE AND NEED

CHAPTER 1 - PURPOSE AND NEED

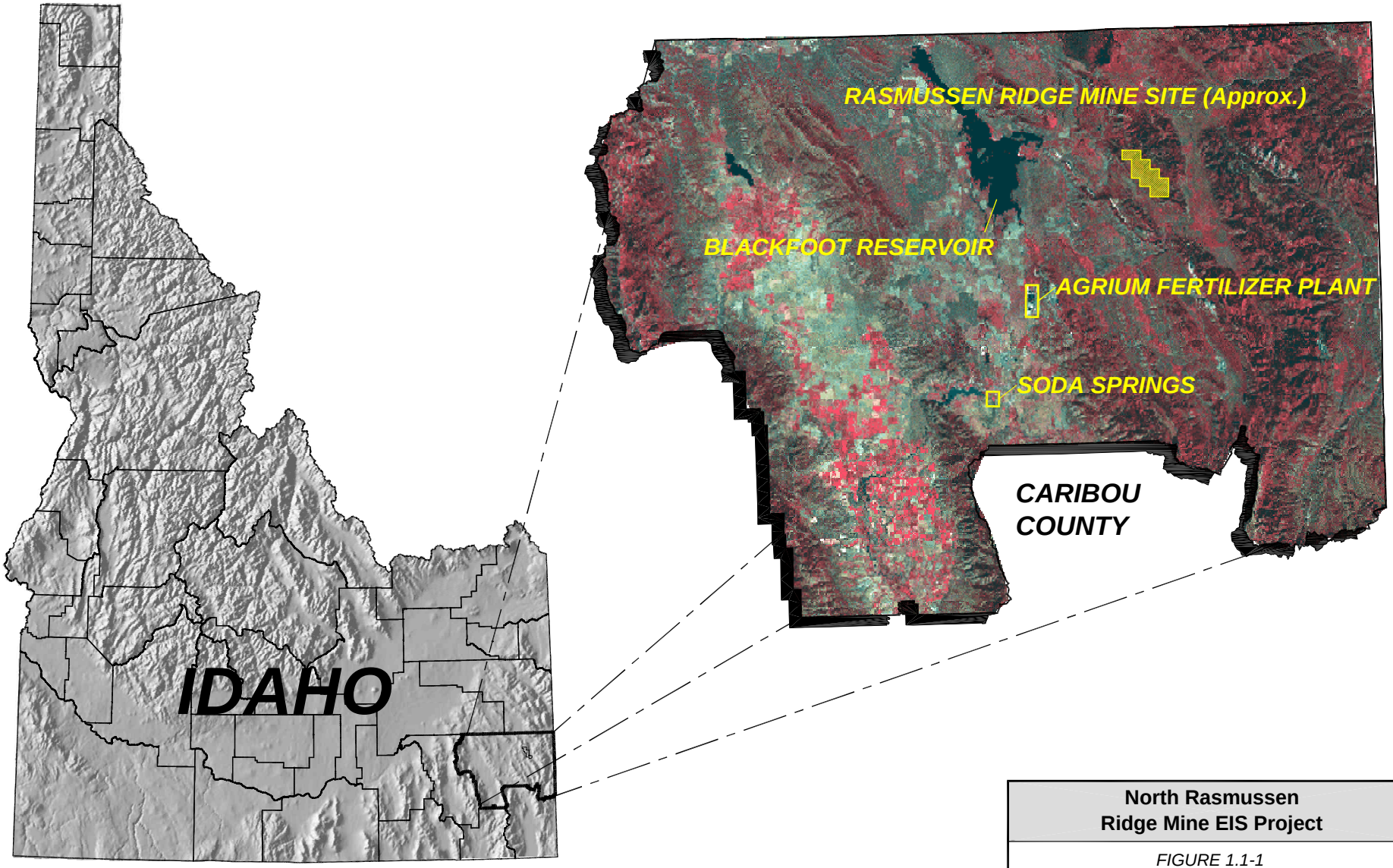
The Pocatello Field Office of the U.S. Department of Interior, Bureau of Land Management (BLM) received an amendment to the Plan of Operations from Nu-West Industries, Inc., doing business as Agrium Conda Phosphate Operations (Agrium) in December 2000 (and supplemented in November 2001). This amendment, known as the North Rasmussen Ridge Supplemental Mine and Reclamation Plan (Proposed Action), proposed activities that would support continued operation and expansion of open-pit phosphate mining at the Rasmussen Ridge Project. The project is located on public lands 19 miles northeast of Soda Springs in Caribou County, Idaho (**Figure 1.1-1**). Since proposed mining operations in North Rasmussen Ridge would be located on federal and state mineral leases administered by BLM and the Idaho Department of Lands (IDL), both agencies require review and approval of Agrium's amended Plan of Operations. The mine area is also located on public lands within the Caribou-Targhee National Forest, which is administered by the U.S. Department of Agriculture, Forest Service (USFS), such that reclamation of disturbed lands would be required. Based on the potential for the Proposed Action to result in significant environmental impacts, BLM determined that an environmental impact statement (EIS) would be necessary, as required by the National Environmental Policy Act of 1969 (NEPA).

The BLM is serving as lead agency in preparing this EIS for the proposed continued operation and expansion of Agrium's existing phosphate mining operation. USFS and IDL are cooperating agencies in preparing this EIS. This document follows regulations promulgated by the Council on Environmental Quality for implementing the procedural provisions of NEPA (Title 40 Code of Federal Regulations [CFR] 1500-1508), BLM's NEPA Handbook (H-1790-1), and the USFS Handbook of Environmental Policy and Procedures (H-1909.15).

1.1 PURPOSE AND NEED

The purpose of the Proposed Action is to recover phosphate ore reserves contained within the North Rasmussen Ridge leases and to transport it by present and future haul roads to the Agrium Conda Phosphate Operations Plant in Soda Springs via an existing railroad spur. The Proposed Action is needed to continue economically viable development of the phosphate resources within the federal and state mineral leases to supply phosphate ore to Agrium's fertilizer plant. The plant produces phosphate-based fertilizer and purified phosphoric acid to help meet demands in the United States.

As required by NEPA, this EIS describes the components of, reasonable alternatives to, and environmental consequences of continued operation and expansion of mining and processing facilities at North Rasmussen Ridge. **Chapter 1** describes Purpose and Need for the project, the role of BLM and other regulatory agencies, summarizes public participation in the EIS process, and identifies those issues that will be addressed in this document. **Chapter 2** provides a complete description of the existing operations and the Proposed Action and alternatives. **Chapter 3** describes the existing environment in the North Rasmussen Ridge area. Direct and indirect impacts associated with the Proposed Action and alternatives, and possible mitigation measures are described in **Chapter 4**. **Chapter 5** describes potential cumulative impacts associated with the project and other past, present, and reasonably foreseeable actions. Consultation and coordination with federal, state, and local agencies and a list of preparers is included in **Chapter 6**. **Chapter 7** contains a list of references cited in developing the EIS, as well as a glossary and a document index.



North Rasmussen Ridge Mine EIS Project	
FIGURE 1.1-1 *GENERAL LOCATION MAP*	
ANALYSIS AREA: Caribou County, Idaho	
Date: 02.27.03	Drawing File: 1164 Loc.dwg
Scale: NTS	DRAWN BY: MTM

1.2 AUTHORIZING ACTIONS

The BLM Pocatello Field Office Manager, who is the responsible official for the EIS and on-lease lands, will make a decision on land use authorizations for this proposal. This manager will consider the following: scoping comments and responses; anticipated environmental consequences discussed in the EIS; and applicable laws, regulations, and policies. The Caribou-Targhee National Forest Supervisor, who is the responsible official for Caribou-Targhee National Forest lands, will make recommendations to the BLM on selection of the preferred alternative and site-specific conditions of approval. The BLM will prepare and sign the Record of Decision (ROD).

The existing and proposed mining operations must comply with all laws and regulations for mining on public lands. A summary of these regulations is included in **Appendix A**. In addition to the BLM, USFS, and IDL, other federal, state and local agencies have jurisdiction over certain aspects of the Proposed Action. **Table 1.2-1** lists the agencies and identifies their authorizing responsibilities.

TABLE 1.2-1
MAJOR PERMITS, APPROVALS, AND CONSULTATIONS POTENTIALLY REQUIRED FOR NORTH RASMUSSEN RIDGE

Issuing Agency/Permit or Approval Name	Nature of Permit Action	Applicable Project Component	Status of Permit or Approval Action
BLM			
Record of Decision	Compliance with National Environmental Policy Act	Activities affecting federal lands and resources	Required for final approval
Mine and Reclamation Plan	Compliance with 43 CFR 3590.2a, 3592.1a	Activities affecting federal leased mineral resources	Pending after Record of Decision on the final EIS
Two lease modifications	Surface disturbance on USFS-managed lands	Disturbance of USFS land off lease.	Lease modification required
Water Management Plan	Compliance with no undue degradation surface management regulations	Activities affecting federal lands and activities.	Required for final approval
FOREST SERVICE			
Consultation and Recommendation.	No permit.	Activities affecting National Forest System lands.	Required for final approval.
ENVIRONMENTAL PROTECTION AGENCY			
National Pollutant Discharge Elimination System (NPDES) Permit	Protects quality of surface waters from stormwater discharge under Clean Water Act	Storm Water Pollution Prevention Plan (SWPPP)	Current permit may require modifications to SWPPP
Spill Prevention Control and Countermeasures (SPCC) Plan	Provides management direction for spills	Bulk petroleum products storage	Current plan may require changes
U.S. FISH & WILDLIFE SERVICE			
Endangered Species Act compliance (Section 7)	Protects threatened and endangered species	Any activity, such as blasting or habitat disturbance, potentially affecting listed or proposed threatened and endangered species	Biological Assessment/Biological Evaluation (BA/BE) has been prepared; consultation is under way
Migratory Bird Treaty Act	Protects migratory birds	All surface disturbing activities	BA/BE is complete

TABLE 1.2-1 (CONT.) MAJOR PERMITS, APPROVALS, AND CONSULTATIONS POTENTIALLY REQUIRED FOR NORTH RASMUSSEN RIDGE			
Issuing Agency/Permit or Approval Name	**Nature of Permit Action**	**Applicable Project Component**	**Status of Permit or Approval Action**
Bald Eagle Protection Act	Protects bald and golden eagles	All surface disturbing activities	BA/BE is complete
U.S. ARMY CORPS OF ENGINEERS			
Permit to discharge dredged or fill material (Clean Water Act [CWA], Section 404 Permit)	Authorized placement of fill or dredged material in waters of the U.S. or adjacent wetlands	No Name or Reese Canyon Creek drainages	Application will be filed to seek approval before construction
BUREAU OF ALCOHOL, TOBACCO, & FIREARMS			
High explosives permit	Possession of explosives	Blasting in open pits	No additional approval required
IDAHO DEPARTMENT OF ENVIRONMENTAL QUALITY			
Air quality permit	Release of air pollutants	Elements that contribute to air quality issues, such as blasting or hauling emissions	Required air approvals for property already in hand
Resource Conservation and Recovery Act program (adopted federal standards)	Management of hazardous waste	Storage and off-site disposal of hazardous wastes	Exempt small quantity generator notification already completed
Board of Health & Welfare	Governs quality and safety of drinking water	Culinary water supply	No additional approval required
Storm Water Pollution Prevention Plan	Compliance with Non-degradation Water Quality Standards	Stormwater discharges from facilities	Plan approval required for operations
Certification of Water Quality (CWA, Section 401)	Protects quality of navigable waters from discharges	Construction activities discharges from disturbed areas	Permit application to be filed prior to any construction
Groundwater Quality Rules	Protects quality of groundwater from contaminants	Potential infiltration of leachate products into groundwater	Demonstration of no degradation of groundwater
IDAHO DEPARTMENT OF WATER RESOURCES			
Stream Channel Alteration Permit, CWA, Section 402 Permit	Protection of stream channels	Haul road crossings	Permit application for construction in No Name and Reese Canyon Creeks will be submitted
IDAHO DEPARTMENT OF LANDS			
Mine and Reclamation Plan Permit	Permit and bonding for reclamation	Mining and reclamation plans	Required for mining regulated by federal agencies
IDAHO STATE HISTORIC PRESERVATION OFFICE			
National Historic Preservation Act compliance Section 106	Protects cultural and historical resources	All ground disturbing activities	As required
CARIBOU COUNTY			
Conditional Use Permit	Approval of facilities within an approved land use	General facilities	No additional permit required

A reclamation performance bond will be required for the North Rasmussen Ridge Mine. The bond calculation is based on the selected alternative as identified in the Final EIS and ROD. Agrium will post bonds for both BLM and IDL leases to ensure compliance with reclamation requirements. The

calculation will be based on acres of disturbance as established by the Idaho Land Board and adjusted as needed when mine disturbance areas increase. The bond will also be based on actual costs of reclamation. Bonds are required to be submitted and approved prior to any land disturbance activities. The amount of the North Rasmussen Ridge bond could range from $2.4 to $4.2 million depending on the selected alternative.

1.3 RELATIONSHIP TO BLM AND NON-BLM POLICIES, PLANS, AND PROGRAMS

The Proposed Action has been reviewed for compliance with agency policies, plans, and programs. The proposal conforms to decisions on minerals in the Record of Decision, Pocatello Resource Area, Resource Management Plan (BLM 1987), approved in 1988. USFS has also concluded that the proposed mining of North Rasmussen Ridge can be implemented in compliance with the Caribou National Forest Land and Resource Management Plan (LRMP) (USFS 1985). Page III-2 of the LRMP includes the statement, “Non-renewable resource development will override renewable resource development as a featured resource use.” On page III-20, it says, “Mineral resources of the Forest that can be produced at a profit, after consideration of the costs of mitigating measures necessary to protect surface resource values will be produced to meet demands.” USFS has recently released a draft revised forest plan (USFS 2001) for the Caribou portion of the Caribou-Targhee National Forest. It uses an adaptive approach to reclamation measures, and incorporates Best Management Practices (BMPs) for selenium. The Proposed Action complies with the revised Forest Plan, which includes the following description of the desired future condition for reclamation of mined or drastically disturbed lands: “Drastically disturbed sites are reclaimed emphasizing: 1) suitable topsoil preservation; 2) use of native plant species; and 3) stable topographic relief that visually conforms to natural surroundings.”

The approach for active phosphate leases in the revised forest plan is to incorporate BMPs into the conditions of approval for site-specific mining and reclamation plans. It also allows for developments in research and technology over time to be incorporated into the prescribed practices and monitoring systems.

1.4 ISSUES

To allow an early and open process for establishing the scope of significant issues related to the Proposed Action (40 CFR 1510.7), a public scoping period was provided by BLM. A Notice of Intent to prepare the EIS was published in the Federal Register on May 18, 2001. Publication of this notice in the Federal Register initiated a 30-day public scoping period for the Proposed Action that provided for acceptance of written comments. Details of scoping are presented in **Chapter 6** of this EIS.

The major issues that were identified by the scoping effort concerned water resources, wildlife, reclamation and restoration, and cumulative impacts. Of major concern was the potential for impacts to the quantity and quality of groundwater and surface water. Specifically, concern focused on whether water entering the backfilled pits could leach any contaminants into the groundwater. Potential effects on wildlife in the area were a major issue, including terrestrial and aquatic wildlife

and the potential for habitat fragmentation and effects on threatened and endangered species. Development of the kinds of alternatives that should be addressed, including total backfill, use of impermeable caps over waste rock, and avoidance of any waste rock dumps outside the pits was conducted by the agencies and was driven by the issues and public comments. The need to address cumulative impacts was emphasized and must include industries and activities other than phosphate mining.

Public comments and agency direction concerning the scope of the EIS are grouped according to issues and summarized in **Table 1.4-1**. This table also provides references to the sections of this EIS that respond to each issue raised in the comments.

TABLE 1.4-1
ISSUES IDENTIFIED IN SCOPING

Issue	EIS Document Section(s)
Water Resources	
The potential effects of water entering the backfill to leach selenium and other contaminants into the groundwater.	Chapters 3 and 4 Geology and Water Resources
The potential effects of trace elements in the waste rock to contaminate soil and surface water resources.	Chapter 4 Water Resources
The potential effects of project roads to degrade surface and groundwater quality.	Chapters 3 and 4 Water Resources and Land Use
The potential effects of the partially backfilled pit to form a lake and associated effects.	Chapter 4 Water Resources
The potential effects of pollutants in runoff from the project on the Blackfoot River watershed.	Chapter 4 Water Resources
Wildlife, Vegetation and Fisheries	
The potential effects of habitat fragmentation and loss on species biodiversity.	Chapter 4 Vegetation and Terrestrial Wildlife
The potential effects of habitat loss on wildlife populations, both resident and migratory, and including threatened or endangered species.	Chapters 3 and 4 Terrestrial Wildlife and Threatened, Endangered and Special Status Species
The potential effects of water quality changes on fish populations and their habitat.	Chapters 3 and 4 Fisheries and Aquatic Resources
Wetlands	
The potential effects of water quantity changes on loss or degradation of wetlands and riparian areas.	Chapters 3 and 4 Vegetation, Riparian Areas and Wetlands
Soils	
The potential effects of soil handling on reclamation potential.	Chapters 3 and 4 Soils and Watershed
Grazing Management	
The potential effects of mine disturbance on grazing allotments.	Chapters 3 and 4 Grazing Management
Air Quality	
The potential effects of mining emissions on ambient air quality.	Chapters 3 and 4 Air Resources
Socio-Economic Conditions	
The potential effects of mine expansion on the regional economy.	Chapters 3 and 4 Social and Economic Resources

TABLE 1.4-1 (CONT.) ISSUES IDENTIFIED IN SCOPING	
Issue	**EIS Document Section(s)**
Hazardous and Solid Wastes	
The potential effects of mining activities contributing to hazardous materials entering the environment.	Chapters 2 and 4 Description of Proposed Action and Hazardous Materials
Reclamation/Restoration	
The potential effects of mine disturbance on reclamation, closure, and restoration success.	Chapter 2 Description of Proposed Action
The potential effects of a complete or total backfill alternative on the area environment.	Chapter 2 Project Alternatives
The potential effects of a no-backfill alternative on the area environment.	Chapter 2 Project Alternatives
The potential procedures and calculations for a reclamation bond.	Chapter 1 Authorizing Actions
Cumulative Effects	
The potential cumulative effects of phosphate mining and other land use activities on the area environment.	Chapter 5 Cumulative Impacts

CHAPTER 2 - PROPOSED ACTION AND ALTERNATIVES

CHAPTER 2 - PROPOSED ACTION AND ALTERNATIVES

The North Rasmussen Ridge Supplemental Mine and Reclamation Plan (November 2001) modifies the North Rasmussen Ridge Mine and Reclamation Plan submitted on December 1, 2000. Agrium's Rasmussen Ridge Property involves Federal Phosphate Leases I-04375 and I-07619. Lease I-04375 contains 920 acres, and Lease I-07619 contains 437 acres, for a total of 1,357 acres. Lease I-04375 in its entirety and 200 acres of Lease I-07619 are located within the Caribou National Forest; the remaining 237 acres of Lease I-07619 are on state land **(Figure 2.1-1)**. The northeast quarter of the northeast quarter of Section 16, Township 6 South, Range 43 East of the Boise Meridian contains a portion of a State of Idaho mineral lease formerly held by P_4 Production LLC. A portion of the North Rasmussen ore body is located within that lease area. Agrium signed an agreement with P_4 (Agrium/P_4 Production Ore and Overburden Exchange Agreement) to acquire the mineral rights for this lease. The IDL has reissued the lease as Agrium State Lease Number 9313.

Two areas would be incorporated into the current federal leases via lease modifications to implement the Mine Plan as proposed. These areas are for pit disturbance and would require two 10.0-acre modifications. Applications for these modifications were submitted to the BLM on February 9, 2001. A State Temporary Use Permit would require a 2.5-acre permit for haul road disturbance. Agrium would apply for the State Temporary Use Permit later. The areas are described as follows:

Lease Modifications

Forest Service	Bureau of Land Management
Surface Owner	Mineral Rights

Township 6 South, Range 43 East, Boise Meridian, Caribou County, Idaho

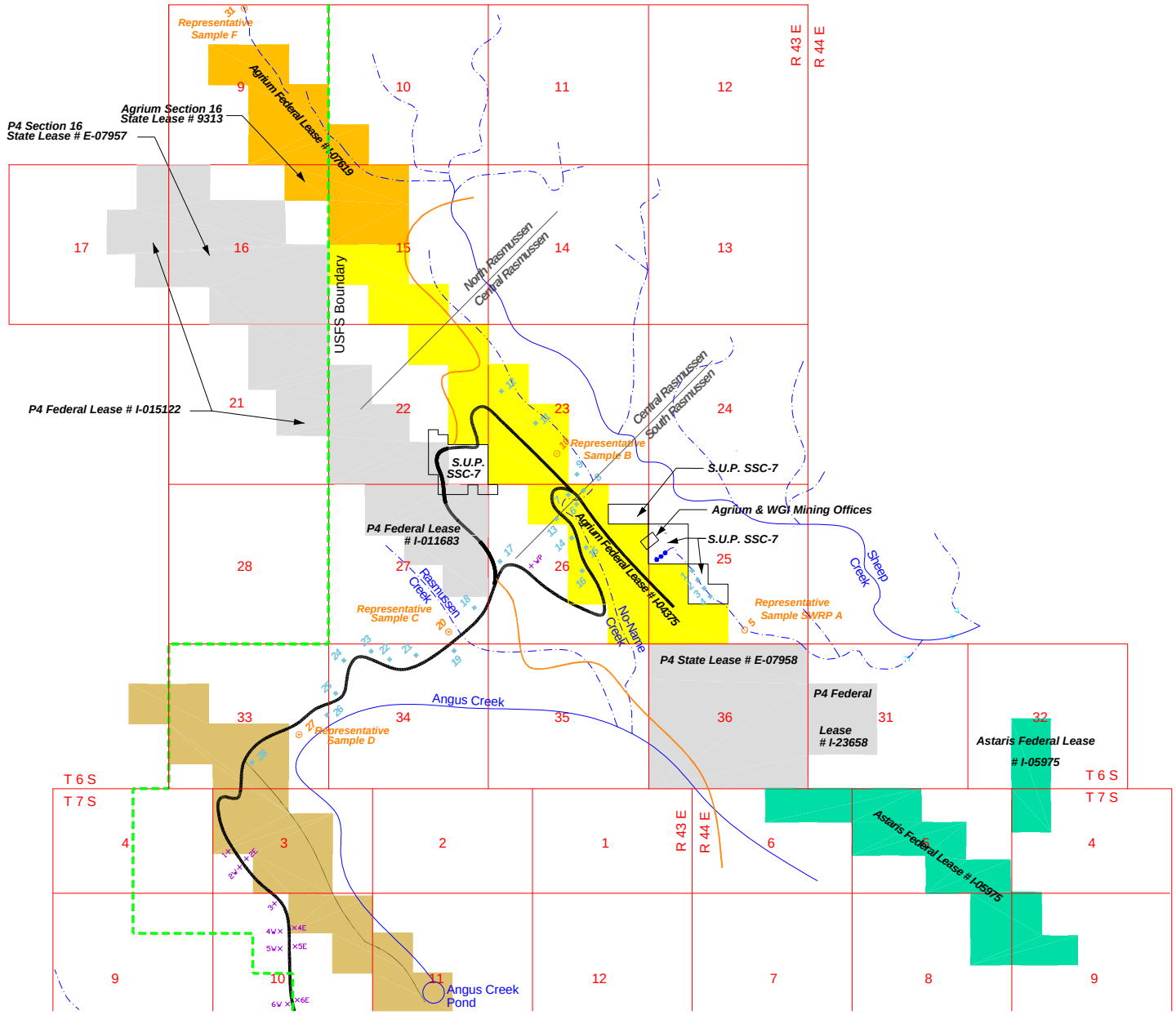
Description	Acres	Use
Section 22 NE1/4 NE1/4 NW1/4	10.0	Pit Disturbance
Section 15 NE1/4 SW1/4 SW1/4	10.0	Pit Disturbance
Total	20.0 Acres	

State Temporary Use Permit

Idaho Department of Lands	Bureau of Land Management
Surface Owner	Mineral Rights

Township 6 South, Range 43 East, Boise Meridian, Caribou County, Idaho

Description	Acres	Use
Section 9 SW1/4 SW1/4 SE1/4 NE1/4	2.5	Haul Road
Total	2.5 Acres	



RASMUSSEN RIDGE

- AGRIUM LEASE I-07619
- AGRIUM LEASE I-04375
- P4 LEASES
- ASTARIS LEASES
- RHODIA HOLDINGS
- AGRIUM S.U.P. SSC-7
- AGRIUM S.U.P. SSC-8 (Rasmussen Ridge Haul Road To Tipple)

- Streams
- Intermittent Streams
- Public Access Roads
- Mine Haul Roads
- U.S.F.S. Boundary
- Storm Water Retention Pond (SWRP)
- Representative Sample
- Other Haul Road Discharges

NORTH

North Rasmussen Ridge Mine EIS Project

FIGURE 2.1-1
SITE LOCATION AND OWNERSHIP

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 SITE MAP.dwg
Scale: NTS	Drawn By: MTM

2.1 EXISTING OPERATIONS

The following sections describe existing operations at the Rasmussen Ridge Mine and exploration activities that defined the North Rasmussen Ridge ore reserve.

2.1.1 Project History

Phosphate mining began at Rasmussen Ridge when Rhone-Poulenc Basic Chemicals Company built the South Rasmussen Ridge Mine and ore haulroad on Federal Lease I-04375 in 1991. An Environmental Assessment (EA) and Finding of No Significant Impact were jointly prepared in 1990 by the USFS – Soda Springs Ranger District, and the BLM – Pocatello Resource Area, Idaho Falls District. The environmental analyses supported the BLM leasing administration and the Caribou National Forest Special Use Permit process. The phosphate ore was shipped over a 4.1-mile haul road to the existing Wooley Valley Mine and then by conveyor and rail to Rhone-Poulenc's elemental phosphorus plant in Silverbow, Montana. The mine plan envisioned mining at Rasmussen Ridge in three phases along a 5-mile reach of Rasmussen Ridge: (1) South Rasmussen Ridge, (2) Central Rasmussen Ridge, and (3) North Rasmussen Ridge. The South mine plan involved disturbing 195 acres and complete backfilling of the pit, and was to last for 15 years. Rhone-Poulenc planned to complete mining at Wooley Valley and move the operations to Rasmussen Ridge.

In 1993, Rhone-Poulenc contracted with Nu-West Industries in Soda Springs to supply ore to the Nu-West fertilizer plant, as well as continuing to supply its phosphorus plant in Montana. This contract required Rhone-Poulenc to expand the mine to 257 acres of disturbance (**Table 2.1-1** and **Figure 2.1-2**). The South Rasmussen Ridge Mine Plan was further amended in 1996 when Rhone-Poulenc applied for approval of the Central Rasmussen Ridge Mine. At that time, all ore was being shipped to the Agrium (Nu-West Industries, Inc.) fertilizer plant in Soda Springs because the elemental phosphorus plant in Montana was idled in 1995. The 1996 amendment also involved an additional 80 acres that were added to Federal Lease I-07619. The Mine and Reclamation Plan for Central Rasmussen Ridge involved backfilling all but 35 acres of the pit (unless waste material became available from North Rasmussen Ridge) and disturbance of 231 acres (**Table 2.1-1** and **Figure 2.1-2**).

In January 1998, Agrium purchased the Rasmussen Ridge leases and the associated Special Use Permits from Rhodia (formerly Rhone-Poulenc). Agrium has been operating the Rasmussen Ridge Mine since March 1998 with Washington Group International, Inc. (formerly Morrison Knudsen) providing contract mining services. Agrium is currently mining the Central Rasmussen portion of the property under the Modified Central Rasmussen Ridge Mine and Reclamation Plan, which was approved by the BLM on February 17, 1999.

Current mining at the Central Rasmussen Ridge mine is conducted using the same mining methods as were used at the South Rasmussen Ridge Mine: an open pit with a retreating haul ramp and a haulage road along the east side. Most overburden waste is used as backfill in the South and Central Rasmussen Ridge mines. Ore produced by the Central Rasmussen Ridge Mine is hauled by truck to the Wooley Valley tipple, where it is loaded on rail cars for travel to Agrium's Conda Phosphate Operations. Current mining is conducted under the approved Central Rasmussen Ridge Modified Mine and Reclamation Plan, which specifies the BMPs and conditions of approval, mitigation measures, and conditions that were stipulated as part of the approval. **Table 1.2-1** presents the regulatory framework that controls current and proposed mining.

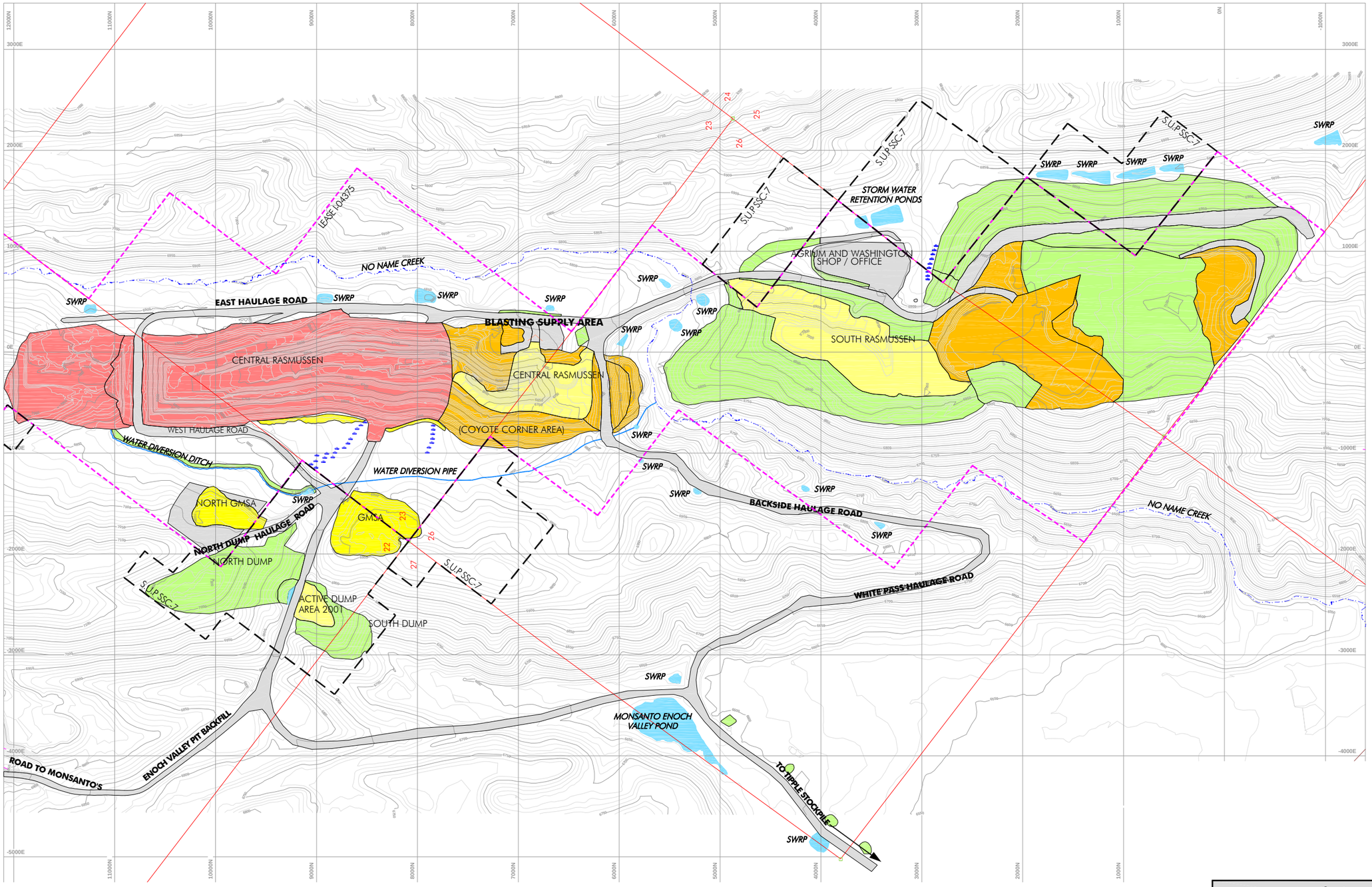
TABLE 2.1-1
EXISTING SURFACE DISTURBANCE AT CENTRAL RASMUSSEN RIDGE AND SOUTH RASMUSSEN RIDGE MINES

Affected Areas	Central Rasmussen Ridge		South Rasmussen Ridge	
	Total Acreage Disturbed	Total Acreage Reclaimed	Total Acreage Disturbed	Total Acreage Reclaimed
Mine Pits	138.9	103.9	107.5	107.5
External Waste	36.3	36.3	72.6	72.6
Haul Roads	45.1	45.1	62.4	62.4
Topsoil Stockpile	7.3	7.3	3.7	3.7
Water Control & Other	3.2	3.2	10.8	10.8
TOTAL	230.8	195.8	257.0	257.0

2.1.2 Geology and Exploration

Typical of the southeast Idaho area, North Rasmussen phosphate occurs in the Meade Peak Member of the Permian-aged Phosphoria Formation. The Meade Peak Member is overlain by chert from the Rex Chert Member of the Phosphoria Formation. It is underlain by dolomite from the Permian-aged Grandeur Tongue of the Park City Formation and limestone and sandstones from the Pennsylvanian-aged Wells Formation. The mineable phosphate rock occurs in two separate ore zones (the upper ore and lower ore) separated by 60 to 100 feet of center waste shales.

The lower ore varies in thickness throughout the property but averages 40 feet. The thickness of the upper ore also varies throughout the property and averages 16 feet. A stratigraphic column that shows the location and general quality of the individual ore beds is shown in **Figure 2.1-3**. The North Rasmussen phosphate deposit generally strikes north 44 degrees west and is normally bedded to the east with dips ranging from 33 degrees to 78 degrees.



SPECIAL USE PERMITS SSC-7
LEASE I-04375
2001 ACTIVE DUMP AREAS
2001 ACTIVE PIT AREA
GROWTH MEDIA STORAGE AREAS
SWRP= STORM WATER RETENTION POND
HAULAGE ROADS, SHOP AREA AND DISTURBANCE AREAS
INACTIVE DUMP AREAS
RECLAIMED
DELINEATED WETLANDS

0 1000 2000
Scale (ft)

NORTH

Source: North Rasmussen Ridge Supplemental Mine and Reclamation Plan, Agrium 2001.
Note: Mine coordinates do not coincide with any map coordinates.

North Rasmussen Ridge Mine EIS Project

FIGURE 2.1-2
EXISTING OPERATIONS

ANALYSIS AREA: Caribou County, Idaho.

Date: 02.27.03	1164 ANN OP 02.dwg
Scale: 1" = 1000 FEET	Drawn By: MTM

Permian Age	PHOSPHORIA FORMATION	Rex Chert Member		100-200 FT	
		MEADE PEAK MEMBER	D1	2.5 FT	High Grade
			D2	1 FT	Mudstone
			D3	2 FT	High Grade
			D4	.5 FT	Mudstone
			Upper Inter-Bed	3 FT	Medium Grade
			D5	4 FT	Low-Medium Grade
			D5-2	3 FT	Low-Medium Grade
			Upper Center Waste	40 FT	Mudstone/Shales
			"F" Bed Marker	2 FT	
			Lower Center Waste	40 FT	Mudstone/Shales
			Upper "C" Bed	4 FT	Low-Medium Grade
			Lower "C" Bed	2 FT	Low-Medium Grade
			Lower Inter-Bed	2 FT	Low-Medium Grade
			False Cap	3 FT	Waste-Low Grade
			Upper "B" Bed	8 FT	Medium-High Grade
			"B" Parting	3 FT	Mudstone
			Lower "B" Bed	7 FT	Medium-High Grade
			"A" Cap	6 FT	Low-Medium Grade
			"A" Bed	5 FT	High Grade
			Footwall Mud	3 FT	Mudstone
Pennsylvanian to Permian	Park City Formation	Grandeur Tongue Member		Varies	Dolomite/Sandstone
	Wells Formation			Varies	Limestone/Sandstone

Upper Ore Approx. 16 FT

Center Waste Approx. 82 FT

Lower Ore Approx. 40 FT

Source: Agrium 2001

North Rasmussen Ridge Mine EIS Project

FIGURE 2.1-3
STRATIGRAPHIC COLUMN

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 Strat Column.dwg
Scale: NTS	Drawn By: MTM

A total of 247 exploratory holes have been drilled on North Rasmussen Ridge over several years. The average drill depth of these holes is 293 feet with a maximum depth of 640 feet. **Table 2.1-2** itemizes the North Rasmussen Ridge exploration drilling by year with the associated footage. The Exploration & Core Drilling Map (Appendix J of the North Rasmussen Ridge Supplemental Mine and Reclamation Plan; Agrium 2001) shows the location of drill holes and exploration drill roads.

TABLE 2.1-2
SUMMARY OF EXPLORATION DRILLING AT NORTH RASMUSSEN RIDGE

Year	Number of Holes	Footage Drilled	Average Depth	Maximum Depth
1987 & 1988	28	5,161	184	300
1996	13	4,428	341	440
1997	57	15,612	274	640
1998	-	-	-	-
1999	40	12,263	307	600
2000	109	34,815	319	578
Totals	247	72,279	293	640

Source: Agrium 2001

All of the data on exploration drilling for North Rasmussen Ridge has been entered into a database for analysis. Computer-generated geologic and block models were created from the database using Surpac mining software. By applying a specific phosphate ore cut-off to these models that represents Agrium's minimum requirement for acceptable quality ore, it was determined that sufficient wet tons of ore are recoverable within the North Rasmussen pits to support operations.

2.2 PROPOSED ACTION

The proposed North Rasmussen Ridge Supplemental Mine and Reclamation Plan is designed to recover phosphate (P_2O_5) ore along with almost 67 million loose cubic yards (lcy) of waste rock (**Table 2.2-1**). All of the waste rock generated from the proposed pits would be placed, as backfill, in the Central and North Rasmussen pits after the ultimate depths have been achieved. A Growth Media Storage Area would be developed and used to accommodate and temporarily store up to 918,284 lcy of material.

All available topsoil and suitable alluvium from the pit would be directly applied to completed and resloped areas when possible, or would be salvaged and placed in the Growth Media Storage Area for future use. Agrium anticipates salvaging approximately 1,015,716 cubic yards of growth media for use in reclamation. Based on Agrium's current annual production rate, the estimated life of the proposed North Rasmussen Ridge Mine would be approximately eight years. These facilities are shown in **Figure 2.2-1**.

TABLE 2.2-1
SUMMARY OF ANNUAL WASTE ROCK SEQUENCING (ALL QUANTITIES SHOWN IN LCY)

Mining Year	Total Waste Rock	Central Coyote Corner	Central Backfill Area F	North Backfill Area A	North Backfill Area B	North Backfill Area C	Total Waste Rock Storage
2004	8,063,400	3,489,969	4,573,431				8,063,400
2005	9,974,303		9,974,303				9,974,303
2006	8,395,342		7,860,694	534,647			8,395,342
2007	8,104,273		7,641,470	462,803			8,104,273
2008	8,486,582		472,094	8,014,488			8,486,582
2009	7,763,419			7,314,832	448,587		7,763,419
2010	10,595,750			3,348,534	5,431,923	1,815,293	10,595,750
2011	5,464,291			4,476,326		987,964	5,464,290
TOTAL	66,847,361	3,489,969	30,521,992	24,151,631	5,880,510	2,803,258	66,847,360
PERCENT TOTAL WASTE ROCK		5.2%	46%	36.1%	8.8%	4.2%	100.0%
TOTAL DESIGN CAPACITY		3,503,674	30,521,993	24,552,774	5,931,487	2,972,771	67,482,699

Notes: Total Design Capacity reflects the total volume available in each backfill area.
Annual waste rock volumes assigned to a specific backfill area may or may not completely utilize the total design capacity.
Backfill areas are shown on **Figures 2.1-2, 2.2-2, and 2.2-3.**
lcy = Loose cubic yards

Source: North Rasmussen Ridge Supplemental Mine and Reclamation Plan, Agrium 2001.

2.2.1 Mining Sequence

The North Rasmussen ore reserve would be developed using an open pit mining method on a series of 40-foot bench cuts, using a combination of in-pit retreating ramps and backfill ramps. The primary equipment for ore and waste rock mining would be a combination of trucks, track-mounted excavators, bulldozers, and front-end loaders. A track-hoe excavator would also be used to maximize recovery of ore in the bottom of the pit (pit crotch).

Initial development of North Rasmussen would begin at mine coordinate section 13200N, which would include any ore that remains under the northernmost Central Rasmussen end wall. Mining would proceed to the north along the strike of the ore body using in-pit retreating and backfill ramps to access the lower pit areas. The retreating ramps would tie in to the East Road Extension via seven different spur tie-in roads, as illustrated on the layout map in **Figure 2.2-1**. Two backfill ramps would tie in to the existing West Road on the west side of the Central Rasmussen pit and would be used to access the pit crotch from mine section 12600N to mine section 16300N. A third backfill ramp would tie in to the East Road Extension at mine section 16350N as the final access to the pit.

The configuration of the North Rasmussen pit is divided into two pit structures separated by about 70 feet of original ground. This small area, between mine sections 16300N and 16400N, lies in a fault zone and would not be mined for the following reasons:

- The strike of the ore body is offset 1,000 feet, which diminishes the quantity and quality of ore in this area, to the point it is not economically viable in the area.

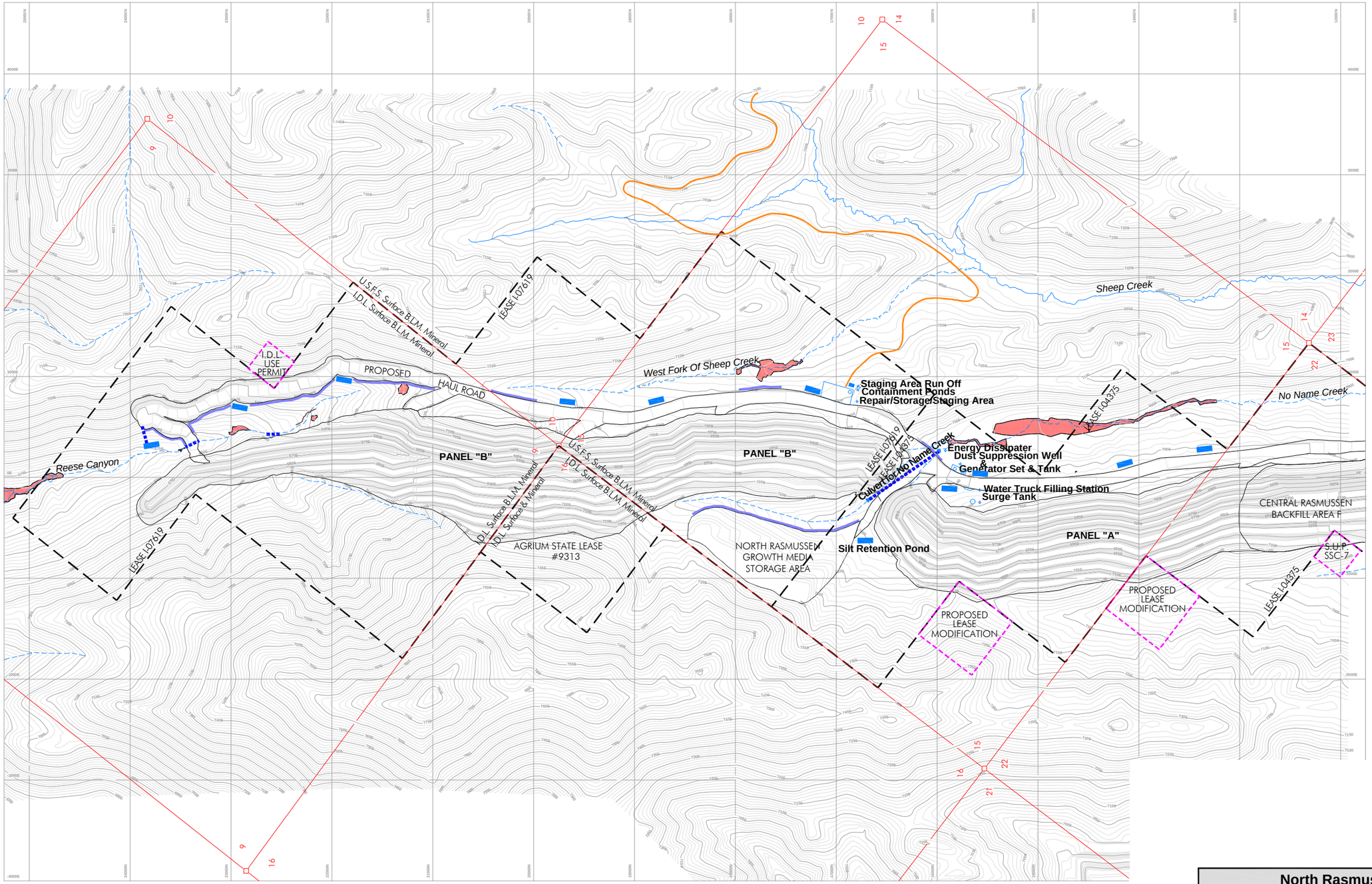
- The 70 feet of original ground that separates the pits would provide a stable base to reestablish the No Name drainage after mining has been completed. Using this corridor to reestablish the drainage would eliminate problems related to reestablishing the drainage across backfill in the pit.

- The 70-foot corridor that separates the two pit structures would also provide access to the proposed Growth Media Storage Area throughout the mining and reclamation process. This corridor would also be used for a culvert to convey the No Name drainage across the pit, thus providing continuous drainage throughout the mining process.

The annual mine sequencing regime is illustrated on the Pit and Backfill Progression in **Figure 2.2-2.**

2.2.1.1 Panel A

The southern portion of the North Rasmussen pit (known as Panel A) would be mined from the Central Rasmussen pit end wall northward to mine section 16300N, where it would be concluded with an end wall at a 45-degree slope that faces south. Two in-pit retreating ramps would be used to access Panel A from the East Road Extension. The first of these ramps would tie in to the East Road Extension at mine section 12900N via a spur tie-in that would be created as part of the Central Rasmussen Modified Mine Plan. The second in-pit ramp would tie into the East Road



LEASE I-07619 & I-04375
LEASE MODIFICATIONS & USE PERMITS
PERENNIAL STREAMS
INTERMITTENT STREAMS
EXISTING ROADS
WATER STRUCTURES
DELINEATED WETLANDS
EROSION CONTROL BMPs
CULVERTS

0 1000 2000
Scale (ft)

NORTH

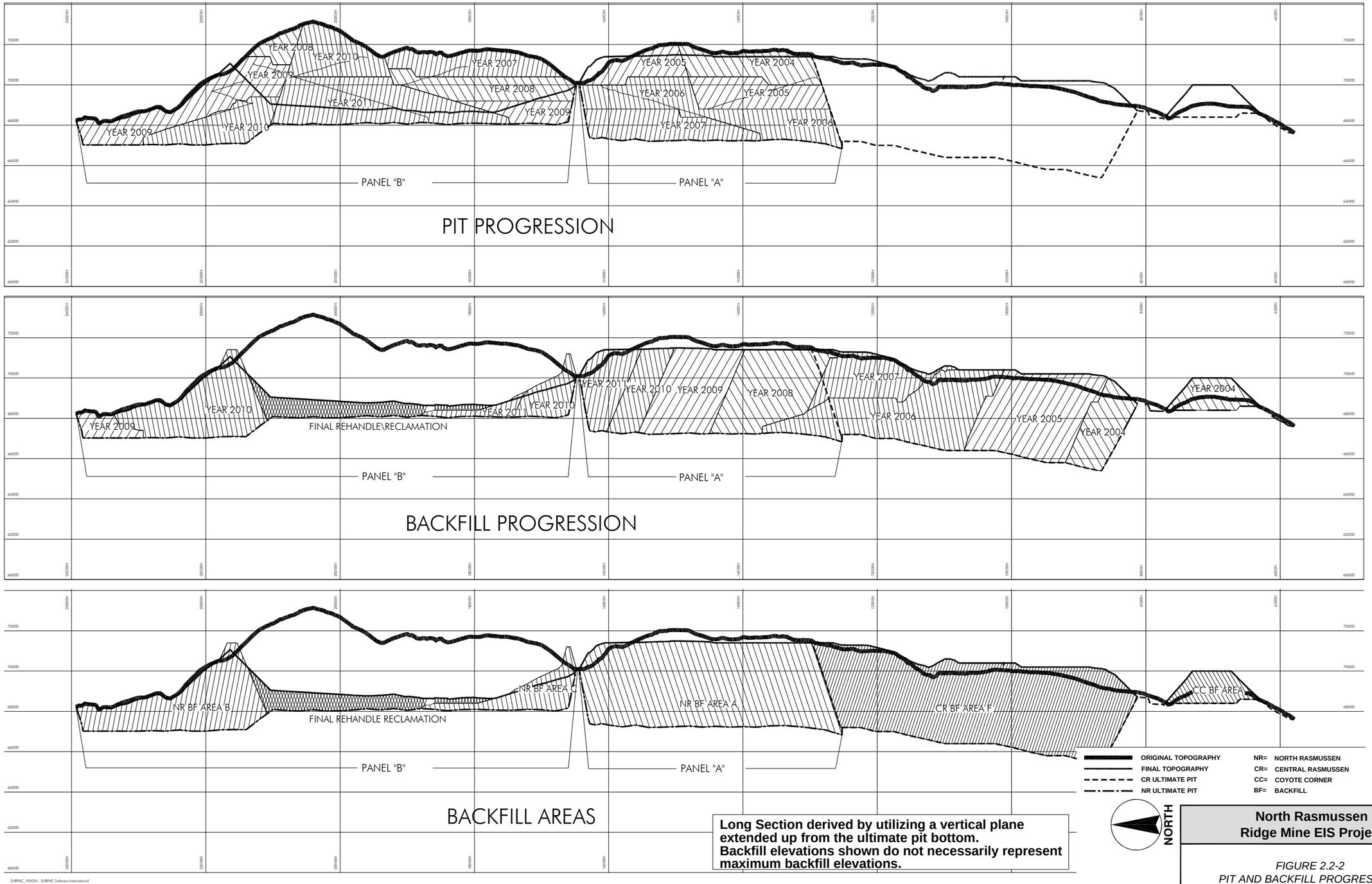
Source: North Rasmussen Ridge Supplemental Mine and Reclamation Plan, Agrium 2001.
Note: Mine coordinates do not coincide with any map coordinates.

North Rasmussen
Ridge Mine EIS Project

FIGURE 2.2-1
PROPOSED ACTION
FACILITY LAYOUT

ANALYSIS AREA: Caribou County, Idaho.

Date: 02.27.03	Drawing File: 1164 ultimate pit.dwg
Scale: 1" = 1000 FEET	Drawn By: MTM



Long Section derived by utilizing a vertical plane extended up from the ultimate pit bottom. Backfill elevations shown do not necessarily represent maximum backfill elevations.

North Rasmussen Ridge Mine EIS Project

FIGURE 2.2-2
PIT AND BACKFILL PROGRESSION

ANALYSIS AREA: Caribou County, Idaho.

Date: 02.27.03	Drawing File: 1164 pit backfill.dwg
Scale: NTS	Drawn By: PBE

Source: North Rasmussen Ridge Supplemental Mine and Reclamation Plan, Agruim 2001.

Extension at mine section 16050N via another tie-in spur (**Figure 2.2-1**)**.** Two backfill ramps would be used to access Panel A from the Central Rasmussen West Road. These backfill ramps would access material from the pit crotch north of mine section 13800N in Panel A.

2.2.1.2 Panel B

Mining of the northern portion of the pit (known as Panel B) would start with a north-facing end wall about 70 feet northeast of Panel A (**Figure 2.2-1**). Panel B would progress northward to mine section 19400N, exposing about 1,000 feet of pit crotch via an internal retreating ramp. This ramp ties in to the East Road Extension via a spur tie-in at mine section 18100N. The mining sequence would then stop in this area and move north to mine section 20500N, leaving 1,100 feet of original ground undisturbed in Panel B. This area would not be abandoned, but would be mined later in the sequence described below.

Mining would proceed from mine section 20500N to the north extent of Panel B at mine section 23935N using a spur road that ties in to the East Road Extension at mine section 21000N (**Figure 2.2-1**). This spur road would access an in-pit ramp that would allow the pit to progress down the steep terrain into Reese Canyon. The East Road Extension would progress northward into Reese Canyon and turn back at mine section 23890N before it connects to a backfill ramp near the north end of Panel B (**Figures 2.2-1 and 2.2-2**). This backfill ramp, along with the East Road Extension, would provide access to the lower portions of the pit in the Reese Canyon area.

After mining ends in the Reese Canyon area, mining would return to the central part of Panel B and mine northward through the 1,100 feet of original ground previously bypassed. Access would be obtained via a tie-in spur at mine section 19500N to an in-pit retreating ramp. The final crotch ore would be accessed via an in-pit backfill ramp, which ties in to the East Road Extension at mine section 16350N.

2.2.1.3 Placement of Backfill

The proposed mine sequencing would eliminate all external waste rock dumps by using the available space in the Central and North Rasmussen pits for backfilling. Waste rock would be contained in the areas of the pit where they originated. Water management would be enhanced by using only backfill areas for placement of overburden. In most cases, the pit slopes would be covered with backfill. During the mining process, backfill material would be used to construct backfill ramps to access middle to lower portions of the pit.

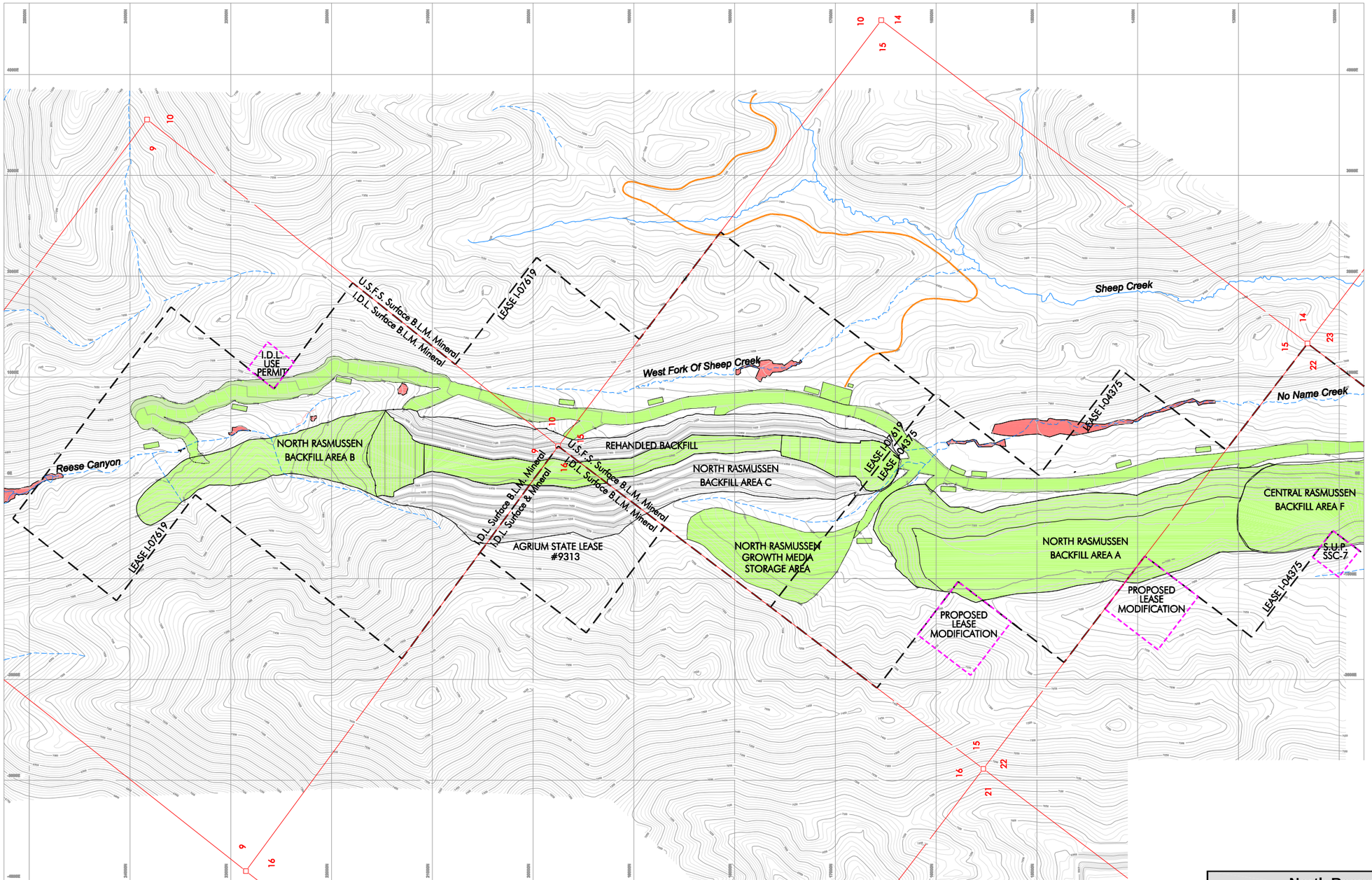
Backfill would be placed selectively so that center waste shale and any other potentially seleniferous material would be located in the middle and deep areas of the backfill. The non-seleniferous limestone and chert would then be used to cover the seleniferous materials. The backfill would be constructed by filling the pit from its crest in most areas. Backfill that extends above the crest of the pit would be constructed in 20- to 40-foot lifts, which would provide for some compaction in the upper areas of the backfill. Areas of the backfill below the crest of the pit that are designated for use as backfill access ramps would also experience some compaction. Backfill would be constructed using repose slope angles and resloped to 3.0h:1.0v after the area has been filled to capacity.

Annual waste rock production and destinations are described in **Table 2.2-1**. Waste rock destinations or backfill areas are illustrated on the Existing Operations, Pit and Backfill Progression, and Final Reclamation Plan in **Figures 2.1-2, 2.2-2, and 2.2-3**, respectively. The first backfill area to be used would be in the mined-out Central Rasmussen pit. A portion of the waste rock produced in the 2004 mining year would be placed in the Coyote Corner area of Central Rasmussen as backfill. The remaining waste rock from year 2004 and years 2005 through most of 2007 would be placed in Central Rasmussen backfill area F. As the Central Rasmussen backfill area F progresses, two backfill ramps would be constructed to provide access to the lower areas of Panel A. Backfilling would progress north from the Central Rasmussen backfill area F to the North Rasmussen backfill area A. The North Rasmussen backfill area A would hold waste rock mined during portions of years 2007 through 2011 (**Table 2.2-1**). Backfill area A includes all of Panel A, as previously described (**Figures 2.2-2 and 2.2-3**).

North Rasmussen backfill area B would be located at the northern end of Panel B and would effectively backfill the pit in Reese Canyon. It would contain waste rock mined during portions of years 2009 and 2010 (**Table 2.2-1**, **Figures 2.2-2 and 2.2-3**). North Rasmussen backfill area C would contain the remaining waste rock produced in years 2010 and 2011. A backfill ramp would be constructed within backfill area C that would be used to mine the last ore from Panel B.

After mining ends in Panel B, it is proposed to rehandle enough backfill to cover the ore and waste shale exposed in backfill area C. Backfill area C would contain 2.8 million lcy of waste rock of which 1.6 million cu yd would be rehandled to that location. This waste rock would be selectively mined and backfilled with non-seleniferous limestone. By selectively using non-seleniferous limestone, an impervious cap would not be necessary. The rehandled material would be placed in the pit bottom to cover the exposures of ore and center waste shale with a minimum of 8 to 10 feet of cover (**Figures 2.2-2 and 2.2-3**). The rehandled material would be graded and sloped so that water would flow away from the hanging wall towards the limestone footwall and down a 1.5 percent grade at the contact between the limestone footwall and backfill. The design would provide ample distance and area for water to drain into either the backfill or the limestone footwall.

This structure would reduce exposure of water, wildlife, and vegetation to the potentially seleniferous ore and waste shale zones. The rehandled materials would be reshaped, covered with 2 to 3 feet of growth media, and re-vegetated as dictated by the BMPs for backfill reclamation (see Section 2.2.3.4).



LEASE I-07619 & I-04375
LEASE MODIFICATIONS & USE PERMITS
PERENNIAL STREAMS
INTERMITTENT STREAMS
EXISTING ROAD
RECLAIMED AREAS
DELINEATED WETLANDS

0 1000 2000
Scale (ft)

NORTH

Source: North Rasmussen Ridge Supplemental Mine and Reclamation Plan, Agrium 2001.
Note: Mine coordinates do not coincide with any map coordinates.

North Rasmussen Ridge Mine EIS Project

FIGURE 2.2-3
FINAL RECLAMATION PLAN

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 Final Reclamation.dwg
Scale: 1" = 1000 FEET	Drawn By:MTM

2.2.2 Mine Planning

2.2.2.1 Design of Pit

Agrium has developed new design parameters for hanging walls that require construction of catch benches and a steeper bench face angle. This new design was developed using experience, slope analysis, and the results of a recent study of slope stability (Call and Nicholas 2000). To aid in this analysis, six core holes were drilled along the entire North Rasmussen strike length to obtain rock quality data. The final recommendations for the footwall slope and footwall bench design parameters for the North Rasmussen pits are nearly identical to those currently in use for the Central Rasmussen pit. The basic North Rasmussen bench design is 80 feet high, and 20 feet wide for the hanging wall and 40 feet wide for the footwall. All benches would be tapered to the inside of the pit to promote drainage of water. However, some alluvial slopes are designed at 1.5h:1.0v or 33.7 degrees as deemed necessary, and overall angle of the pit slope is 0.95h:1.0v or 46.5 degrees.

The design of the North Rasmussen pit, both Panel A and Panel B combined, would be 10,735 feet in length, starting on the southern end at mine section 13200N and ending on the northern end at mine section 23935N. These pits are separated by 70 feet of original ground. **Table 2.2-1** summarizes the waste rock quantities in the North Rasmussen Ridge Mine pits. The elevation of the pit floor in Panel A is constant at 6,760 feet above mean sea level (amsl). The Panel B floor elevation is not constant, but varies in elevation as follows:

- From mine section 16600N to 21000N, the floor elevation in Panel B is 6,840 feet amsl.
- From mine section 21000N, to 21400N the Panel B floor decreases 100 feet in elevation from 6,840 to 6,740 feet amsl. This produces a 25 percent floor slope over a distance of 400 feet.
- From mine section 21400N to 23830N, the Panel B floor remains constant at 6,740 feet amsl.

A south-facing end wall finishes the Panel B pit (**Figures 2.2-1 and 2.2-2**). The pit depths designed for any area were calculated by the use of a pit optimization algorithm, strip ratio calculations, and by the quality of the modeled ore. Panels A and B would disturb 196.9 acres on lease and 1.8 acres off lease, which would require a lease modification in two areas on the national forest and a Temporary Use Permit issued by the IDL (**Table 2.2.2**). Areas of pit disturbance outside of the lease are approximately at mine sections 13930N and 15700N. Portions of both of these areas would be disturbed by development of the pit. An application for these lease modifications was submitted to the BLM on February 9, 2001. The East Haul Road Extension also crosses the lease boundary at mine section 22600N (0.2 acres) as described in section 2.2.2.3, which would require a Temporary Use Permit from the State of Idaho.

2.2.2.2 Design of Waste Rock Backfill

Waste rock produced from the mining process would be placed in the unbackfilled portions of the Central Rasmussen pit and the mined-out areas of the North Rasmussen pits as they become available. Under this proposed design, no external waste rock dumps would be required for mining the North Rasmussen pits. Although no external waste rock dumps are required, a Growth Media

Storage Area or stockpile would be developed to store available topsoil and alluvium that cannot be immediately used for reclamation during the mining sequence. Material from the Growth Media Storage Area would be used for reclamation as areas become available. **Table 2.2-2** summarizes the areas of disturbance and reclamation for backfill and the Growth Media Storage Area.

Disposal areas for backfill are designed to incorporate convex faces at 3.0h:1.0v slopes and a one percent out-sloped top to prevent erosion and enhance revegetation. Additionally in panel A, surface ditches would intercept the runoff from a modified 2 percent top surface slope to minimize the infiltration into the overburden. The ditches would divert surface flow to access roads used by trucks during the backfill placement. The roads would be reduced in width to 20-feet, and covered with compacted alluvium to further minimize infiltration into the overburden. The ditches and roads would have velocity-reducing structures (rocks, logs) to slow the water and reduce erosion. Runoff would be channeled down the roads to energy dissipater/silt retention ponds between the pit crests and the east haul road. On panel B backfill, Agrium would construct two 50-foot wide corridors (located at mine sectors N22550 and N23500) to transport run-on water across the backfill. These corridors would also be constructed of alluvium compacted into a 3-foot thick layer. The corridors would be sloped across the backfill from west to east and velocity-reducing/silt retention structures would be placed in them. On the east side of the pit crest, the water would re-enter the original drainage prior to converging with the Reese Canyon Creek. These corridors would intercept water from approximately 111 acres up-gradient of the backfilled pit. These designs are estimated to reduce water infiltration into the overburden by 85 percent.

All slopes would be shaped to blend with the natural surrounding topography. Water management BMPs listed in Section 2.2.3.2 would be used to control erosion and sedimentation on the reclaimed backfill slopes. All backfill areas would be reclaimed to USFS and IDL specifications. Material from the Growth Media Storage Area, along with direct placement of topsoil and alluvium, would be used to cover the backfill slopes and other reshaped areas as part of the reclamation process. Covering of the backfill areas with growth media would be followed by the application of a fertilizer and seed mix approved by USFS and IDL.

2.2.2.3 Ore and Waste Rock Transportation

Ore produced from the North Rasmussen pits would be hauled by truck to the Wooley Valley rail loading facility (tipple). The haul routes would include using the East Road Extension, as described below, the existing West Road, and the existing haul road from the mine to the tipple. One new haul road would be constructed within the boundary of the lease to accommodate haulage needs for the North Rasmussen pits. This haul road would be built by extending the approved East Road from Central Rasmussen northward paralleling the proposed North Rasmussen pits. This extension of the East Road would involve areas of cut and fill as it progresses north along the proposed pit and into Reese Canyon. Cut and fill slope ratios would be variable along the road's length. Berms along the road would be as high as the highest axle on the haul trucks. Cut and fill slopes would be seeded after the road was constructed. The East Road Extension would provide

TABLE 2.2-2
ACREAGE DISTURBANCE AND RECLAMATION SUMMARY

Description	Disturbed	Reclaimed
United States Forest Service Surface Disturbance		
Pit Disturbance	120.40	85.20
Haul Roads Disturbance	27.23	27.23
Staging and Well Areas	1.18	1.18
Water Management Disturbance	1.23	1.23
Wetland Disturbance	0.00	0.00
Growth Media Storage Disturbance	20.78	20.78
Total	**170.82**	**135.62**
Idaho Department of Lands Surface Disturbance		
Pit Disturbance	78.30	41.30
Haul Roads Disturbance	19.60	19.60
Water Management Disturbance	0.50	0.50
Wetland Disturbance	0.00	0.00
Growth Media Storage Disturbance	0.00	0.00
Total	98.40	61.40
Total Disturbance		
Pit Disturbance	198.70	126.50
Haul Roads Disturbance	46.83	46.83
Staging and Well Areas	1.18	1.18
Water Management Disturbance	1.73	1.73
Wetland Disturbance	0.00	0.00
Growth Media Storage Disturbance	20.78	20.78
Total	**269.22**	**197.02**

Note: Pit and road disturbance includes areas outside lease boundaries.
Source: North Rasmussen Ridge Supplemental Mine and Reclamation Plan, Agrium 2001.

access to the pit as well as ore and waste rock haulage routes for the entire strike length of the North Rasmussen pits. Nearly the entire haul road would be constructed within the boundaries of the lease and the terrain would be less severe than on the west side of the pit. Part of the East Road Extension lies outside the boundary of the lease at section 22600N. The area of disturbance of the East Road Extension outside of the boundary of the lease is 0.2 acres and would be permitted under the IDL with a Temporary Use Permit. Seven access spur roads would be developed from the East

Road Extension to the in-pit access ramps. These spur roads would be constructed with both cut and fill areas, depending on each specific spur and its position on the original topography. New roads would be constructed with road cut materials, chert, limestone, or a combination.

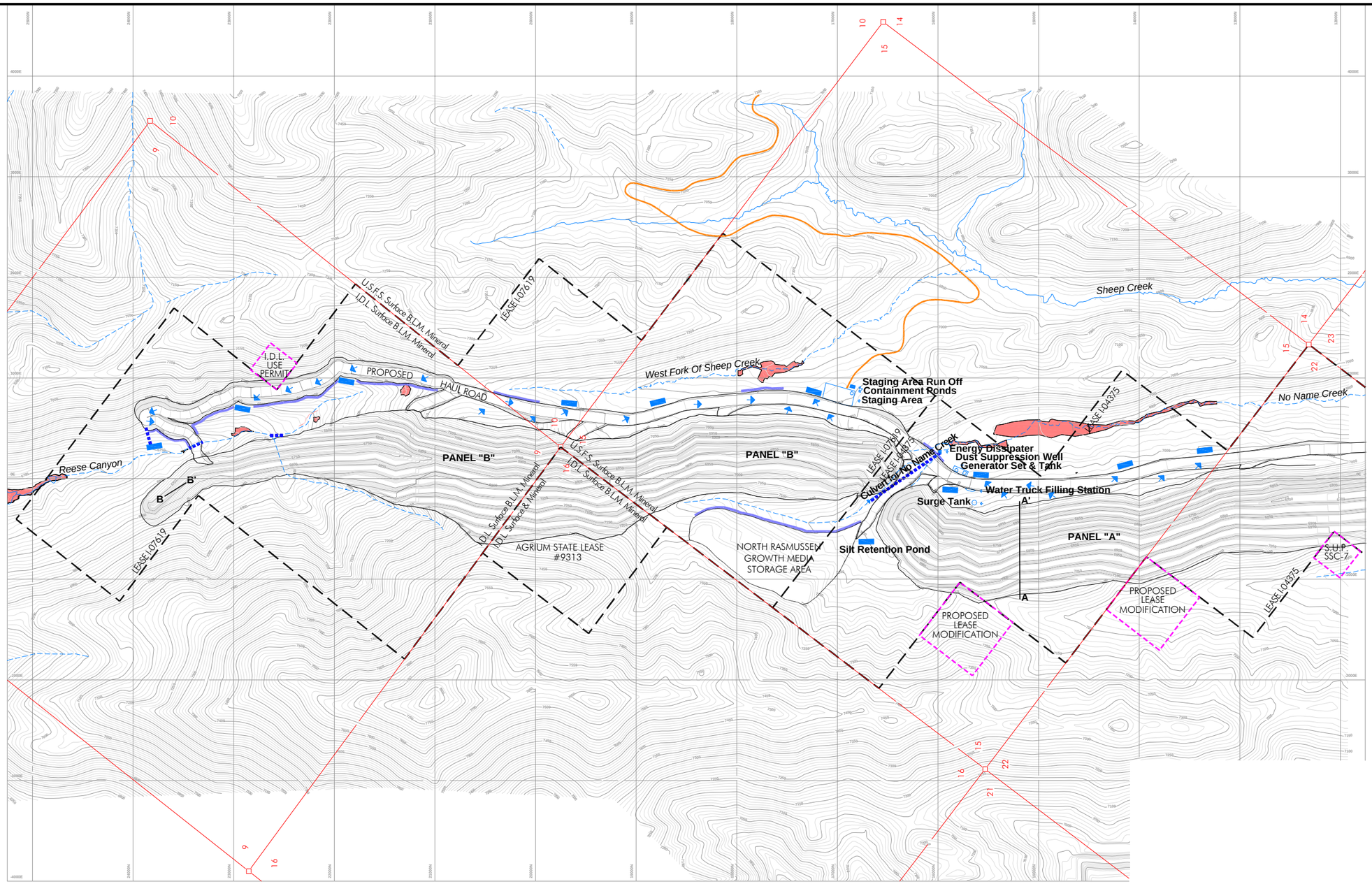
Using in-pit retreating and backfill ramps that tie into the East Road Extension and the Central Rasmussen West Road would provide access to the pit in a reasonable manner. In-pit retreating ramps would be removed as mining progresses, which can be difficult and costly. However, the adverse effects of in-pit ramps are less than an all-cut ramp with respect to the North Rasmussen Mine Plan. The existing Central Rasmussen West Road would be used as an in-pit backfill ramp for access. A single-lane haul road would also be constructed across the unmined land bridge between the northern (Panel B) and southern (Panel A) pits to access the proposed Growth Media Storage Area located on the west side of the pit. Special care would be given to the cut and fill slopes on all roads so that disturbance by water and sediment to nearby drainages is minimized or eliminated. BMPs listed in Section 2.2.3 that apply would be used, and may include erosion matting, silt fencing, and straw bales/wattles.

When these roads and accesses are no longer needed, they would be reclaimed to USFS and IDL specifications. Reclamation would be accomplished by pulling material up, or hauling material into, the cut portions of the road and shaping the materials to blend with the surrounding topography. The fill portions of roads would be shaped at 3.0h:1.0v slopes to blend with surrounding land forms. Topsoil or other growth media would be placed on all shaped areas whenever possible, followed by fertilization and seeding.

2.2.2.4 North Rasmussen Staging and Well Areas

A small staging area would be constructed on the east side of the East Road Extension at or near mine section 17000N. The dimensions of this area would be 150 feet wide by 300 feet long. This area would be used for activities such as in-field mechanical repairs, storing wear components, and short-term equipment parking. No fuel or lubricant tanks would be installed, as equipment and vehicles would be fueled and lubricated from a service truck that would travel to the parked equipment. A containment pond would be designed and built to contain any possible contaminants associated with run-off water from this staging area (**Figures 2.2-1 and 2.2-4**).

A second area would be constructed on the east side of the East Road Extension at or near mine section 15900N. This area would contain a water well for dust suppression and generator to supply power to the well pumping system. The generator and its fuel tank would be set in a concrete containment structure to contain any possible spills or leaks. The containment would be designed to contain twice the capacity of the fuel tank. The pump would transport well water under the East Road Extension to a surge tank. The surge tank would be located between the East Road Extension and the pit crest in Panel A at or near mine section 15750N. This location would provide the surge tank with the elevation needed so that water in the tank can feed by gravity into a water truck below on the East Road Extension. A small turnout would be constructed on the west side of the East Road Extension directly below the surge tank to provide space for a filling station for water trucks (**Figure 2.2-1**).



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LEASE MODIFICATIONS & USE PERMITS
PERENNIAL STREAMS
INTERMITTENT STREAMS
EXISTING ROADS
WATER STRUCTURES
DELINEATED WETLANDS
DRAINAGE DIRECTION
EROSION CONTROL BMPs
CULVERTS
B – B' CROSS SECTIONS IN FIGURES 2.2-5 AND 2.2-6

0 1000 2000
Scale (ft)

NORTH

North Rasmussen Ridge Mine EIS Project

FIGURE 2.2-4
WATER MANAGEMENT PLAN FOR ULTIMATE PIT

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 Water Man.dwg
Scale: 1" = 1000 FEET	Drawn By: ETC

Source: North Rasmussen Ridge Supplemental Mine and Reclamation Plan, Agrium 2001.
Note: Mine coordinates do not coincide with any map coordinates.

2.2.3 Environmental Monitoring, BMPs and Reclamation

The following sections summarize the environmental monitoring, BMPs and reclamation plans that Agrium has developed as part of the Proposed Action.

2.2.3.1 Cultural Resources Inventory

All of the proposed areas of disturbance in the North Rasmussen Ridge Supplemental Mine and Reclamation Plan have been inventoried to current standards for cultural resources. For the baseline cultural resources data collection, Maxim (2000) resurveyed any areas that had been surveyed prior to 1990. Areas that were resurveyed by later studies included portions of the NE/NE Section 16 (Druss 1983) and portions of Sections 15 and 22 where sample transects had been surveyed by Basin and Range Research that same year. Other portions of the North Rasmussen Ridge Mine area in Sections 9, 10, 15 and 22 were surveyed (Polk 1991; Polk 1993).

The portion of Agrium state lease (9313) that required new inventory, and portions of lease areas I-07619 and I-04375 that had not been covered were surveyed by Maxim (2000). No historical properties were identified by the cultural resource inventories, and cultural resource clearance was recommended. Because no historical properties were identified within the North Rasmussen Ridge Mine area, no avoidance, monitoring, or mitigation measures would be needed for cultural resources. If unanticipated human remains or cultural materials are encountered during mining, operations would be halted in the vicinity of the discovery and the Forest Service archaeologist would be notified. If vertebrate fossils are uncovered during mining, operations would also be halted and the archaeologist would be notified.

2.2.3.2 Water Management

Three drainages could be affected by development of the North Rasmussen Ridge Mine. Two of these drainages, No Name Creek and Reese Canyon Creek, would be minimally disturbed by the North Rasmussen pit and haul road. No Name Creek is considered to be ephemeral while Reese Canyon Creek is considered to be intermittent. The third drainage, the West Fork of Sheep Creek, is perennial in its lower half and would be paralleled by the East Road Extension. Numerous BMPs would be used for water management at North Rasmussen Ridge, as discussed below. The number, size, and location of these BMPs may be adjusted as mining progresses and the run-off characteristics of the area are better defined. New BMPs would be implemented as they are developed and proven to be viable **(Figure 2.2-4** and **Table 2.2-3)**.

Water Run-Off/Run-On Management

North Rasmussen Pit Area. Run-off water from the undisturbed ground on the east side of the pit is expected to be minimal as a result of the close proximity of the haul road to the ultimate pit crest. The run-off water that is produced would either be trapped in natural depressions between the haul road fill and original ground, or be contained in retention ponds that would be constructed as shown on the Water Management Plan (**Figure 2.2-4**). The sediment ponds are designed to accommodate the 100-year, 24-hour storm event.

TABLE 2.2-3
WATER MANAGEMENT CALCULATIONS

						Potential Inflow										
Pond	Size	Adjusted Capacity Cubic Feet	Drainage Acres			(Acre Feet)			(Gallons)			(Cubic Feet)			Excess Capacity	
			Road Surface	Original Ground	Total	Road Surface	Original Ground	Total	Road Surface	Original Ground	Total	Road Surface	Original Ground	Total	Gallons	%
A	150'x50'x10'	56,250	2.300	2.500	4.800	0.690	0.750	1.440	224,837	85,536	310,372	30,058	11,435	41,494	14,756	36
B	150'x50'x10'	56,250	2.300	2.750	5.050	0.690	0.825	1.515	224,837	94,089	318,926	30,058	12,579	42,637	13,613	32
C	150'x50'x10'	56,250	1.800	3.440	5.240	0.540	1.032	1.572	175,959	117,697	293,656	23,524	15,735	39,259	16,991	43
D	150'x50'x10'	56,250	2.980	0.910	3.890	0.894	0.273	1.167	291,310	31,135	322,445	38,945	4,162	43,108	13,142	30
E	175'x50'x10'	65,625	3.440	1.210	4.650	1.032	0.363	1.395	336,277	41,399	377,676	44,957	5,535	50,492	15,133	30
F	150'x50'x10'	56,250	2.060	0.920	2.980	0.618	0.276	0.894	201,375	31,477	232,852	26,922	4,208	31,130	25,120	81
G	100'x50'x10'	37,500	0.918	2.750	3.668	0.275	0.825	1,100	89,739	94,089	183,828	11,997	12,579	24,576	12,924	53
H	150'x50'x10'	56,250	2.200	0.820	3.020	0.660	0.246	0.906	215,061	28,056	243,117	28,751	3,751	32,502	23,748	73
I	150'x50'x10'	56,250	2.02	1.51	3.53	0.606	0.453	1.059	197,465	51,664	249,129	26,399	6,907	33,306	22,944	69
J	150'x50'x10'	56,250	2.04	1.72	3.76	0.612	0.516	1.128	199.420	58,849	199,421	26,660	7,867	34,528	21,722	63

Equations Used

Adjusted Capacity (Cubic Feet)	(L' x W' x D') *0.75(% of usable pond capacity
Potential Inflow (Acre Feet)	(Acres * 3.6(max run-off))/12
Potential Inflow (Gallons)	((Acre Feet * 325,850(gallons/acre foot)) * (100% infiltration)
Potential Inflow (Cubic Feet)	((Gallons/7.48(gallons/cubic foot))
Excess Capacity (Gallons)	Adj. Capacity (Cubic Feet) – Potential Inflow (Cubic Feet)
Excess Capacity (%)	Excess Capacity (Gallons)/Potential Inflow (Cubic Feet)

Source: North Rasmussen Ridge Supplemental Mine and Reclamation Plan, Agrium 2001.

General Information

Maximum inches of run-off	3.6
Infiltration rate on haulroad	0%
Infiltration rate on original ground	65%
Actual % of useable pond capacity	75%
(ponds would not have vertical walls)	
Gallons per acre foot	325,850
Gallons per Cubic Foot	7.48

Generally, run-off water from undisturbed ground on the west side of the pit should pose no problems. Either the water would flow toward the west, which drains away from the pit, or the amount flowing east toward the pit would be so small that pit dewatering or concerns for wall stability would not be anticipated.

An 85 percent reduction in water infiltration would be achieved in backfill areas A and B. The top of backfill area A would be sloped toward the east at a 2 percent grade (**Figure 2.2-5**). This would allow water from snowmelt and summer storms to flow into two water interceptor trenches. These trenches would be constructed at the break in slope between the top of the backfill and the 3.0h:1.0v side slopes of the backfilled pit. The water would drain to the south in these trenches at a 2 percent grade. The trenches would intercept the backfill access roads that were used to haul overburden to the dump top. These access roads would be reduced in size to about 20-feet wide and would extend down the side slope to the original ground. The interceptor trenches would be constructed with compacted alluvium in the base to reduce infiltration and a small berm would also be constructed on the west side to contain the water in the trenches. The drainage ramps would have compacted clay in the base and would have rip-rap placed on the ramp to reduce the water velocity and erosion. The ramps would extend out into the original ground and into energy dissipaters.

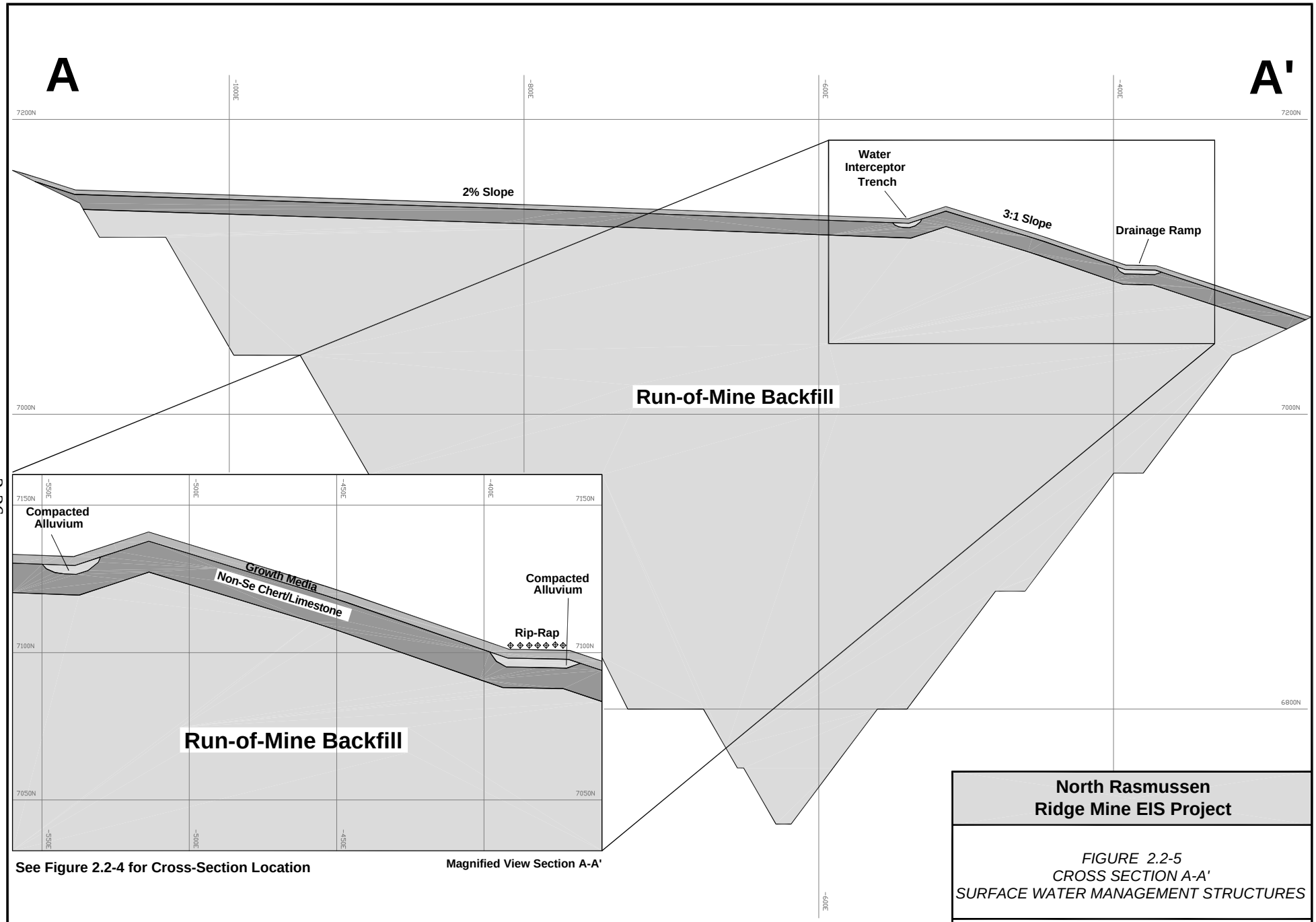
The run-on water onto backfill area B originates from undisturbed areas to the east of the pit (**Figure 2.2-6**). There are two drainages that would be intercepted by Panel B. In both cases, the water would be handled the same. The run-on water would be carried across the backfill pit to undisturbed ground on the west side via a constructed drainage. The drainages would be made of compacted alluvium in the base to reduce water infiltration down into the backfill. The slope of the drainage would be at a 2 percent grade to the west. To reduce erosion in the drainage, logs and rip-rap would be used to slow the velocity of any runoff.

Agrium has obtained a Multi-Sector General Permit for storm water discharges from the U.S. Environmental Protection Agency (EPA). Currently, all of South and Central Rasmussen fall under the provision of this permit. North Rasmussen would also fall under the provisions of this permit. In general, the requirements are as follows:

- Visual inspections of all storm water retention structures at least quarterly with documentation of results.
- Annual year-end inspection of all storm water structures with results, recommendations for improvement, and an action plan for the improvements.
- Frequent (three per week) inspections during spring run-off and after summer thunderstorms with documentation of findings.
- Regular compliance inspection of all fueling areas or any area where hazardous substances could be spilled.
- Removal of retention structures during site closure.

The inspections would evaluate the pollution prevention structures and procedures and develop improvements as needed or as processes change.

Growth Media Storage Area. The proposed Growth Media Storage Area would be constructed



See Figure 2.2-4 for Cross-Section Location

Magnified View Section A-A'

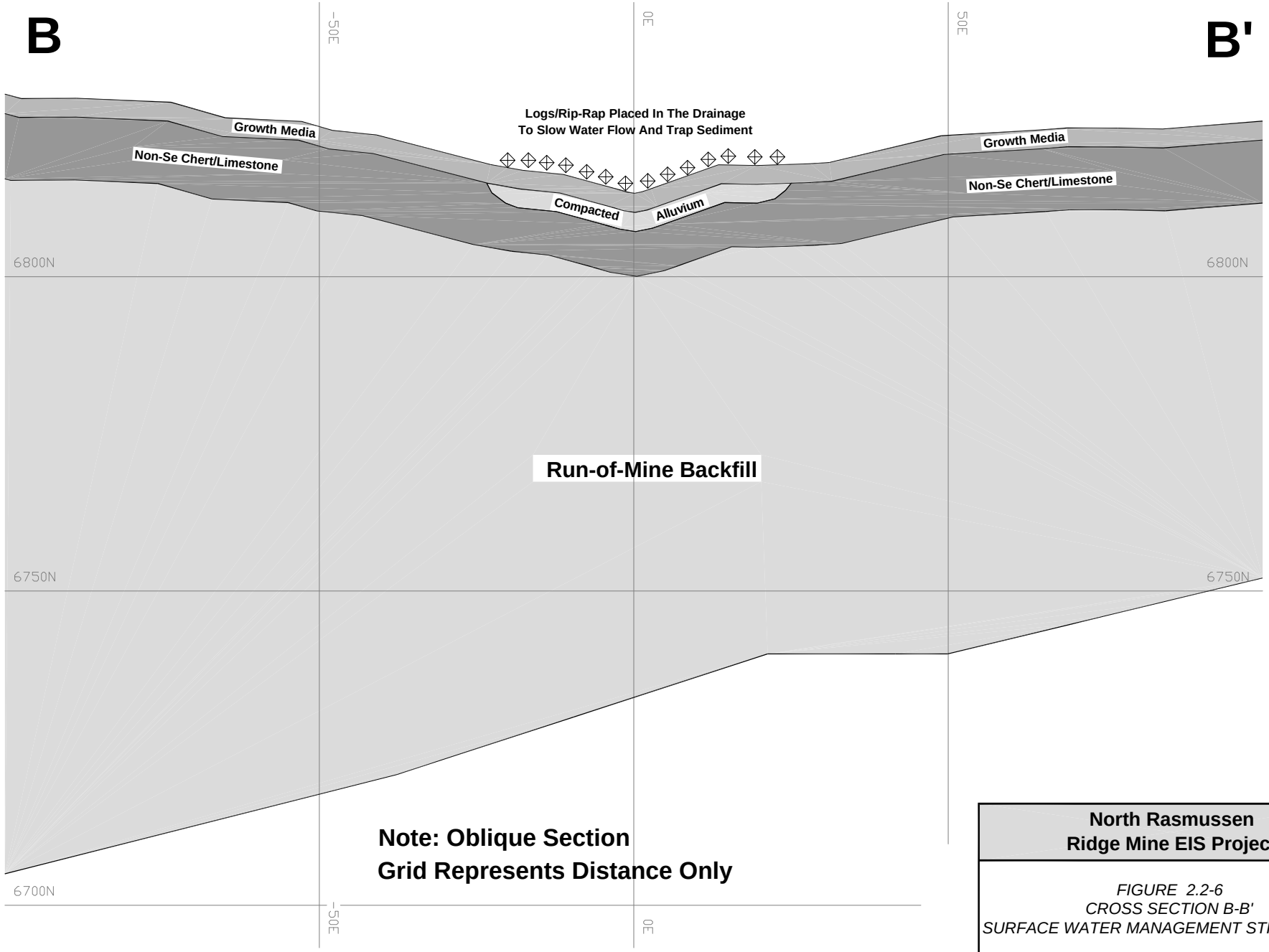
Source: Agrium 2001

North Rasmussen Ridge Mine EIS Project

FIGURE 2.2-5
CROSS SECTION A-A'
SURFACE WATER MANAGEMENT STRUCTURES

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 A-A'.dwg
Scale: NTS	Drawn By: ETC



Note: Oblique Section
Grid Represents Distance Only

See Figure 2.2-4 for Cross-Section Location

Source: Agrium 2001

North Rasmussen Ridge Mine EIS Project	
FIGURE 2.2-6 *CROSS SECTION B-B'* *SURFACE WATER MANAGEMENT STRUCTURES*	
ANALYSIS AREA: Caribou County, Idaho	
Date: 02.27.03	Drawing File: 1164 A-A'.dwg
Scale: NTS	Drawn By: ETC

with 3.0h:1.0v slopes and seeded to prevent slope toe failure and to reduce run-off rilling. The storage area would be surrounded by a barrier of trees and shrubs removed from the footprint of the stockpile to act as a barrier to sediment. The storage area has been designed with a 100-foot buffer zone between the toe of the stockpile and the ephemeral drainage of upper No Name Creek. After the Growth Media Storage Area is removed, the trees would provide natural debris to be returned to the footprint to slow run-off until vegetation can be reestablished. A water retention pond would be constructed at the base of the access road to the Growth Media Storage Area. This pond would collect any water run-off from the road.

No Name Creek and Reese Canyon Creek. Agrium plans two stream diversions in the North Rasmussen Mine area. The first is in the ephemeral No Name Creek drainage (**Figure 2.2-4**). The water at this point in the drainage originates from snowmelt in the spring. The southern end of Panel B would intercept this drainage during mining, resulting in water that enters the pit and mining area. To prevent water from entering and to continue the flow of water down the No Name drainage, Agrium proposes to place a 24-inch culvert in the drainage west of the Panel B pit. The culvert would divert the water around the proposed pit, adjacent to the growth media access road, under the haul road, and back into the original drainage east of the haul road (**Figure 2.2-4**). A standpipe at the entrance of the culvert to prevent plugging, and an energy dissipater at the outflow of the culvert would be used to maintain flow and reduce erosion. By diverting the water though a culvert before it reaches any mining disturbance and discharging the water past any disturbance, this plan would keep the water free of associated mining sediments. The total length of the culvert would be 700 feet. Once mining is completed in this panel and the access road to the Growth Media Storage Area and the haul road are no longer needed, the culvert would be removed. A third-party contractor would design a new drainage channel around the backfilled Panel B pit, through the haul road, and into the original drainage. Stream meanders and proper vegetation would be incorporated, along with materials needed to stabilize the stream bank such as matting.

The placement of the culvert and the reestablishment of the drainage would take place during summer, when the area is dry. Currently, the Forest Service Sheep Creek Road crosses this drainage at the point where Agrium proposes to place the 24-inch culvert. The Forest Service culvert is 18 inches in diameter. The stream flow 4,000 feet downgradient of Agrium's proposed culvert site in No Name Creek on June 14, 2000, was 0.10 cubic feet per second (cfs); on September 12, 2001, the flow was too small to be measured (Maxim 2001a). The 24-inch culvert was designed to pass the 100-year, 24-hour storm.

The second stream diversion is the intermittent drainage in Reese Canyon Creek at mine section 22500N on the east side of the pit (**Figure 2.2-4**). The water in this drainage originates from snowmelt and from a small wetlands seep to the south. Agrium proposes to place a 24-inch culvert in the drainage, divert the water past the point where it could seep into the pit, and then return it into the original channel. The total length of the culvert would be 100 feet and would also pass the 100-year, 24-hour storm. Once mining is completed in this panel, the culvert would be removed. A third-party contractor would be retained to design a new stream channel at the location of the culvert. This plan would keep the water away from the pit and prevent any water loss into the pit. The stream flow 1,200 feet downgradient of Agrium's proposed haul road crossing of Reese Canyon Creek was 0.15 cfs on June 14, 2000; on September 12, 2000, the flow was too small to be measured (Maxim 2001a).

All culvert work in both No Name Creek and Reese Canyon Creek would occur at the time of the year when there is no water in the drainage. There would be no direct disturbance to wetlands in either No Name Creek or Reese Canyon Creek. The topsoil in and adjacent to the channels at the stream crossings would be salvaged and stored for use during reconstruction of the drainages.

Backfill Slopes. Backfill slopes would be shaped to a final 3.0h:1.0v slope. Non-seleniferous chert and limestone placed over any shale wastes during backfill construction would be covered with an average of 2 to 3 feet of growth media. The final reclaimed slope would be blended smoothly onto the original undisturbed ground, thus eliminating any ponding of run-off water between the reclaimed slope and the pit crests. There are no external overburden dumps in the North Rasmussen Ridge Mine Plan. All overburden would be stored as backfill in the pits.

Staging Area and Water Well/Dust Suppression Tank. A small run-off collection pond would be constructed at the southeast corner of the staging area. The staging area would be sloped toward this pond to collect possible run-off water contaminated with hydrocarbons. The haul road would be sloped to the west and away from the staging area to keep any run-off water from the adjacent haul road from filling this pond. An underflow drainpipe would pass from the staging area collection pond to a water containment pond constructed in original ground east of the staging area. A gate valve would be attached to the underflow drainpipe to drain water from underneath any hydrocarbons floating on the water surface. Water stored in the containment pond would be evaporated. Periodically, the collection pond would be cleaned out with a backhoe and any accumulated hydrocarbons in soil would be bacteriologically digested or disposed of according to federal requirements. **Figures 2.2-4**, **2.2-7**, and **2.2-8** illustrate these facilities.

A well would be drilled to supply water for dust suppression near section 15900N. A diesel-powered generator would be located next to the well to power the well pump. The diesel fuel tank and generator would be held inside a concrete containment structure to separate any surface run-off from any leaks or spills from the generator or fuel tank. The surface water would be directed to haul road retention pond D for storage. This retention pond is on the west side of the haul road, so a fuel spill outside the containment structure would be unlikely to travel toward the No Name Creek drainage (**Figure 2.2-4**).

The water storage tank and associated filling area for water trucks would be located on the west side of the haul road so that any fuel leaks would be held in haul road retention pond D and would not be able to reach No Name Creek (**Figures 2.2-4**). Periodically, the retention pond would be cleaned out with a backhoe and any accumulated hydrocarbons and soil would be bacteriologically digested or disposed of according to federal requirements.

In-Pit Water

Water that accumulates in the North Rasmussen pit from snowmelt, rain, or groundwater seepage and could interfere with mining or could create a workplace hazard to employees in the pit would be pumped into a water truck and hauled to a mined-out pit. If any of the water in the pit is needed for dust control, samples of the water would be tested for selenium before it is used. No water in the pit would be dumped into any drainage.

Snow Removal and Storage

Snow that accumulates in the pits, ramps or roads that could reach drainages or other sensitive areas would either be picked up by the mine operator and dumped into a mined-out backfill pit or removed and placed on undisturbed ground. Removal of snow would decrease the volume of water in active mining areas and consequently reduce the sediment load possibly leaving the site.

2.2.3.3 Selenium Issues and Planned BMPs

With the on-going selenium investigations and testing efforts, all the BMPs needed have not yet been identified. As new proven BMPs become available, Agrium would put them in place where practical. The BMPs to be used at this time for reduction and control of selenium are described in the following sections.

Mine Planning

One of the most significant BMPs to reduce movement of selenium through the environment is the elimination of external overburden dumps. Any movement of selenium is held within the original pit profile and is not allowed to reach any surface waters.

Selective overburden handling is important for correct placement of seleniferous waste rock. Haul road construction materials, energy dissipaters, and any other materials placed near water would be non-seleniferous. Placement of center waste shales that are high in selenium within the mined-out pit would be toward the middle and the lower parts of the pits. Mine sequencing is designed to accomplish this objective.

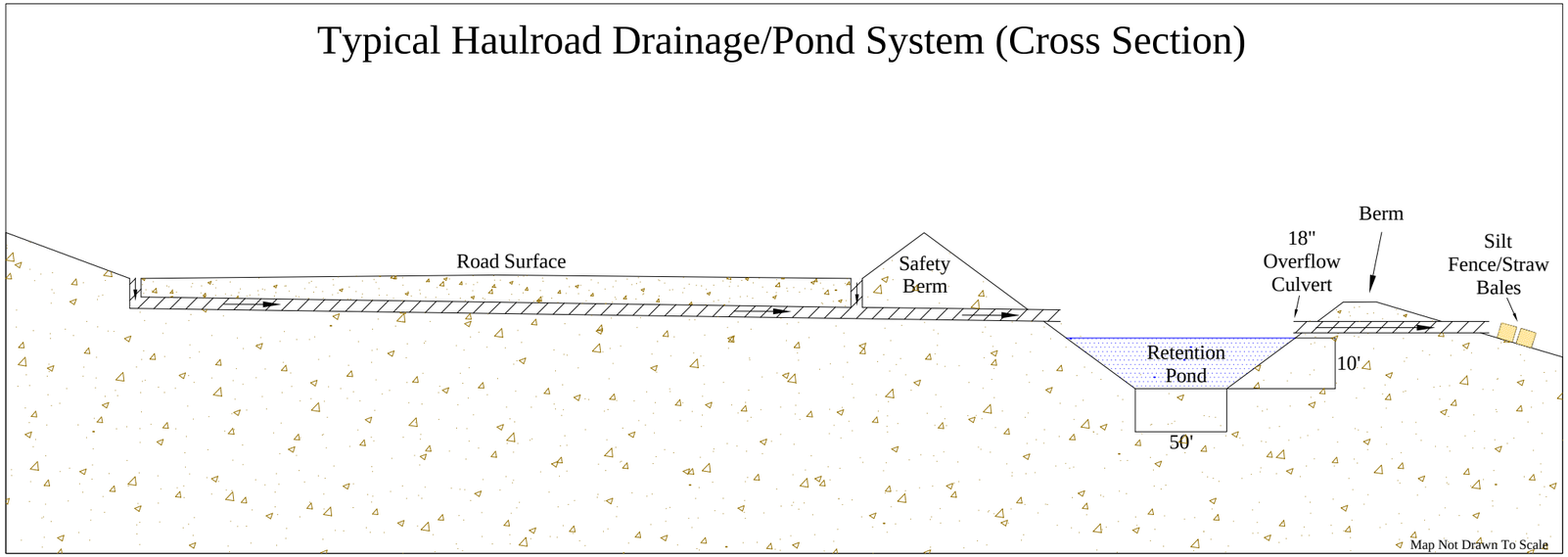
Water Management

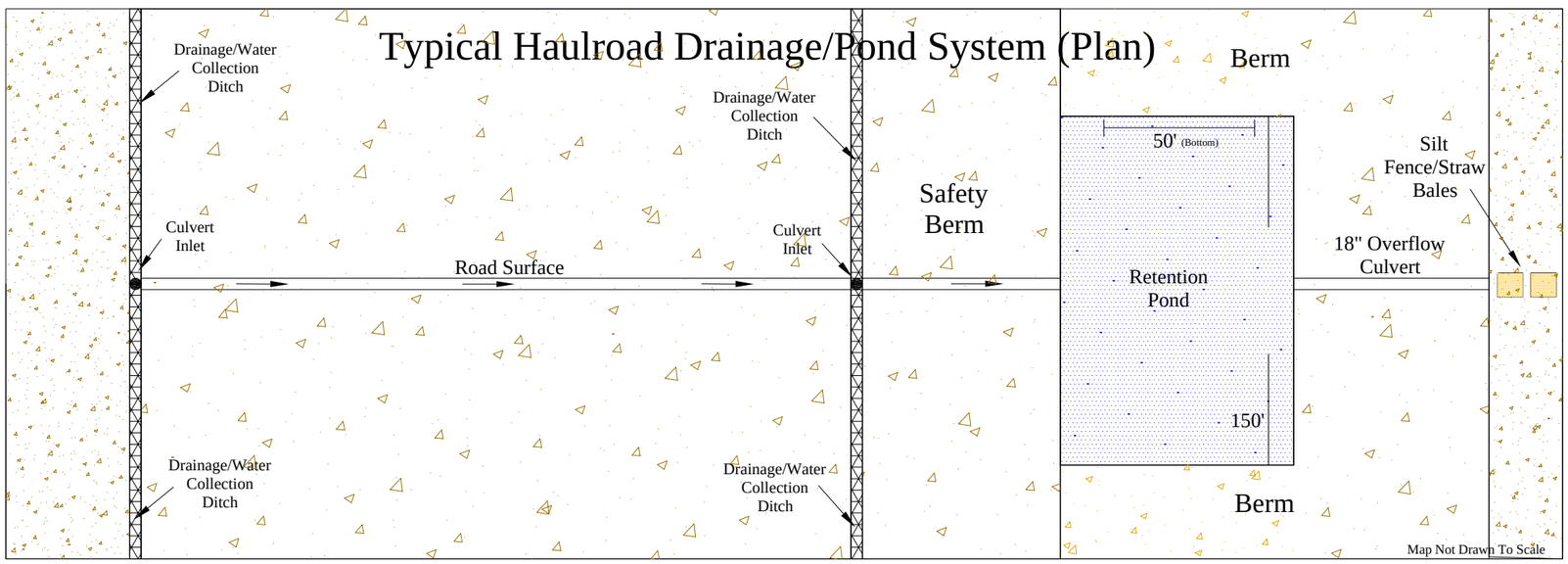
Isolating and controlling the movement of water with culverts and retention ponds can reduce possible selenium uptake in vegetation. Any discharge water would be monitored to control and document concentrations of selenium until reclamation is complete.

Stream alterations of No Name Creek and Reese Canyon Creek would prevent water from coming in contact with any mine disturbances that could transport selenium downstream.

Water drainage on haul roads would be controlled with sloping and crowning to direct run-off into planned retention ponds.

Soil stabilization depends on water movement over and down slopes. Erosion matting would be used on fill slopes for haul roads where possible movement of soil into drainages would be controlled. Silt fencing and straw bales/wattles would also be used extensively to control movement of water and soil from mining disturbances.





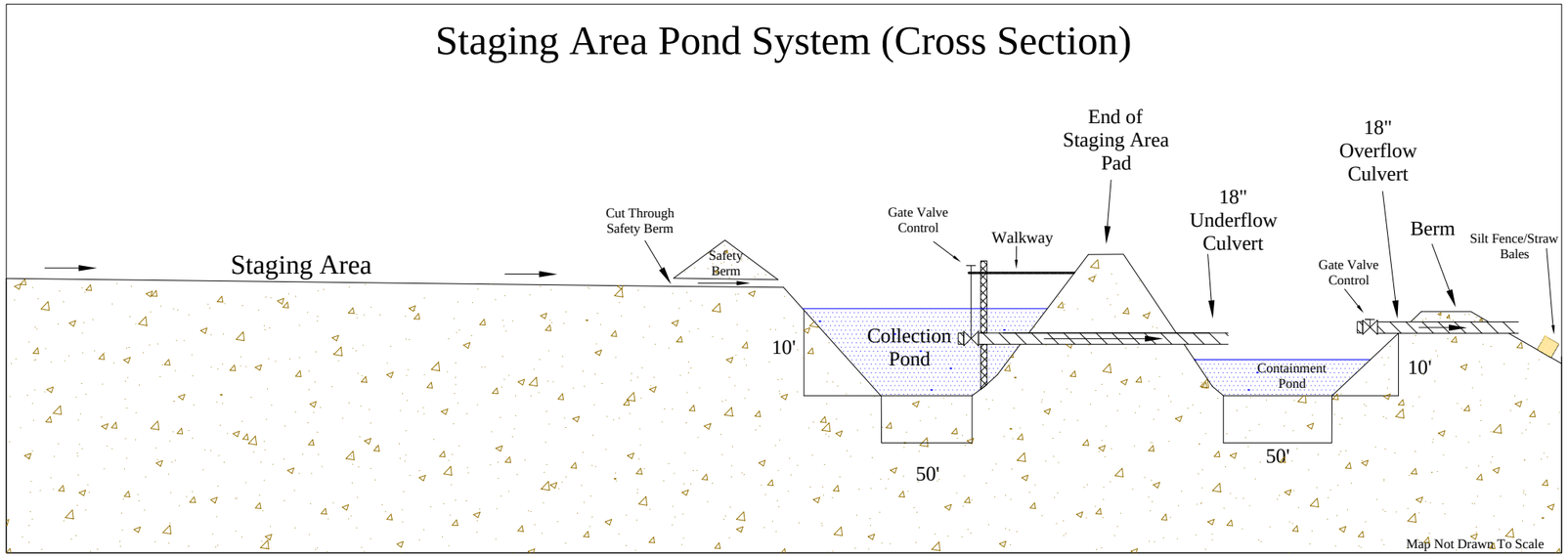
Source: Agrium U.S. Inc. 2002

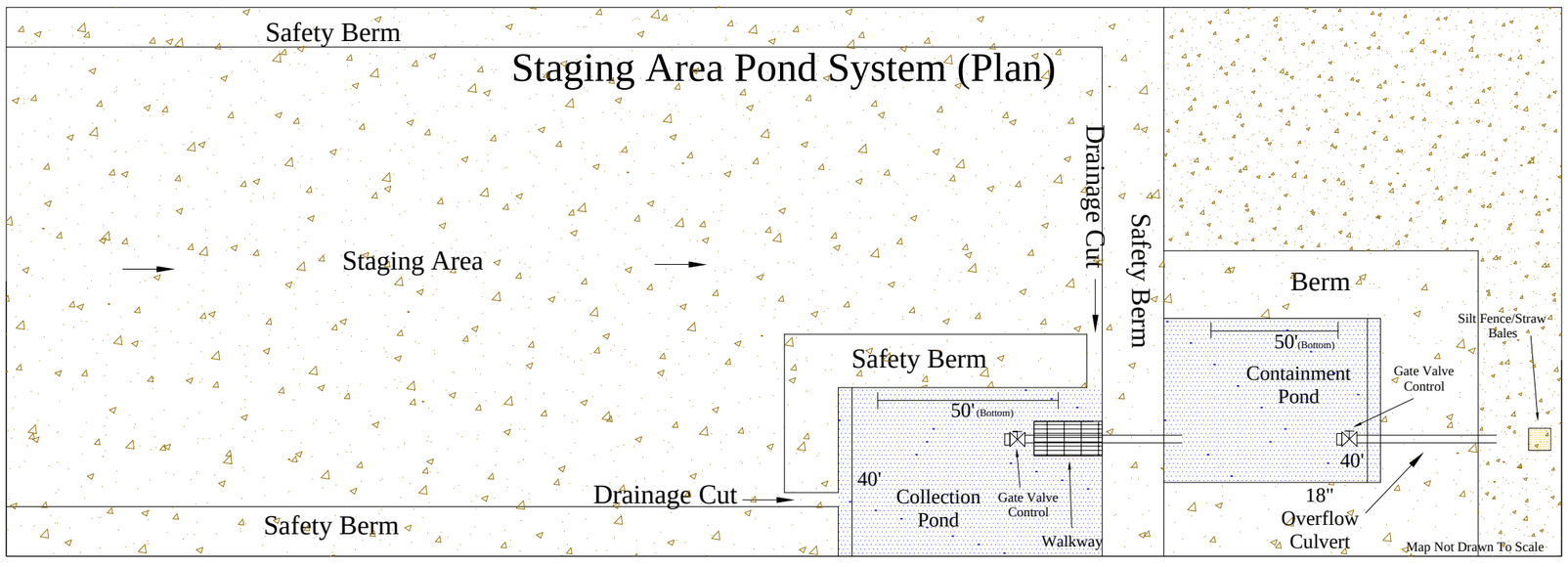
North Rasmussen Ridge Mine EIS Project

FIGURE 2.2-7
HAUL ROAD DRAINAGE / POND SYSTEM

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 PONDS.dwg
Scale: NTS	Drawn By: MTM





Source: Agrium U.S. Inc. 2002

North Rasmussen Ridge Mine EIS Project

FIGURE 2.2-8
STAGING AREA POND SYSTEM

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 PONDS.dwg
Scale: NTS	Drawn By: MTM

Brush barriers would be used where possible to control the movement of soil from slopes during run-off. Final reclamation would incorporate the brush barrier back onto the slopes to reduce erosion and to provide a source of nutrients and some wildlife habitat.

Seeding and Vegetation

Management of growth media is critical to success of the revegetation. All soil deemed suitable for a growing media would be salvaged and stockpiled or placed directly on areas ready for reclamation. Suitability would depend on physical and chemical characteristics, some of which are yet to be determined. Brush and small trees that were not removed for a brush barrier would be included with the growth media to be spread on the final reclaimed slopes.

The final reclaimed slope angle would be no greater than 3.0h:1.0v. The growth media would be spread over the final backfill slope to an average depth of 2 to 3 feet with minimum compaction.

Seeding would be completed as soon as possible to reduce rilling and soil movement. Selection of plant species would concentrate on shallow-rooting species of mostly native plants (**Table 2.2-4**). Species selection can vary depending on future research and studies. Currently, testing of selected native woody species is under way. The survivability and possible contaminate uptake by these species would be evaluated for their possible future use on the North Rasmussen Ridge Mine area.

Sampling and Monitoring

Monitoring is a critical component of reclamation. Determining plant success, cover, and productivity is an important part of the monitoring process. The measurement of selenium in forage is required for any decisions on range management and the ultimate release of the mined lands back to multiple use.

Current or historical monitoring at Rasmussen Ridge includes:

- Surface and groundwater monitoring.
- Storm water discharge monitoring.
- Collection and analysis of samples of growth media.
- Historical analysis of vegetation on waste rock dumps.
- Experimentation with seed and container stock of various native tree and shrub species.

TABLE 2.2-4
PROPOSED RECLAMATION SEED MIX AND FERTILIZING RATE[1]

Seed Description	% of Mixture	lbs/Acre
Mountain Brome (*Bromus marginatus*)	20	10
Orchard Grass (*Dactylis glomerata*)	14	7
Bluebunch Wheatgrass (*Agropyron spicatum*)	12	6
Sheep Fescue (*Festuca ovina*)	12	6
Slender Wheatgrass (*Agropyron trachycaulum*)	12	6
Great Basin Wildrye *(Elymus cinereus)*	10	5
Idaho Fescue (*Festuca idahoensis*)	10	5
Western Wheatgrass (*Agropyron smithii*)	10	5
Totals	100	50

[1]Seeding would be done with a rangeland drill at a rate of 50 lbs/acre. Fertilizer application rates would be established after soil testing has been completed.
Source: North Rasmussen Ridge Supplemental Mine and Reclamation Plan, Agrium 2001.

2.2.3.4 Reclamation

The North Rasmussen Ridge Supplemental Mine and Reclamation Plan is designed to maximize pit backfilling and minimize the long-term impacts to the environment. The complex mining sequence described in section 2.2.1 was developed for several reasons, including the case that backfill would provide a base for reclamation of more of the disturbed area, eliminate exposure of the pit wall, and eliminate development of a post mining pit lake in the Reese Canyon area from groundwater infiltration and surface water run-off (**Figures 2.2-2 and 2.2-3**). Under this proposed plan, all disturbed areas that are amenable to reclamation would be reclaimed. Vegetation would be established during the first growing season after final surface preparation to reduce the exposure time to potential erosion and effects to the surrounding environment (**Figure 2.2-4**).

All suitable topsoil and alluvium would be salvaged from all mining and road-building areas for use in reclamation (about 1,015,716 cu yd). Direct placement of this material to resloped areas is the preferred option; however, a Growth Media Storage Area would be used to temporarily hold up to an estimated 918,000 lcy of material. The growth media is composed of topsoil and alluvium. The actual volume of suitable topsoil and alluvium was calculated from the Order II baseline soil survey as defined by draft USFS selenium criteria for useable reclamation soils. This material would be used to cover resloped backfill and roads where possible.

Pit Backfill Areas

All backfill faces would be shaped to blend into the surrounding land forms with a 3.0h:1.0v slope. The top surfaces would all be graded at a 2 percent slope away from the faces to enhance revegetation and reduce erosion. Trees and shrubs piled at the boundaries of the pit at the start of mining would be pushed back onto the reclaimed and contoured backfill slopes for use as erosion control and wildlife habitat. Vegetation would be established using a rangeland seed drill pulled by a D-4 dozer. All disturbed areas that have been resloped and covered with growth media would be seeded. The proposed seed mix and fertilizer rates are shown in **Table 2.2-4**. The fertilizer application rate would be adjusted depending on the quality of the growth media. Shown in **Table 2.2-5** is a list of possible native tree and shrub species that could be planted on the backfill areas. The seeds for the tree and shrubs would be collected on site before mining begins and started in a nursery before they are planted on the reclaimed backfill areas. As additional testing and research is completed and proven to be beneficial as selenium BMPs for the seed mix and other plantings, Agrium would adjust the seed and brush species accordingly.

TABLE 2.2-5
CONTAINER PLANTINGS OF NATIVE SHRUB AND TREES FOR PIT BACKFILL AREAS

Possible Tree and Brush Species[1]
Mountain Snowberry (*Symphoricarpos oreophilus*)
Mountain Big Sagebrush (*Artemisia tridentata* var. *vaseyana*)
Woods Rose (*Rosa woodsii*)
Serviceberry (*Amelanchier alnifolia*)
Deerbrush (*Ceanothus velutinus*)
Lodgepole Pine (*Pinus contorta latifolia*)

Note: [1]Aspect and slope would determine the location and amounts of container plantings. Bucket planting of aspen and other native species would be used where possible.
Source: North Rasmussen Ridge Supplemental Mine and Reclamation Plan, Agrium 2001.

Haul Roads

Agrium would reclaim haul roads as they are no longer needed for access. The road prisms would be eliminated to blend into the pre-mining topography, either by removing the fill material or in some cases by spreading and shaping the fill into a natural configuration. Road cuts would be filled in so that no steep cut faces remain. Any road culverts would be removed to reestablish original drainages. Before road construction begins, all suitable topsoil and alluvium would be removed and saved. Before areas are seeded and fertilized, an average of 2 to 3 feet of growth media would be placed over the sloped and shaped haul roads. In sensitive areas or any area of concern, silt fencing or straw bales would be placed at the toe of the reclaimed road fill to protect surface waters until vegetation is deemed adequate to eliminate any erosion problem. Matting would also be placed on the slopes to stabilize soils and reduce erosion.

Staging and Water Well Area

The soils at the planned staging area and the water well for dust suppression would be tested for hydrocarbon contamination before the sites are reclaimed. If contamination is detected, proper disposal or remediation of the soils would be undertaken. Disposal would involve hauling to an approved disposal site. Remediation would be accomplished by means of bacterial digestion. If testing reveals no or acceptable levels of contamination after remediation, then the areas would be sloped to blend into the pre-mining topography. The concrete containment structure for the generator would be broken up, removed, and buried at a suitable depth in an appropriate location.

Water Management Retention Ponds

After mining is completed and haul roads are reclaimed, the retention ponds adjacent to the haul road would also be reclaimed. Any overflow pipes or culverts would be removed and the ponds would be filled in with suitable material. The fill material would be shaped to blend in with the topography. Growth media would be spread over the disturbance to an average depth of 2 to 3 feet. The areas would be fertilized and seeded with a USFS-approved seed mix (**Table 2.2-4**).

Growth Media Storage Area

After all the growth media has been removed from the Growth Media Storage Area, the trees and shrubs that had been used as a barrier to silt and run-off at the toe of the stockpile would be spread over the disturbance footprint. This debris would provide some wildlife habitat and soil nutrients. Agrium anticipates salvaging 1,015,716 cu yd of growth media for storage to meet reclamation needs. The area would be fertilized and seeded with native grasses along with container tree and shrub plantings from a nursery at a similar elevation (**Tables 2.2-4 and 2.2-5**).

No Name Creek and Reese Canyon Creek

The preferred design of the pit intercepts small areas of the No Name Creek and Reese Canyon Creek (**Figure 2.2-1**). During mining in these areas, any water would be diverted through a pipe or culvert that would extend over a corridor of unmined ground and back into the original drainage downstream. After mining is completed, an experienced third-party contractor would design a new section of natural-appearing stream channel to take the place of the pipe or culvert. The design would include meanders, pools, and vegetation. The stream flow would be reestablished in the original channel location, so that the stream channel water would not be affected by flowing over unconsolidated backfill material.

Rehandle Area In Pit Bottom

Agrium would rehandle 1,164,112 lcy of non-seleniferous clean limestone overburden material to cover the exposed ore and waste shale left in backfill area C of mining Panel B. The overburden would be placed and sloped at 3.0h:1.0v or less to drain any run-off away from the hanging wall and toward the limestone footwall. At the toe of the rehandle, water would flow south along the limestone contact at a 1.5 percent grade, thus eliminating the possibility that a post-mining pit lake

would develop. This rehandled overburden would be covered with an average of 2 to 3 feet of growth media, fertilized, and seeded with an approved USFS seed mix (**Table 2.2-4**).

2.2.3.5 Air Quality

Agrium recognizes that mining produces minimal quantities of particulate emissions (dust) and gases from internal combustion engines. Potential sources of dust include mining of ore and waste rock, drilling and blasting, and material haulage. Mining ore and waste rock would produce a minimal amount of dust based on the relatively high moisture content of the material. Dust produced from the blast hole drill would be minimized by dust control devices installed on the drill. Dust produced from material haulage would be kept to a minimum by using water trucks to apply water as a dust suppressant to the roads. Dust suppressing chemicals such as magnesium chloride and calcium chloride would also be used on some road areas as needed.

2.2.3.6 Hazardous Materials and Wastes

The proposed project would comply with the applicable federal hazardous materials regulations, including the Resource Conservation and Recovery Act of 1976 (RCRA), the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA or "Superfund") the Superfund Amendments and Reauthorization Act of 1986 (SARA), the Clean Air, Clean Water, and Clean Drinking Water Acts, and other applicable federal and state laws and regulations.

Surface mining operations are subject to the Federal Mine Safety and Health Act of 1997 (MSHA). Training for site personnel in hazard recognition and spill response is required, in addition to standard health and safety procedures and policies.

The term "hazardous wastes" designates materials defined in 40 CFR Part 261.3 and are regulated under RCRA. Hazardous wastes are regulated from the point of generation to the point of disposal. If less than 100 kilograms of hazardous waste is generated per month, the facility is considered a small-quantity generator. If 100 kilograms or more of hazardous waste is generated per month, the facility is considered a large-quantity generator.

The materials used at the existing operations at Rasmussen Ridge Mine are listed in **Table 2.2-6**. The Rasmussen Ridge Mine is considered a small-quantity generator because less than 100 kilograms of hazardous waste (solvents) are generated per month. Overburden produced from mine operations is exempted from hazardous waste regulations.

All hazardous materials and wastes would be stored and shipped in appropriate containers and labeled according to the U.S. Department of Transportation regulations for hazardous materials as provided in 40 CFR Parts 171-180. The transport of hazardous materials would be via regulated transporters. Currently, the primary route for transporting hazardous materials from Soda Springs to and from the Central Rasmussen Ridge Mine is via State Highway 34, Blackfoot River Road, and the existing haul road to the mine site. Transportation of hazardous materials and wastes associated with the Proposed Action would comply with federal regulations.

Under CERCLA, listed "hazardous substances" are defined as the elements, chemical compounds, and hazardous wastes appearing in Table 302.4, 40 CFR Part 302, Designation, Reportable

TABLE 2.2-6
HAZARDOUS MATERIAL INVENTORY

Material	Purpose for Use	Storage Location	Quantity Used/Day	On-Site Storage Quantity/Week	Waste Management
Diesel	Fueling heavy equipment	Shop area	10,000 gallons	37,120 gallons	Not Applicable
Gasoline	Fueling pickups and mechanics trucks	Shop area	100 gallons	2,000 gallons	Not Applicable
Oil	Lubrication of mining equipment	Shop area	500 gallons	5,800 gallons	Waste Oils Stored On-Site & Disposed Off-Site
Solvents	Parts cleaning	Shop	5 gallons	50 gallons	Waste Solvents Disposed Off Site
Waste Oil	Used motor oil	Shop	Varies	8,000 gallons	Waste Oils Disposed Off Site
Antifreeze	Cooling for mining equipment	Shop area	100 gallons	4,000 gallons	Waste Coolants Disposed Off Site
Mining Overburden	Phosphate ore recovery	Mine area	20,000 tons	120,000 tons	Not Applicable
Explosives -Prill -Emulsion	Overburden removal	Shop area Shop area	Varies Varies	60 tons 20 tons	Not Applicable Not Applicable

Source: Agrium 2002.

Quantities, and Notification. The reportable quantity for each listed hazardous substance is also provided in Table 302.4 of 40 CFR Part 302. Spills or releases of reportable quantities, and those that occur beyond the boundary of the facility, would be reported to EPA and appropriate local agencies as required by Section 101 (14) of CERCLA. For petroleum products, the reportable spill quantity is 25 gallons or more that is spilled onto the ground. Any quantity of petroleum product that is spilled into a stream is reportable. For 100 percent antifreeze (undiluted), the reportable spill quantity is 5,000 pounds or more.

“Hazardous chemicals” are defined in 1910.1200 (c) of Title 29 of CFR. Under 40 CFR Part 370, Hazardous Chemical Reporting: Community Right-to-Know, facilities that are required to have available a material safety data sheet for every chemical or hazardous material brought on site.

“Extremely hazardous substances” and the threshold planning quantities of each are listed in the appendices to 40 CFR Part 355, Emergency Planning Notification. The chemicals and materials typically used in surface mine development and operations are not classified as extremely hazardous substances.

“Toxic chemicals” are defined as those chemical listed in Subpart D of 40 CFR Part 372, Toxic Chemical Release Reporting: Community Right-To-Know, along with their reportable threshold amounts. For community right-to-know and emergency planning, facilities that use toxic chemicals in amounts over the defined threshold quantities are required to provide notification to

EPA. The chemicals and materials typically used in surface mine development and operations do not include toxic chemicals.

Oil is defined in 40 CFR Part 112, Oil Pollution Prevention, as "oil of any kind or in any form, including, but not limited to, petroleum, fuel oil, sludge, oil refuse, and oil mixed with wastes other than dredged spoil." Oil storage facilities or tanks with more than 1,320 gallons of combined storage capacity, which are not buried, or with a single container with a storage capacity of more than 660 gallons, require a Spill Prevention Control and Countermeasures (SPCC) Plan in accordance with 40 CFR Part 112, Oil Pollution Prevention. Oil spills that may affect navigable waters must be reported to the EPA National Response Center as required by 40 CFR Part 110, Discharge of Oil.

Hazardous materials that are regulated must be stored at designated locations on site in approved containers. Spill containment structures must be provided for liquid hazardous materials that are stored on site.

An existing Storm Water Pollution Prevention Plan (SWPPP; Agrium 2002) is in place for the mine, providing management direction for preventing and controlling potential spills, describing the above ground tanks and secondary containment structures for bulk petroleum products, solvents, and antifreeze, identifying the routine monitoring requirements, and describing the BMPs for the pollutants of concern. The pollutants of concern are defined as any with potential to be released from the site and include sediment discharge from storm water runoff and fuels and oil from the vehicle maintenance shop. The SPCC for the mine is also incorporated in the SWPPP document.

All liquid petroleum products, solvents, and antifreeze at the project are currently stored in above ground storage tanks (**Table 2.2-6**). The existing secondary containment facilities have sufficient capacity to hold the entire contents of the largest tank within the storage area, including freeboard for precipitation. No significant spills or leaks of fuel have occurred during operation of the site (Agrium 2002).

Oil is changed and other equipment is maintained at the Rasmussen Ridge Shop (Agrium 2002). Used engine oil is stored on site and then sent to a recycling company located in Pocatello, Idaho.

2.3 ALTERNATIVE 1 - PROPOSED ACTION WITH IMPERMEABLE CAPPING OF BACKFILLED AREAS

Alternative 1 was developed to address the issue of the potential for selenium to leach into the groundwater. As phosphate mining has developed in southeast Idaho, concern for groundwater contamination has lead to the development of various BMPs to control potential selenium migration from the mines. An impermeable (low-permeability) cover over external waste rock dumps and over backfilled areas is perceived as a way to reduce infiltration into the materials and thus reduces the potential leaching of selenium from the materials. Analysis of the mobility of selenium under Alternative 1 presents information that can be compared with analysis of the Proposed Action. In this manner, the agency decision-maker can see the differences between the alternatives in the fate and transport of selenium and other potential contaminants.

This alternative is essentially the same as the Proposed Action except that Agrium would construct a layer of impermeable material between the seleniferous waste rock and the applied growth media to eliminate potential effects of water infiltrating into the backfill. This type of layer would be constructed on backfill slopes shallower than the proposed 3.0h:1.0v to avoid slope failures. A 4.0h:1.0v slope would be appropriate to construct such a layer (BLM, USFS, and USACE 2000). **Figure 2.3-1** illustrates the conceptual construction of 4.0h:1.0v slopes in cross-section, and **Figure 2.3-2** shows the areas in plan view where 4.0h:1.0v slopes would be constructed (Central Rasmussen Ridge backfill area F, and North Rasmussen Ridge backfill areas A, B, and C).

Designing the backfill slopes at a 4.0h:1.0v would decrease the available volume in Central Rasmussen backfill area F by a critical amount. This would cause the progression of backfill to catch up to the progression of mining. The consequence would be the need to create an external waste rock dump (outside of the perimeter of the pit) to contain the lost capacity in backfill caused by the reduced backfill slopes. In turn, the total area of disturbance outside of the perimeter of the pit would increase by 26.4 acres (**Figure 2.3-2**), thus increasing the cumulative impacts of the area. The external waste rock dump would likely include forested lands and other habitats, both on and off the leases.

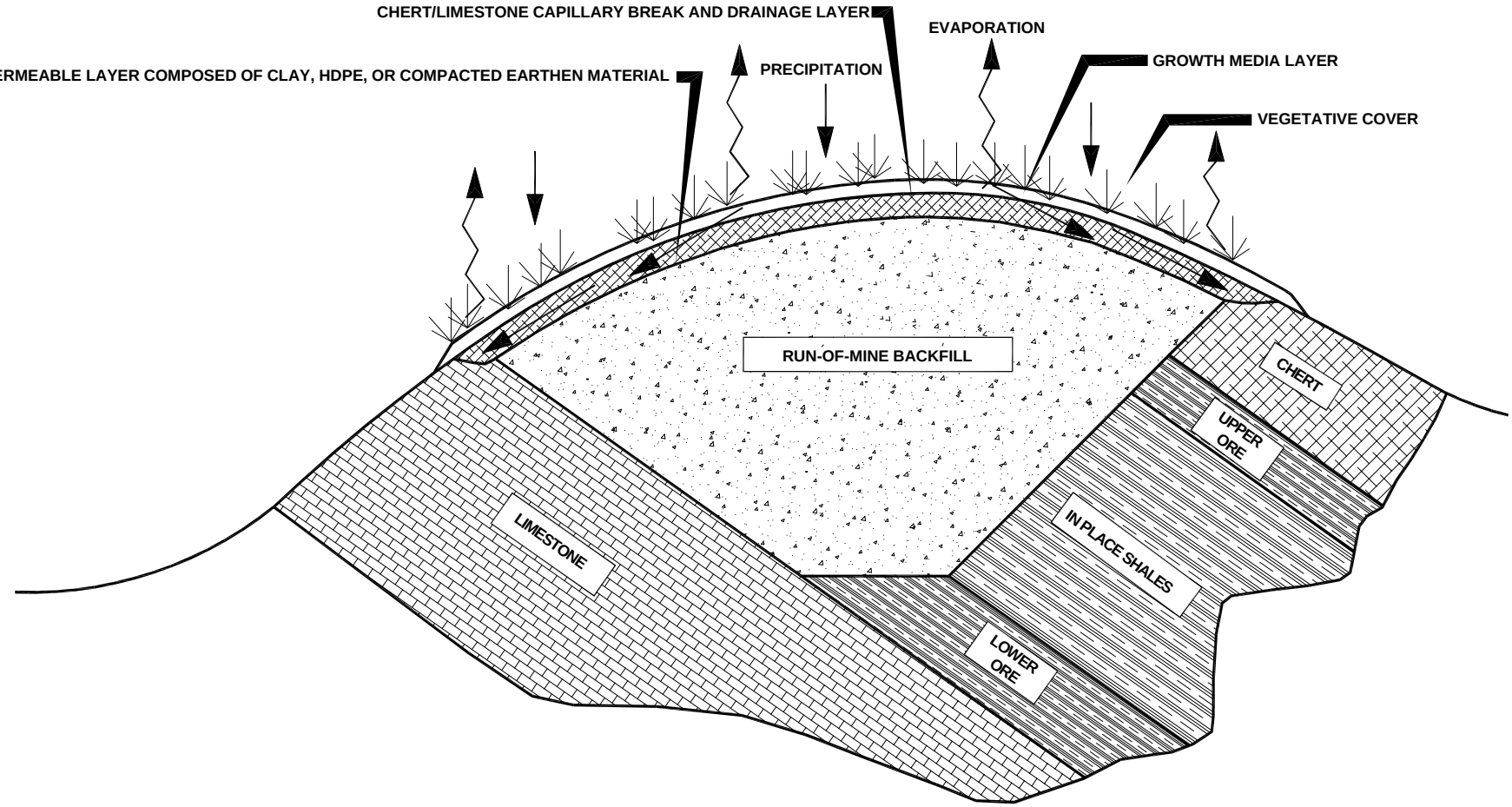
Some miscellaneous costs associated with the external dump (that were not evaluated in this analysis) are the purchase of timber, pre-stripping and hauling of slash and growth media, and water management and silt retention structures. Off lease Special Use Permits for mine waste dumps can no longer be obtained from the USFS. As a result, a lease modification would be proposed to the BLM.

Two different kinds of materials were evaluated for this alternative: natural clay, and synthetic liners. The following sections describe constructing the alternative with the different materials.

2.3.1 Clay Cap Design and Costs

Construction of an impermeable clay cap on 4.0h:1.0v backfill slopes would start with preparation of a sub-grade or base for the clay. The sub-grade would be constructed with compacted, 4-inch minus limestone. This limestone would be hauled from the active mining area to a mobile screening plant, where it would be sized and then hauled to the resloped backfill area as sub-grade material. The sub-grade material then would be moved into position with a dozer and compacted with a sheep's foot roller pulled behind another dozer. The final compacted sub-grade would be 1 foot thick.

The clay to be used for the impermeable cap would be excavated and hauled to the backfill area. Suitable clay is not found near Rasmussen Ridge; therefore, it is assumed that suitable clay would be found and excavated on Agrium's privately owned land in Wooley Valley, southwest of the tipple. If the clay is not found, Agrium's cost would increase substantially. The required volume of clay to cap the backfill is estimated at 360,000 bank cubic yards (bcy) and would be extracted from a 35-foot-deep pit. The configuration of the pit assumes that the upper 15 feet of material is unusable alluvium that would be discarded near the pit site. Total disturbance associated with the pit would be about 25 acres. Costs for materials testing, site preparation, and any state or local permits and reclamation plans are estimated at $250,000. Mining and hauling costs from the clay



North Rasmussen Ridge Mine EIS Project

FIGURE 2.3-1
CONCEPTUAL PIT BACKFILLS WITH IMPERMEABLE LAYERS

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 PIT.dwg
Scale: NTS	Drawn By: MTM

Source: Johnson 2001

pit to the backfill areas (approximately 9 miles) are estimated to be $3.9 million. The clay would be pushed into place with a dozer and compacted with a sheep's foot roller pulled by another dozer. The final layer of compacted clay would be 1-foot thick.

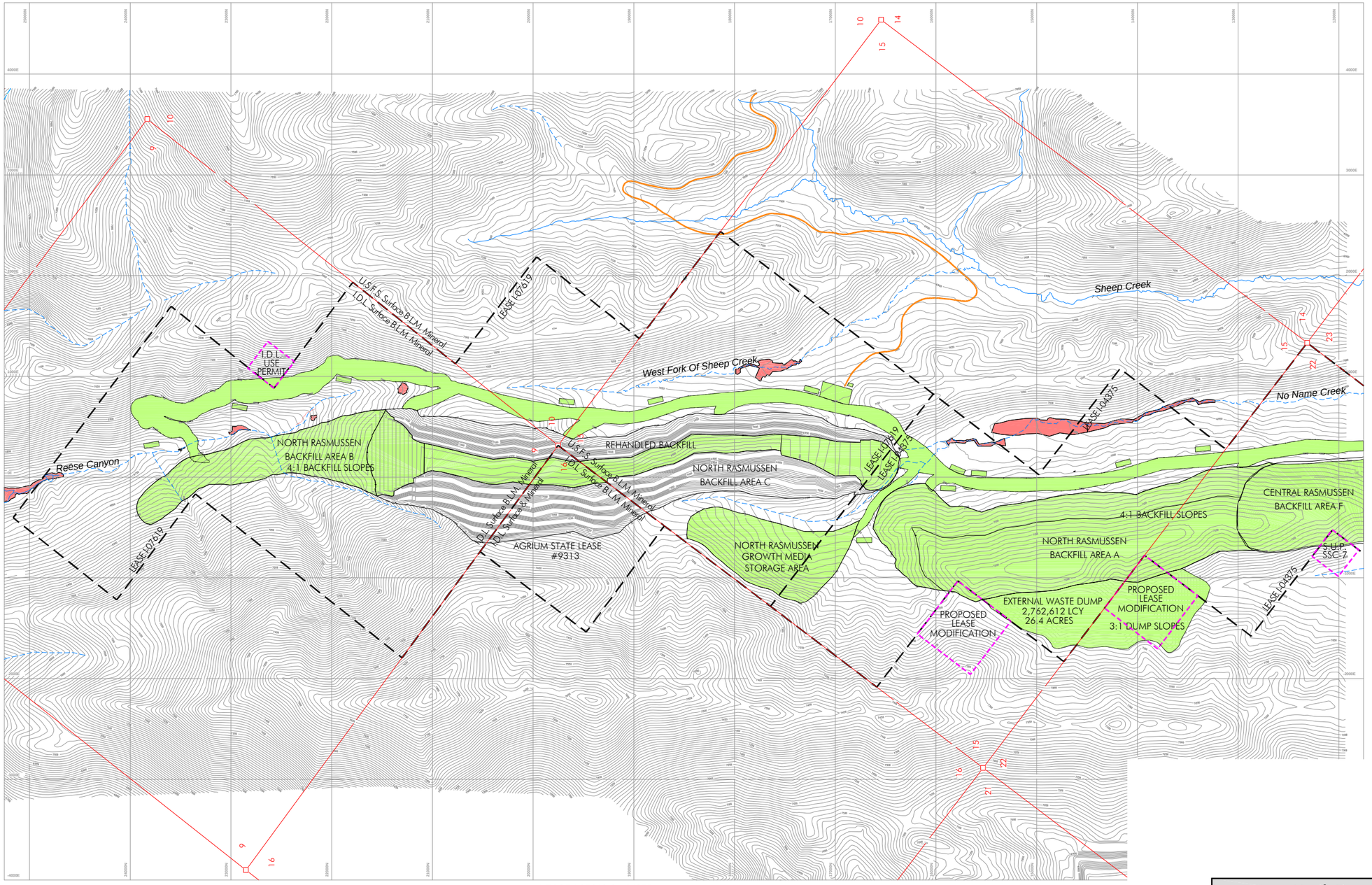
After placement of the clay layer, a 1-foot thick layer of graded limestone would be placed to act as a lateral drain off the backfill area. Limestone would be hauled from the pit to a screening plant where the 2-inch to 4-inch material would be screened off for use as drain material. A dozer would move the drain material into place. The material would need a high level of hydraulic conductivity to act as a drain; therefore, no compaction of this material would take place. The lateral drain would allow water to rapidly drain away from the clay cap so there would be no build up of hydraulic or pore pressure in or above the clay layer. The drain would also reduce the time that water is contained in the system and thus reduce the potential for water to infiltrate into the backfill.

The final step would be to place a minimum of 2 to 3 feet of growth media over the lateral drain. The growth media would be pushed into place with a dozer. Additional dozer costs for placement of the growth media on a 4.0h:1.0v slope versus a 3.0h:1.0v slope are estimated at $15,326. A sheep's foot compactor and screening plant would be purchased. Itemized costs for design of the impermeable clay cap include additional costs to slope the backfill, construct the clay pit, mine and haul clay, place and compact the clay, mine, screen and haul limestone, place the lateral drain, and place the growth media. These itemized costs total $9.5 million over the cost of the Proposed Action. This alternative would disturb 51 additional acres for the clay pit and the external waste rock dump.

2.3.2 Synthetic Liner Design and Costs

Placing a synthetic liner on backfilled slopes would also require the slopes to be at 4.0h:1.0v. Preparing the sub-base for a synthetic liner is more critical than for a compacted clay layer. A limestone sub-grade would be placed using a dozer to push the limestone and a second dozer to pull a roller compactor. Sub-grade for a synthetic liner must be stable to support the liner and any material overlying the liner without allowing deformation and requires higher degrees of compaction and thickness of the sub-grade. The sub-grade must also be sized properly to eliminate any large components that might tear or otherwise compromise the liner. With these criteria in mind, the sub-grade would be prepared using 1-inch minus material compacted to a thickness of 3 feet. A non-woven pad would be placed directly on the sub-base and covered with the synthetic liner, and another non-woven pad would be placed above the synthetic liner to protect it from any unseen jagged edges and tearing from operating a bulldozer on it while pushing the additional cover materials.

A lateral drain, constructed of graded limestone, would be placed over the liner and upper non-woven pad. Limestone would be mined from the pit and hauled to a screening plant where 2-inch to 3-inch material would be segregated for use in the lateral drain. The lateral drain provides the same type of water control as was described with the clay liner. However, the lateral drain above the synthetic liner would be required to be 3 feet thick, rather than 1 foot thick as over the clay liner. This increased thickness would be necessary to provide a surface for dozers to work



LEASE I-07619 & I-04375
LEASE MODIFICATIONS & USE PERMITS
PERENNIAL STREAMS
INTERMITTENT STREAMS
EXISTING ROAD
RECLAIMED AREAS
DELINEATED WETLANDS

0 1000 2000
Scale (ft)

NORTH

North Rasmussen Ridge Mine EIS Project

FIGURE 2.3-2
ALTERNATIVE 1
FINAL RECLAMATION PLAN

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	1164 ALT 1.dwg
Scale: 1" = 1000 FEET	Drawn By: ETC

Source: North Rasmussen Ridge Supplemental Mine and Reclamation Plan, Agrium 2001.
Note: Mine coordinates do not coincide with any map coordinates.

without damaging the underlying pad or liner. The last step would be placing growth media over the drain with a dozer.

Estimated costs for the use of a synthetic liner to cap the backfilled area would include sloping the backfill to 4.0h:1.0v; purchase of the 40 mil-thick liner and non-woven fabrics; purchase of a screening plant; mining, hauling and screening the limestone; placing the sub-base; installing the liner and lateral drain; and placing the growth media. Capital costs would include a roller compactor and a screening plant. These itemized costs total $20.7 million over the cost of the Proposed Action. This alternative would disturb an additional 26.4 acres for the external waste rock dump that would be located west of the pit.

2.3.3 Environmental Monitoring, BMPs and Reclamation

Because Alternative 1 is essentially the same as the Proposed Action with minor additional activities (construction of external waste rock dump, construction of clay quarry) all monitoring and BMPs and reclamation procedures described in section 2.2.3 would be applied to this alternative as well. Additionally, if a clay quarry would be required, a reclamation plan would be prepared as part of the permitting process.

2.4 ALTERNATIVE 2 – NO ACTION

A No Action Alternative would preclude mining or any associated development in any of the North Rasmussen Ridge areas. However, the No Action Alternative would not provide the required ore for Agrium's processing plant and would leave the mineral resource unusable. Furthermore, Agrium has determined that the mineral reserves are economically recoverable and that holding valid leases for the North Rasmussen Ridge mineral rights provides the right to recover the minerals.

The No Action Alternative would involve continued mining at the Central Rasmussen Ridge mine until all ore was recovered. This mining effort would involve disturbance of 231 acres and reclamation of 196 acres, or 85 percent of the disturbed area. The Central Rasmussen Ridge pit would not be backfilled, but would remain in an unreclaimed state as per the approved mine plan. The external waste rock dump at Central Rasmussen Ridge would cover 36.3 acres. **Figure 2.1-2** - Existing Operations presents the facilities that are representative of activities under the No Action Alternative.

2.5 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED EVALUATION

2.5.1 Continuous Mining from South to North

This alternative would involve mining North Rasmussen Ridge from south to north along the length of the strike in an uninterrupted, continuous manner. This alternative would be beneficial to waste rock haul distances and optimization of the cost of mining. However, it would also leave an open pit at the end of mining in the Reese Canyon drainage, which would in turn affect the watershed of the drainage and leave uncovered pit walls. Other consequences of leaving an open

pit in Reese Canyon are the likely development of a post-mining pit lake through infiltration of groundwater and possible visual impacts from the Henry Cutoff Road. The potential adverse effects in Reese Canyon Creek eliminated this alternative from further analysis.

2.5.2 Continuous Mining from North to South

This alternative would involve mining North Rasmussen Ridge from north to south in an uninterrupted manner. This alternative would require excessive long hauling of waste rock from the north end of North Rasmussen to the Central Rasmussen pit for disposal. This long haul could be avoided by the construction of external (outside of the pit backfill area) waste rock dumps. The entire East Road would be constructed before mining begins and would be maintained during the entire mining sequence of North Rasmussen. The longer use of this road would increase the environmental impacts, such as dust and exhaust emissions, as well as prolonged exposure to the streams. This alternative does not allow for a smooth transition into North Rasmussen from Central Rasmussen and could result in a loss of ore caused by sluffing of the Central Rasmussen end wall. The excessive waste rock haulage and long-term maintenance of the East Haul Road eliminated this alternative from further analysis.

2.5.3 Partial Backfill Mining

The easiest and most cost-effective method to deal with waste rock disposal from North Rasmussen Ridge would be to develop one or more external waste rock dumps and not backfill all overburden materials. However, this type of waste rock disposal on the North Rasmussen lease areas would not be appropriate or prudent based on several factors. Use of the external waste rock dumps would reduce the amount of the North and Central Rasmussen pits that would be backfilled and would consequently leave these pits open to accumulate both meteoric water and groundwater, and possibly form a post-mining pit lake. Remaining open pits and external waste rock dumps would also increase the potential for selenium and other contaminants to be released into the environment. A significantly larger area of disturbance would be developed, permitted, and maintained. Off-lease Special Use Permits for mine waste rock dumps are no longer available from the USFS and a lease modification would be required from the BLM.

2.5.4 Complete Backfill Mining

Effects on mining would be reduced if all mine pits could be completely backfilled. However, due to mine sequencing, the initial waste rock from North Rasmussen would be used to backfill the last pit of Central Rasmussen. This results in a shortage of material to backfill the last pit in North Rasmussen. An additional 100 to 200 acres of land disturbance would be required to obtain sufficient material to complete the backfill process. This disturbance would increase effects on vegetation, watersheds, and wildlife and the potential release of contaminants into surface and groundwater. These potential effects eliminated this alternative from further analysis.

2.5.5 Exposed Pit Crotch

This alternative would use the same plan of mining as the Proposed Action. However, Agrium would leave the pit crotch open and unreclaimed at the conclusion of the Panel B mining process. This alternative would leave 3,600 feet of the ore and center waste shales exposed from mine sections 17500N to 21100N. Meteoric water would not be controllable and could possibly produce a post-mining pit lake. Such a lake could contain elevated levels of selenium from the exposed ore and waste shales. This area also contains the highest walls in the Panel B pit. If the entire height of the pit wall were left open and exposed, the result could be post-mining wall failures that, as the wall raveled, could take with it excessive amounts of undisturbed ground outside the shell. Additional area disturbed by any wall failures would not be restored or reclaimed. This alternative would be the most cost effective in that no post-mining work would be performed on the open pit. However, the potential risks to water quality and pit wall failure were major deterrents to this alternative.

2.5.6 West Side Haulage Roads

Developing a system of haul roads on the west side of the North Rasmussen Ridge pit would be one alternative for transportation of ore and waste rock. However, the topography on the west side of the pit is significantly more rugged and provides less room between the pit crest and the boundary of the lease. A system of haul roads on the west side of the pit would intercept several drainages, which would increase the potential impact of the mine on the surrounding environment. A system of roads on the west side of the pit would be from 100 to 200 feet higher in elevation than the road on the east side. This change in elevation would mean that loaded haul trucks would have a higher climb from the pit bottom in their travel to the ore dumping location. The potential for additional environmental impacts in drainages on the west side, plus increased haulage costs, deterred the analysis of this alternative.

2.5.7 All Cut Pit Access Ramp

The development of an all-cut pit access ramp would provide adequate, reliable access to the middle and lower areas of the pit. However, the ramp would increase the waste rock stripping required by 1.0 to 1.5 million bcy. This increase in turn would likely impose the need to permit and construct an external waste rock dump. An all-cut ramp would also move the east pit crest approximately 100 feet east that, in turn, would push the East Road, around section 18000N, closer to the West Fork of Sheep Creek. This move could increase the potential for sedimentation and accidental spills to reach the creek. The potential adverse effects that would result from an external waste rock dump and increased proximity to West Fork Sheep Creek forced elimination of this alternative.

2.6 SUMMARY COMPARISON OF ALTERNATIVES

A summary of the key issues related to the Proposed Action and comparison of the Alternatives for each environmental resource is presented in **Table 2.6-1**. Detailed descriptions of impacts for specific resources are included in **Chapters 4 and 5**.

2.7 AGENCY PREFERRED ALTERNATIVE

The BLM preferred alternative is the Proposed Action.

TABLE 2.6-1
ALTERNATIVE COMPARISON AND EFFECTS SUMMARY

Resource	Proposed Action	Alternative 1 Proposed Action with Impermeable Cap on Backfill	Alternative 2 No Action Alternative
Geology, Minerals, Topography, and Paleontology	Modification of 269 acres of natural terrain.	Modification of 320 acres of natural terrain.	No terrain modified or mining activities beyond that approved for Central Rasmussen Ridge Mine. 35 acres of Central pit not reclaimed.
	Removal of phosphate resource.	Removal of the same amount of phosphate resource would occur under this alternative.	No phosphate would be removed from North Rasmussen Ridge.
	All overburden to be backfilled. 72 acres of pit would not be reclaimed.	External disposal of overburden would require 26 acres and a clay pit would need 25 acres.	No overburden generated at North Rasmussen Ridge.
	Minimum of 8 to 10-foot thick cap on all areas of seleniferous overburden disposal.	Overburden would be capped with impermeable layer and would be sloped at 4.0h:1.0v.	No overburden generated at North Rasmussen Ridge.
	Panel B partially backfilled to cover ore and center waste shale outcrops.	Panel B partially backfilled as in the Proposed Action.	No mining at North Rasmussen Ridge. A 35-acres open pit would remain at Central Rasmussen Ridge.
	Potential for paleontological resources to be destroyed.	Effects on paleontological resources would be the same as for the Proposed Action.	No effects on paleontological resources.
Air Resources and Noise	Shift air quality impacts from existing mine about 2 miles north.	Air quality impacts similar to Proposed Action.	Air impacts remain at Central Rasmussen Ridge area until mining ceases in 2003.
	Fugitive dust (516 typ) from handling overburden.	Same as Proposed Action with minor increase in fugitive dust from constructing the external dump and hauling additional covering materials.	No fugitive dust generated at North Rasmussen Ridge.
Water Resources	New road construction in No Name Creek, West Fork of Sheep Creek, and Reese Canyon Creek would cause temporary increased sediment load in intermittent sections of these drainages.	Sedimentation could be slightly higher than Proposed Action due to construction of external waste rock dump and clay quarry.	Impact to No Name and West Sheep creeks would remain at current levels. No impacts in Reese Canyon Creek.

TABLE 2.6-1 (CONT.)
ALTERNATIVE COMPARISON AND EFFECTS SUMMARY

Resource	Proposed Action	Alternative 1 Proposed Action with Impermeable Cap on Backfill	Alternative 2 No Action Alternative
	Minimum 8 to10-foot thick cap on all seleniferous overburden would reduce migration of contaminants to surface and groundwater resources.	Impervious cap on backfill would slightly (10 to 20%) reduce migration of contaminants to groundwater over the Proposed Action.	No overburden would be produced after mining at Central Rasmussen Ridge ceases.
	Intermittent flow in West Fork of Sheep Creek, No Name Creek and Reese Canyon Creek would temporarily decrease 37, 11, and 31 percent, respectively, due to interception of runoff from mine areas. After mining the percentages would be 37, 3, and 4 percent, respectively.	Effects on intermittent flows would be the same as for Proposed Action.	Intermittent flow in West Fork of Sheep Creek, No Name Creek, and in Reese Canyon Creek would not be impacted beyond the effects from the Central Rasmussen Ridge Mine. If a pit lake forms at Central Rasmussen, it may have elevated levels of selenium.
	Disposal of seleniferous overburden would increase potential leaching exposure from infiltration in the backfilled areas A and B.	External overburden site (26 acres) would increase potential leaching exposure over the Proposed Action.	No overburden produced therefore no leaching due to mining.
	Potential for effects on springs fed by alluvial flow downgradient of the pit. Selenium levels may increase and flow rates may decrease.	Effects on springs would be similar to those in the Proposed Action.	No effects on springs.
	Groundwater quality would be impacted due to the COPCs in the overburden in the backfilled pits. Re-charge through the backfilled pits into the underlying bedrock would be increased. No impacts to human health, vegetation or animals are expected.	Effects on groundwater would be slightly less than the Proposed Action (10-20%).	No groundwater impact would occur. No increase in recharge to the bedrock would occur in the North Rasmussen Ridge area.
Soil and Watershed	Loss of soil productivity during salvage and replacement of growth media.	Loss of soil productivity during salvage and replacement increased in areas of external waste rock dump and clay quarry.	No soil impacts beyond those from Central Rasmussen Ridge Mine.

TABLE 2.6-1 (CONT.)
ALTERNATIVE COMPARISON AND EFFECTS SUMMARY

Resource	Proposed Action	Alternative 1 Proposed Action with Impermeable Cap on Backfill	Alternative 2 No Action Alternative
	Approximately 269 acres of soil would be disturbed. Soil erosion within disturbed area is possible but controlled with BMPs.	Approximately 320 acres of soil would be disturbed. Soil erosion within disturbed area possible but controlled with BMPs.	No soils would be disturbed at North Rasmussen Ridge.
	Total reclaimed area of 197 acres, 72 acres of highwall unreclaimed and exposed.	Total reclaimed area of 248 acres, 72 acres of highwall unreclaimed and exposed.	No highwalls at North Rasmussen Ridge Area. No reclamation would be necessary.
	Minimum 8 to 10-foot thick cap of nonseleniferous materials and 2 to 3-feet of growth media would most likely prevent plant uptake of selenium and trace metals from overburden.	Effects on plant uptake of selenium and trace metals from overburden considered less than for Proposed Action because of impermeable cap.	No overburden generated
Vegetation, Wetlands, and Riparian Areas	Vegetation communities would be altered on 269 acres of new disturbance, including conifer - 69 ac., mixed aspen/conifer - 192 ac., and sagebrush - 8 ac.	Vegetation communities would be altered on 320 acres of new disturbance, including conifer - 69 ac., mixed aspen/conifer - 218 ac., and sagebrush - 33 ac. Other effects would be essentially the same as for the Proposed Action.	No vegetation impacts beyond those at Central Rasmussen Ridge Mine.
	Revegetation would replace forest and shrub communities with grass and forb communities except on 72 acres of highwall unreclaimed.	Revegetation would be the same as under the Proposed Action.	There would be no highwalls or removal of vegetation at North Rasmussen Ridge.
	Minimum of 8 to 10-foot thick cap would minimize plant uptake of selenium and trace metals from overburden.	An impervious cap would minimize plant uptake of selenium to a greater degree than under the Proposed Action.	No overburden would need to be capped.
Wetlands and Waters of the U.S.	No wetland areas would be directly affected. Indirectly, some wetlands may lose a portion of their water supply.	Potential effects on wetlands would be essentially the same as for the Proposed Action.	No wetlands would be impacted.

TABLE 2.6-1 (CONT.)
ALTERNATIVE COMPARISON AND EFFECTS SUMMARY

Resource	Proposed Action	Alternative 1 Proposed Action with Impermeable Cap on Backfill	Alternative 2 No Action Alternative
	Culverts would be used to cross Reese Canyon Creek and No Name Creek of 100-feet and 700-feet in length, respectively.	Effects in drainages from culverts would be the same as the Proposed Action.	No new disturbance in drainages would occur.
	Intermittent flow in West Fork of Sheep Creek, No Name Creek, and Reese Canyon Creek would temporarily decrease due to interception of runoff from mine areas. Post-mining flow in Sheep Creek could be reduced by approximately 11%.	Changes in stream flows would be the same as for the Proposed Action.	No interception of any flow would occur from mining.
Terrestrial Wildlife	Direct loss of mixed vegetation habitat on 269 acres, displacing wildlife from direct impact areas. A total of 197 acres would be reclaimed.	Direct loss of habitat, mostly forest habitat, on 320 acres, displacing wildlife from direct impact areas. Reclamation would occur on 248 acres.	No habitat loss or displacement of wildlife would occur beyond that approved for the Central Rasmussen Ridge Mine.
	Temporary exposure of wildlife to elevated selenium levels in water and sediments of mine areas until 2011 or until reclamation is completed. Such exposure is considered to be a minor effect.	Temporary affects as for the Proposed Action.	No exposure of wildlife to elevated selenium levels beyond what may occur at Central Rasmussen Ridge Mine.
	Reclamation would replace natural plant communities with grass/forb communities on 197 acres of new disturbance, 72 acres of unreclaimed highwall could provide habitat for some species.	Reclamation would be the same as for the Proposed Action on 248 acres.	No disturbance of natural plant communities on North Rasmussen Ridge.
	Cover design on the backfill would most likely prevent selenium and trace metals uptake by plants thereby reducing potential for ingestion by wildlife.	Impermeable layer on backfill would reduce the potential for plant uptake and ingestion by wildlife by a greater degree than the Proposed Action.	No additional overburden would be produced beyond that approved for the Central Rasmussen Ridge Mine.
Fisheries and Aquatic Resources	Intermittent flow in West Fork of Sheep Creek, No Name Creek, and Reese Canyon Creek would temporarily decrease due to interception of runoff from mine areas. Post-mining flow in Sheep Creek would be reduced by about 11%.	Intermittent flows would temporarily decrease as for the Proposed Action.	Intermittent flow in area drainages would not be affected.

TABLE 2.6-1 (CONT.)
ALTERNATIVE COMPARISON AND EFFECTS SUMMARY

Resource	Proposed Action	Alternative 1 Proposed Action with Impermeable Cap on Backfill	Alternative 2 No Action Alternative
	New construction would cause a temporary increase in sedimentation in intermittent portions of West Fork of Sheep Creek, No Name Creek, and Reese Canyon Creek.	Temporarily, sedimentation effects could be slightly greater than the Proposed Action due to increased disturbance area.	No sedimentation effects at North Rasmussen
	Selenium may affect fisheries through discharges to springs that have source areas intercepted by the pit.	Potential effects from selenium would be the same as for the Proposed Action.	No effects to surface waters or aquatic resources from selenium.
	The project would be in compliance with INFISH Riparian Management Objectives.	This alternative would also comply with INFISH.	No Action would not affect the Riparian Habitat Conservation Areas of the INFISH program.
Threatened, Endangered, and Sensitive Species	Exposure to concentrations of selenium and trace metals in water and vegetation is not expected to occur.	Effects of exposure to selenium would be the same as for the Proposed Action.	Elevated concentrations of selenium and trace metals in water and vegetation would not occur at North Rasmussen Ridge. If a pit lake forms at Central Rasmussen, it may have elevated levels of selenium.
	Goshawk, 3-toed woodpecker, boreal and flammulated owls and other sensitive species minimally impacted by clearing of 69 acres of conifers.	Effects of habitat reduction would be greater by 51 acres.	No clearing of conifer habitat would occur on North Rasmussen Ridge.
Grazing Management	Forage for grazing would be removed from 269 acres. Stocking rates on one allotment could be affected.	Forage for grazing would be removed from 320 acres.	No impacts to forage by mining.
	Forage for grazing would be permanently removed from 72 acres of unreclaimed highwalls.	Forage for grazing would be permanently removed from 72 acres of unreclaimed highwalls.	No highwalls would be created.
	Cover design over overburden would minimize selenium and trace metals for plant uptake thereby reducing potential for ingestion by livestock.	Impermeable cap design over overburden would make selenium and trace metals less available for plant uptake thereby reducing potential for ingestion by livestock.	No mining of overburden would occur.

TABLE 2.6-1 (CONT.)
ALTERNATIVE COMPARISON AND EFFECTS SUMMARY

Resource	Proposed Action	Alternative 1 Proposed Action with Impermeable Cap on Backfill	Alternative 2 No Action Alternative
	Potential for noxious weed invasion on 197 reclaimed acres.	Potential for noxious weed invasion on 248 reclaimed acres.	No disturbance on grazing allotments. Loss of 35 acres of restored grazing lands at Central Rasmussen in unreclaimed pit area.
Recreation	Dispersed recreation and hunting on North Rasmussen Ridge would be temporarily halted until 2011.	Effects on recreation would be the same as for the Proposed Action.	There would be no additional restrictions on hunting or dispersed recreation in the North Rasmussen Ridge Area.
Visual Resources	Open pit mining of Panels A and B would not be visible to significant numbers of people or create substantial effects in remote Caribou County.	Visual effects would be slightly greater than the Proposed Action due to the 26 acre external waste rock dump and 25 acre clay quarry.	No mining would occur at North Rasmussen Ridge and visual effects at Central Rasmussen Ridge would be reclaimed after 2003.
	Large-scale visual changes to characteristic landscape, but would meet VQ objectives of Modification, Maximum Modification, or Low SIO.	Same effects as Proposed Action.	Same effects as Proposed Action without reclamation of Central Rasmussen final pit.
Land Use and Access	Impacts of traffic volume to and from the mine on existing roads would not be changed from current conditions.	Impacts would be the same as for the Proposed Action.	Impacts of traffic volume to and from the mine would be reduced starting around 2003 when mining at Central Rasmussen Ridge would cease.
Cultural Resources	No direct impacts to any NRHP eligible sites.	No direct impacts to any NRHP eligible sites.	No cultural resources would be disturbed at either Central or North Rasmussen Ridge.
Social and Economic Resources	Annual impact to socioeconomic resources would be same as current conditions until approximately 2011 when mining and reclamation is completed. Agrium contributes up to 15 percent of the property taxes in Caribou County, plus other taxes and fees.	Annual beneficial impacts would be the same as for the Proposed Action.	Annual beneficial impacts would continue until 2003 when mining at Central Rasmussen Ridge would likely cease. This could result in layoffs of employees and a reduction in local purchases.
	Costs associated with reclamation due to proposed mining includes additional costs for the rehandling of overburden to partially backfill the open pit.	Costs would be greater than Proposed Action due to costs for the impermeable layer and different designs, ranging from $9.4 to $20.7 million, depending on materials used.	Reclamation costs would not be necessary.

TABLE 2.6-1 (CONT.)
ALTERNATIVE COMPARISON AND EFFECTS SUMMARY

Resource	Proposed Action	Alternative 1 Proposed Action with Impermeable Cap on Backfill	Alternative 2 No Action Alternative
Environmental Justice	Issues associated with environmental justice would not be affected by the Proposed Action.	Issues associated with environmental justice would be the same as for the Proposed Action.	There would not be any issues associated with environmental justice.
Hazardous Materials	Annual use and handling of hazardous materials would be the same as existing conditions.	Annual use and handling of hazardous materials would be the same as for the Proposed Action.	Annual use and handling of hazardous materials would be the same as existing conditions until 2003 when mining at Central Rasmussen Ridge would cease.

CHAPTER 3 - AFFECTED ENVIRONMENT

CHAPTER 3 - AFFECTED ENVIRONMENT

This chapter describes the affected environment for the Proposed Action and Alternatives. The affected environment varies for each resource. For example, for most of the potentially affected resources, the affected environment is defined as the areas of proposed mine disturbance and the immediate vicinity (study area); however, for socioeconomic resources, the affected environment includes Caribou and Bear Lake Counties. The study area is defined in the section on each individual resource.

Of the 12 critical elements of the environment listed in the BLM NEPA Handbook (now 14 with the addition of noxious weeds and environmental justice), this EIS will discuss all but five. There are no areas of critical environmental concern within the area of influence of this project; there are no prime or unique farmlands in the area; and there are no wild and scenic rivers in the vicinity. The nearest wilderness area is more than 25 miles away and outside the area of influence of this project. The project area is in the headwaters of small streams, so floodplains are not an issue. Noise generation will not be discussed because there are no receptors within 2.5 miles. Noise effects on wildlife have been occurring on Rasmussen Ridge for approximately 20 years. It is assumed that wildlife have acclimated to the noise conditions. The list of critical elements to be discussed in this EIS includes air quality, noxious weeds, threatened and endangered species, solid and hazardous wastes, cultural resources, Native American traditional concerns, water quality, wetlands and riparian zones, and environmental justice. Other elements of the environment are also discussed in the following sections.

3.1 MINERALS, TOPOGRAPHY, GEOLOGY, AND PALEONTOLOGY

3.1.1 Mineral Resources

During the Permian Period, the Phosphoria Formation was deposited in a deep basin, at depths of several hundred feet over a large area of eastern Idaho, northern Utah, western Wyoming, and southwestern Montana (BLM and USFS 2002). The Phosphoria Formation forms the western phosphate field and comprises one of the world's largest known reserves of phosphate. The phosphate-bearing Meade Peak Member of the Phosphoria Formation is located on the east limb of the Snowdrift Anticline (**Figure 3.1-1**). The study area and general geology are shown in **Figure 3.1-2**.

The most important mineral commodity in the Rasmussen Ridge area is the phosphate rock of the Meade Peak Phosphatic Shale Member of the Phosphoria Formation. This rock is composed of carbonate fluorapatite minerals that occur as nodules, pisolites, oolites, pellets, and fossil fragments, along with organic matter and quartz, muscovite, and calcite as accessory minerals, and very small amounts of such metals as vanadium, uranium, chromium, nickel, and rare earths. Minor phases of numerous other minerals have also been identified in the deposit (Knudsen et al 2000).

Phosphate is a leasable mineral and one of a group of minerals named in the Mineral Leasing Act of 1920, as amended. Leasable minerals include oil, gas, geothermal, uranium, and coal. These

minerals have widespread occurrence and purchasing a Federal or State lease gives an operator the right to mine these minerals. Leasable minerals are in contrast to locatable minerals for which a claim is staked after an ore body is found. Locatable minerals are those with intrinsic value and include base and precious metals and others with very specific chemical composition.

3.1.2 Topography Disturbance

The study area consists of a series of ridges and valleys (anticlines and synclines) with elevations ranging from 6,560 feet in Rasmussen Valley to 7,200 feet at Rasmussen Ridge. Henry's Peak, at an elevation of 8,319 feet, is about 2 miles north of the proposed North Rasmussen Ridge Mine site.

The existing total disturbance from mining within the Central and South Rasmussen Ridge Mine is 488 acres, which is located immediately southeast of the proposed North Rasmussen Ridge Mine. All of the waste rock generated for the proposed North Rasmussen Ridge Mine would be placed, as backfill, in the Central and North Rasmussen pits after the ultimate depths have been achieved. Changes in topography as a result of the South and Central operations include external waste rock dumps and the planned partial backfill of the last pit at Central Rasmussen.

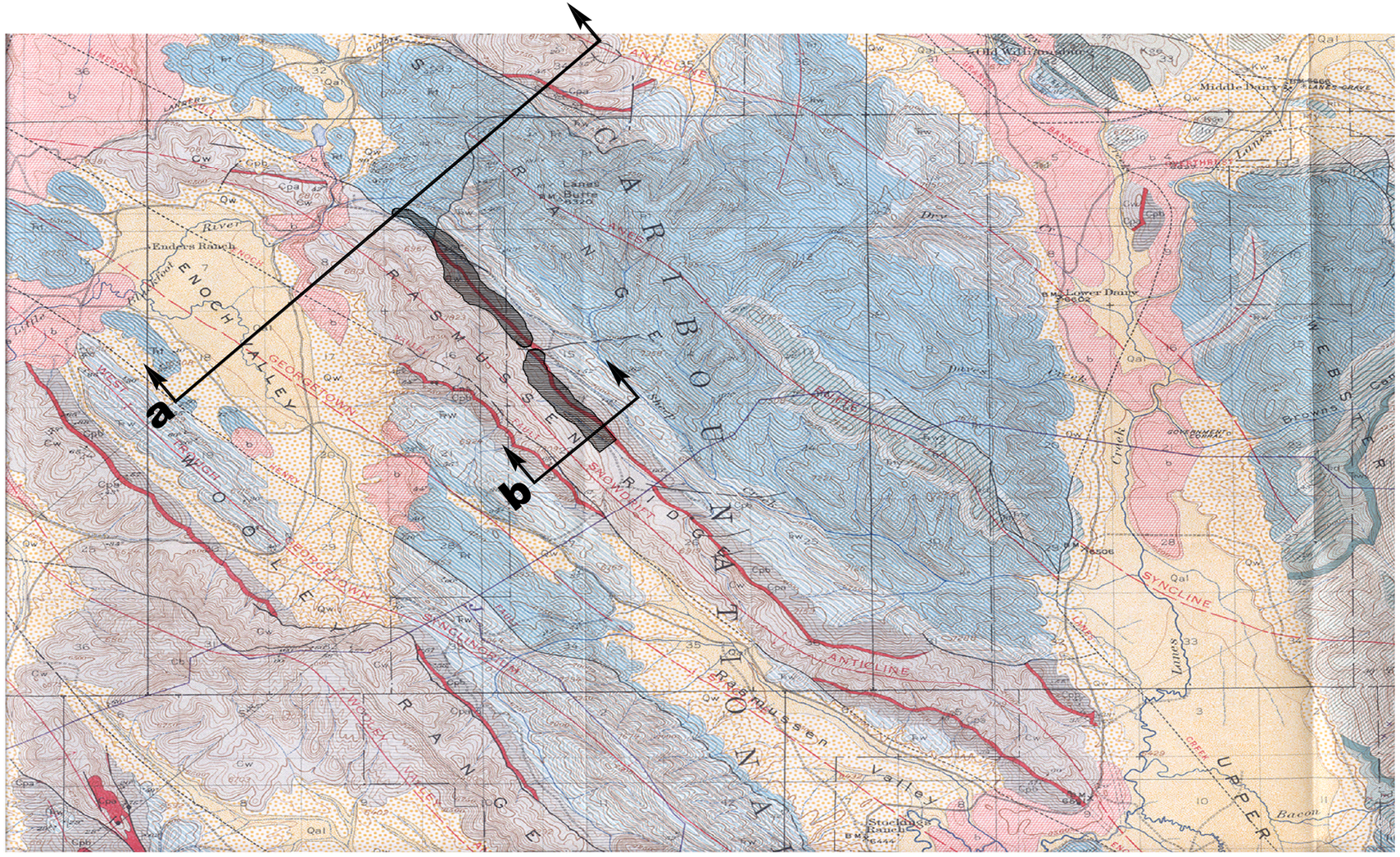
3.1.3 Geology/Geologic Hazards

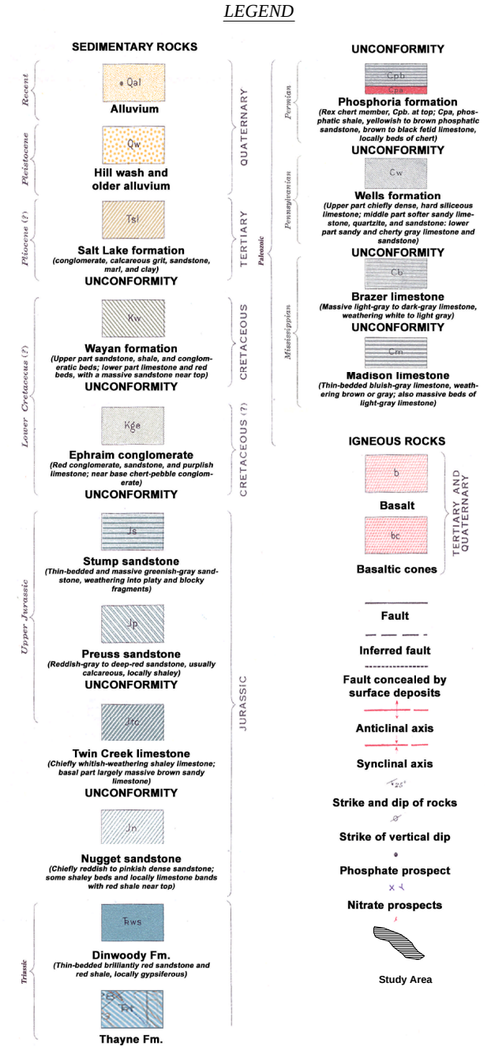
3.1.3.1 Geologic Setting

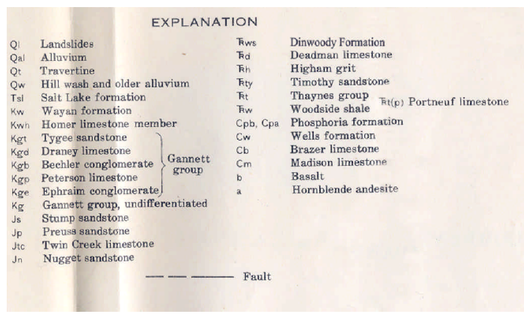
The Western Phosphate Field occurs within the Rocky Mountain Basin and Range physiographic province and extends across portions of eastern Idaho, western Wyoming, northern Utah and southwestern Montana. During the Permian and Triassic Periods, several thousand feet of marine limestone, chert, dolomite, shale and sediments accumulated in an interior sag basin located along the western margin of the North American Craton (Piper 1999). Economically important deposits of phosphate formed during Permian time that are contained within the Meade Peak Member of the Phosphoria Formation. Paleontologic evidence suggests that the phosphatic marine mudstones and shales of the Meade Peak Member were deposited at depths possibly as shallow as 600 feet (Yochelson 1968).

Rocks in the project area were folded and faulted during the Larimide Orogeny (late Cretaceous), which formed the predominant regional structural fabric of northwest trending anticlines and synclines. Northwest trending folds and faults in the project area are related to large-scale movement along the Bannock Overthrust that placed older western assemblage rocks over younger eastern assemblage rocks. The Bannock Overthrust is mapped at a depth of 3,000 to 4,000 feet below ground surface at Rasmussen Ridge and is not exposed in the project area (Mansfield 1927). Block faulting related to Basin and Range extension began about 17 million years ago and continues to the present.

Rocks that crop out within the study area range from Pennsylvanian to Permian in age. Stratigraphic units exposed at the surface include Alluvium, the Triassic-age Thaynes and



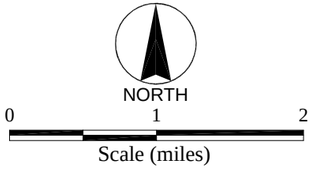




EXPLANATION

Ql	Landslides	Trws	Dinwoody Formation
Qal	Alluvium	Trd	Deadman limestone
Qt	Travertine	Trh	Higham grit
Qw	Hill wash and older alluvium	Trty	Timothy sandstone
Tsl	Salt Lake formation	Trt	Thaynes group — Trt(p) Portneuf limestone
Kw	Wayan formation	Trw	Woodside shale
Kwh	Homer limestone member	Cpb, Cpa	Phosphoria formation
Kgt	Tygee sandstone (Gannett group)	Cw	Wells formation
Kgd	Draney limestone (Gannett group)	Cb	Brazer limestone
Kgb	Bechler conglomerate (Gannett group)	Cm	Madison limestone
Kgp	Peterson limestone (Gannett group)	b	Basalt
Kge	Ephraim conglomerate (Gannett group)	a	Hornblende andesite
Kg	Gannett group, undifferentiated		
Js	Stump sandstone		
Jp	Preuss sandstone		
Jtc	Twin Creek limestone		
Jn	Nugget sandstone		
	Fault		

a. Cross Section in Figures 3.3-7a and 4.3-4a
b. Cross Section in Figures 3.3-7b and 4.3-4b



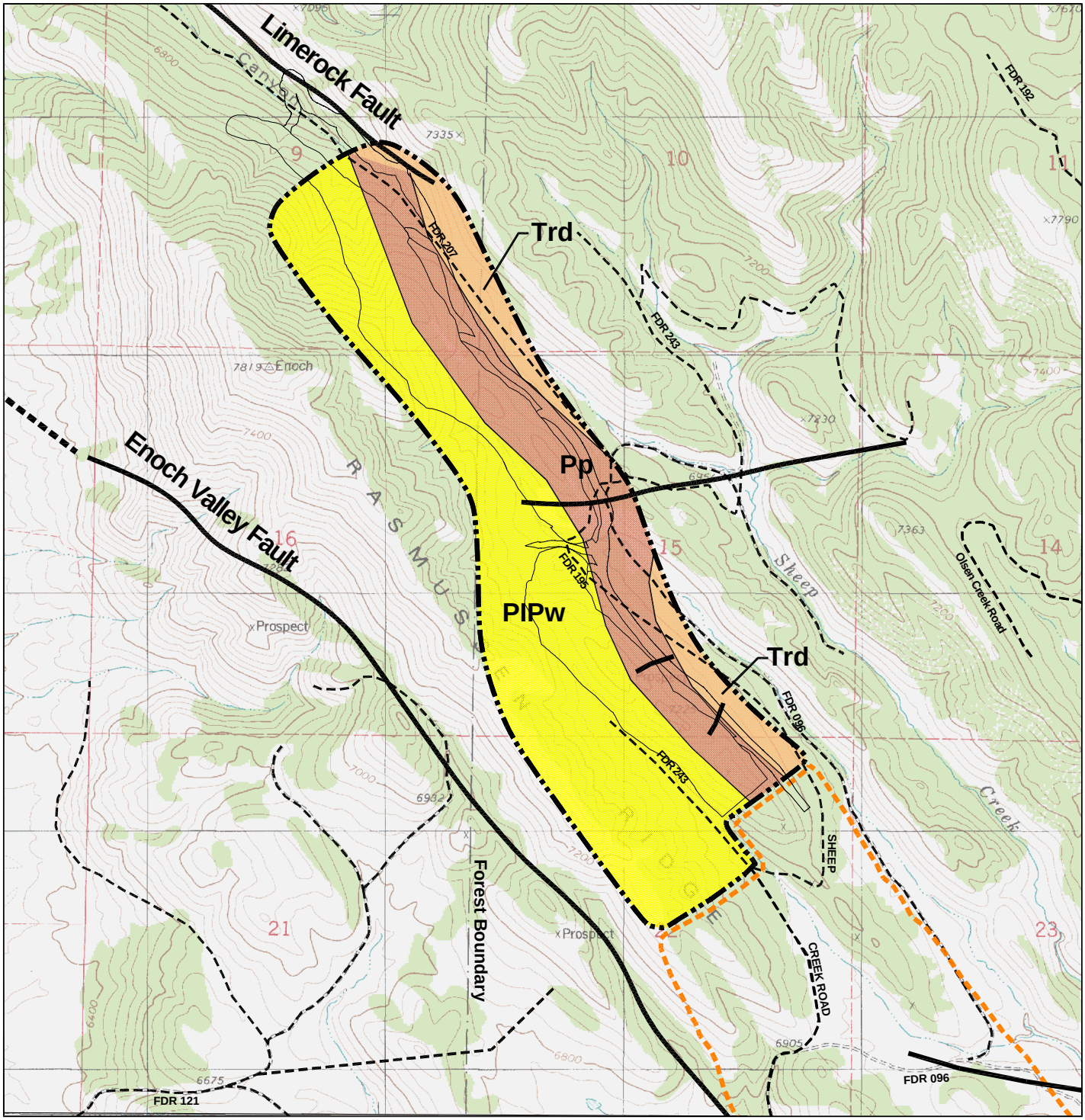
North Rasmussen Ridge Mine EIS Project

FIGURE 3.1-1
REGIONAL GEOLOGIC MAP

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 Geo.dwg
Scale: As Noted	Drawn By: ETC

Source: Mansfield 1927



Source: USGS 7.5' Quadrangles, Lower Valley, Upper Valley, Wayan East, Wayan West, ID.

LEGEND

- *Study Area*
- *Forest Road*
- *Approved Central Rasmussen Ridge Area*

GEOLOGY

Trd — DINWOODY FORMATION (LOWER TRIASSIC)
Gray limestone and olive to greenish-brown siltstone. Thins eastward from 500 to 300m.

Pp — PHOSPHORIA FORMATION (PERMIAN)
Upper part dark to light-gray chert and shale; lower part brown-weathering phosphatic shale and limestone. Thins easward from 110 to 70 m.

PIPw — WELLS FORMATION (PERMIAN AND PENNSYLVANIAN)
Interbedded gray limestone and pale-yellow calcareous sandstone, minor gray dolomite; cherty in lower part. Thins eastward from 600 to 180m.

Fault

0 2000' 4000'
Scale (ft)

NORTH

North Rasmussen Ridge Mine EIS Project

FIGURE 3.1-2
GEOLOGY MAP

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 Base.dwg
Scale: As Noted	Drawn By: ETC

Dinwoody Formations, the Permian-age Phosphoria Formation, and the Permian to Pennsylvanian-age Wells Formation. The Phosphoria Formation is divided into two members that include the Rex Chert and underlying Meade Peak Member. Locally, the Grandeur Member of the Park City Formation is also present above the Wells Formation, but the two units are mapped together because of the similarities in lithology (Maxim 2002a; Mansfield 1927). A partial generalized stratigraphic cross-section for the region is presented on **Figure 2.1-3**.

3.1.3.2 Stratigraphy

Paleozoic and Mesozoic rocks in the project area are overlain by alluvium and colluvium of Quaternary age. Unconsolidated deposits are present on slopes and in drainages in the project area and are composed of silt, sand, gravel, and clay. Drilling data indicate that the thickness of the alluvial cover varies from 20 to 65 feet in the area of the North Rasmussen Ridge pit. Alluvial thickness in drainages varies from 5 to 65 feet (Maxim 2002a).

The youngest rocks in the section are of the Thaynes Formation that outcrops northeast of the project area along West Sheep Creek. The Thaynes Formation is between 2,200 and 2,800 feet thick and can be divided into five members that include from top to bottom, the Portneuf Limestone, Nodular Siltstone, Black Shale, Platy Siltstone, and Black Limestone (Mansfield 1927; Ralston, Brooks, Cannon, Corbet, Jr., Singh, Winter, and Wai 1980). Studies by Robinette (1977) and Mohammad (1976) indicate that the Thaynes Formation is typically water bearing and may be part of an intermediate scale groundwater flow system in the Idaho phosphate region.

The Dinwoody Formation is present below the Thaynes Formation and has an approximate thickness of 900 feet. It is composed of interbedded limestone and siltstone with discontinuous shaley zones in the upper portion of the formation and calcareous shale and siltstone with thin limestone beds in the lower portion of the formation. The Dinwoody Formation outcrops northeast of the proposed North Rasmussen Ridge pit along the ridge between West Sheep Creek and No Name Creek. The Dinwoody Formation is water bearing in some locations and may be part of an intermediate scale groundwater flow system (Robinette 1977; Edwards 1977; Mohammad 1976).

The Phosphoria Formation is divided into two formally recognized members. The uppermost member is the Rex Chert that occurs stratigraphically below the Dinwoody Formation. The Rex Chert is 100 to 200 feet thick at Rasmussen Ridge and is composed of thick bedded to massive dark gray to blue-gray chert and cherty mudstone and limestone with interbedded gray to black shale. Locally, the Rex Chert is water bearing and forms part of a local groundwater flow system. The Meade Peak Member occurs below the Rex Chert and is the host of phosphate ore in the district. Rocks of the Meade Peak can be subdivided into five informal units that include the Hanging Wall Mud, the Upper Ore Zone, Center Waste Shale, the Lower Ore Zone and the Footwall Mud (Maxim 2002a; Petrun 1999; Piper 1999). The uppermost unit of the Meade Peak is the Hanging Wall Mud that varies in thickness from 10 to 15 feet and is composed of mudstone, siltstone, and cherty phosphorite. The upper ore zone occurs below the Hanging Wall Mud and is composed of about 15 to 16 feet of gray-brown to brown interbedded phosphatic mudstone, argillaceous phosphorite, oolitic phosphorite, and cherty mudstone. The Center Waste Shale occurs below the Upper Ore Zone and is composed of about 65 to 100 feet of dark

gray to black mudstone, siltstone, argillaceous carbonate, and thin oolitic phosphorite interbeds. The Lower Ore Zone is about 40 to 45 feet thick and is composed of gray to brown interbedded oolitic phosphorite, phosphatic mudstone, siltstone and limestone, and argillaceous phosphorite. The Footwall Mud is the lower most unit of the Meade Peak and is composed of about 5 feet of massively bedded reddish brown siltstone with a thin layer of black fossiliferous phosphatic siltstone at the base. As a package, the predominantly fine-grained rocks of the Meade Peak Member have low permeability and act as a barrier to groundwater flow.

The Grandeur Tongue of the Park City Formation underlies the Phosphoria Formation and is mapped as part of the Wells Formation locally (Mansfield 1927). Rocks of the Grandeur Tongue are thick to massively bedded gray dolomite that is occasionally sandy or argillaceous and may be recrystallized in its upper portion. Locally the unit is 65 to 100 feet thick (Ralston et al 1980; Petrun 1999).

The Wells Formation underlies the Grandeur Tongue is divided into two members. The upper member is between 1,000 and 1,400 feet thick and is composed of buff colored sandy limestone, gray to reddish brown sandstone and interbedded gray limestone and dolomite (Ralston et al 1980). The lower member is 500 to 950 feet thick and consists of medium-bedded gray cherty limestone with some interbedded sandstone (Ralston et al 1980). In the area of the mine, the combined thickness of the Wells Formation (including the Grandeur Member of the Park City Formation) is mapped as being about 2,400 feet (Mansfield 1927). The Wells Formation is water bearing and is part of the regional aquifer (Ralston et al 1980).

3.1.3.3 Structural Setting

The proposed North Rasmussen Ridge Mine is located on the eastern limb of the Snowdrift Anticline that is situated on the upper plate of the Bannock Overthrust. Rocks in the project area dip 78 to 33 degrees east with the steeper dip being the predominant attitude of the rocks. The strike of bedding is approximately north 45 degrees west and is parallel to the axis of the anticline (Mansfield 1927).

Two northwest trending high-angle normal faults are mapped in the project area. The Enoch Valley Fault occurs along the southwestern limb of the Snowdrift Anticline and bounds the anticline in some locations (Mansfield 1927; Garrand 1974). The Limerock Fault is located northeast of the proposed pit and follows the drainage in Reese Canyon to the top of the watershed divide with West Sheep Creek (Mansfield 1927; Garrand 1974). Based on geologic interpretation by Mansfield (1927), the Enoch Valley and Limerock faults are continuous over distances of several miles (**Figure 3.1-1**).

Near the center of the proposed pit, the northern portion of the ore zone is displaced approximately 1,000 feet to the east by the Offset Fault. The Offset Fault strikes approximately east-west and is a high-angle normal fault dipping steeply to the north. The expansion plan for the North Rasmussen specifies that approximately 70 feet of the original ground that contains the Offset Fault would remain unmined between sections 16,300N and 16,400N.

3.1.3.4 Seismicity

The North Rasmussen Ridge study area lies within a Zone III seismic region that extends from northern Arizona through the Wasatch Front in Utah to the Yellowstone and Hebgen Lake regions in Wyoming and Montana. About 20 earthquakes capable of damaging structures (greater than 5.0 on the Richter Scale) have occurred within this seismic region from 1880 through 1994. The near-future earthquake activity would probably be similar to the past 100 years (BLM and USFS 2002).

3.1.4 Geochemistry

Selenium and other potential contaminants occur naturally in rocks associated with phosphatic ore in southern Idaho. Selenium has been identified as a constituent of special concern in the South East Idaho Phosphate District because of its potential to leach into groundwater and surface water and bioaccumulate in vegetation (Desborough et al 1999).

3.1.4.1 Occurrence and Environmental Mobility of Selenium and Metals in Overburden

Many metals and metalloids occur in elevated concentrations in the Paleozoic rocks of the region. Selenium (a metalloid) is the element of principal concern and occurs at concentrations above average crustal abundances in the Meade Peak Member of the Phosphoria Formation (Gulbrandsen 1960; Desborough et al 1999; Herring et al 1999). Selenium is an essential nutrient for the maintenance of health in mammals, but at high concentrations it can be toxic. Because of its potentially toxic effects and occurrence in waste rock from phosphate mines in southeastern Idaho, this EIS gives special consideration to mobility of selenium in the environment.

Geochemical studies of Permian-age rocks in southeastern Idaho indicate they generally contain less than 165 parts per million (ppm) selenium with the marine shales of the Meade Peak Member being the principal geologic reservoir (Gulbrandsen 1960; Desborough et al 1999). Selenium substitutes for sulfur in the lattices of sulfide minerals (Rapp 1972) and may be associated with sulfur in organic matter. Mineralogical studies by the U.S. Geological Survey (USGS) document the occurrence of seleniferous sphalerite, pyrite and organic compounds, as well as native selenium in rocks of the Meade Peak Member (Grauch et al 2001; Desborough et al 1999). Preliminary results of geochemical studies at the Rasmussen Ridge Mine also indicate that a significant portion of the total selenium content occurs outside of the identified mineralogical and organic reservoirs (Maxim 2001b). This finding suggests that selenium may also be present as surficial complexes adsorbed onto clay, carbonate minerals, and oxides of iron, aluminum, and manganese (Maxim 2002a).

The principal mineralogic reservoirs of selenium in the Meade Peak Member are the sulfide minerals sphalerite (ZnS) and pyrite (FeS_2) where selenide substitutes for sulfur in the crystal lattice. Native selenium has also been observed in rocks in the Idaho Phosphate District (BLM and USFS 2002). Reduced forms of selenium such as selenide and native selenium are relatively insoluble in water and have low environmental mobility. Exposure to the atmosphere, however, can oxidize selenide and native selenium into more mobile forms such as selenite and selenate.

Selenium that is released due to oxidation of the sulfide host minerals will also assume more mobile forms.

In general, selenium mobility increases with increasing oxidation state. Analysis of rocks from the Meade Peak Member sampled at Pole Creek indicates that only 2 percent of the total selenium content occurs as selenite which is mobile in water. Selenate and other highly mobile forms of selenium have not been observed in unweathered rocks in the region, but preliminary work by the USGS indicates that some rocks at Rasmussen Ridge are more weathered than most other locations in southeast Idaho (Maxim 2002a), yielding a very complex suite of secondary minerals.

In addition to selenium, overburden materials from Rasmussen Ridge contain elevated concentrations of other metals that could be mobile in the environment. Metals present at elevated levels in waste rock include aluminum, cadmium, antimony, manganese, nickel, and zinc (Gulbrandsen 1960, BLM and USFS 2002, Herring et al 1999; Desborough et al 1999; Maxim 2002a; Piper 1999). Concentrations of sulfate, fluoride, and total dissolved solids may also be increased in groundwater and surface water that receives runoff or infiltration from the waste rock.

Metal mobility in water is strongly influenced by pH, with most metals being more soluble and mobile under acidic conditions. At near-neutral pH, the solubility and mobility of most metals in the environment is low (Hem 1989). Increased mobility has been noted for some elements (notably selenium) under alkaline conditions at elevated pH (Desborough et al 1999; Munkers 2000).

3.1.4.2 Characterization of Overburden

Volume of Overburden

The study of environmental geochemistry prepared by Agrium (Maxim 2002a) focused on overburden and did not characterize the ore horizons that would be removed and shipped off site for processing, as they would not affect the environment at the mine site. The principal lithologies in the overburden at the proposed North Rasmussen Ridge Mine include Rex Chert, Hanging Wall Mud, Footwall Mud, Center Waste Shale, and limestone and dolomite of the Grandeur Member/Wells Formation (Maxim 2002a). A significant volume of alluvium would also be moved as overburden during mining operations, that would be used as growth media for reclamation. Volumes of overburden materials to be mined under the Proposed Action is summarized **Table 3.1-1**. Salvaged soils (some to 5 feet in depth) are not included in the totals in the table.

TABLE 3.1-1
OVERBURDEN VOLUMES AND PERCENTAGES

OVERBURDEN TYPE	VOLUME (BCY)	RUN-OF-MINE PERCENTAGE
Alluvium	8,655,770	16
Rex Chert	17,467,107	31
Hanging Wall Mud	3,079,634	6
Center Waste Shale	12,517,933	22
Footwall Mud	896,463	2
Wells Limestone	13,089,069	23
TOTAL	**55,705,976**	**100**

Note: BCY = Bank Cubic Yards

Geochemical Testing

The geochemical characterization program included sampling historical and active waste rock dumps at Rasmussen Ridge and testing of drill samples from the proposed mine expansion area (Maxim 2002a). Geochemical testing included acid-base accounting (ABA), analysis of selected metals content (aluminum, cadmium, iron, manganese, nickel, antimony, selenium, and zinc), paste extraction of pH and EC, and column leaching tests. An overview of the geochemical characterization program is summarized in **Tables 3.1-2**.

TABLE 3.1-2
SUMMARY OF GEOCHEMICAL TESTING FOR OVERBURDEN

		Number of Samples Tested						
Test Type	Sample Source	Alluvium	Rex Chert	Hanging Wall Mud	Center Waste Shale	Footwall Mud	Limestone	Total
ABA	Existing Waste Rock	1	4	2	17	5	3	**32**
	Proposed Waste Rock	20	20	20	20	20	20	**120**
Total Metals	Existing Waste Rock	1	4	2	17	5	3	**32**
	Proposed Waste Rock	20	20	20	20	19	20	**119**
Paste Extract	Existing Waste Rock	0	0	0	0	0	0	**0**
	Proposed Waste Rock	19	0	0	0	0	0	**19**
Column Testing	Existing Waste Rock	0	0	0	0	0	0	**0**
	Proposed Waste Rock	1	1	1	4	1	3	**11**

Acid rock drainage (ARD) can occur when sulfide minerals react with oxygen and water to produce sulfuric acid and other reaction products. Many metals become more soluble under acidic conditions and the formation of ARD can result in increased mobility of metals in groundwater and surface water. Acid produced by sulfide minerals can be neutralized by a number of reactions that involve carbonate minerals and basic silicates (Morin and Hutt 1994). The potential for ARD formation can also be minimized using appropriate engineering practices to reduce the availability of oxygen and water for the reaction.

ABA testing provides a theoretical estimate of the net acid-producing potential of waste rock by comparing the total acid forming potential to the neutralizing potential of the material. ABA tests do not consider the rates of acid formation or neutralization, which in many cases determine whether a material will produce acidic drainage. The ratio of acid neutralizing potential to acid generating potential (ANP/AGP) is typically used to evaluate data on ABA. Samples with ANP/AGP ratios greater than 3 are considered to have low potential to produce acid. ANP/AGP ratios between 3 and 1 are indeterminate, and ratios below 1 are potentially acid generating. The BLM risk threshold for acid rock drainage is based on an ANP/AGP ratio of 3 (BLM and USFS 2002).

A total of 152 ABA tests were conducted to evaluate the potential for production of ARD from overburden (Maxim 2002a). Samples submitted for ABA testing included 32 rock samples from historical and active waste rock dumps at Rasmussen Ridge and 120 samples from overburden in the proposed pit area. The average ANP/AGP ratio for run of mine overburden was calculated to be 23 for the combined historical and active waste rock dumps, and 17 for overburden samples from the proposed pit area. With the exception of center waste shale from existing waste rock dumps, the average values for ANP/AGP all exceed the threshold criterion of 3 and are considered non-acid generating. The average ANP/AGP value for historic center waste shale was calculated to be 2, which is indeterminate, but indicates that neutralizing potential is 2 times greater than acid-producing potential. The results of ABA testing agree with field observations of the weathering behavior of historic overburden materials and indicate that overburden from the mine is not expected to generate ARD. ABA results are summarized in **Table 3.1-3**.

The geochemical characterization program also included testing of 152 samples for total content of 50 elements (Maxim 2002a). Whole rock analysis of total elemental content was performed using a 75 percent aqua regia digestion with multi-element analysis by ICP-MS (inductively coupled plasma-mass spectroscopy). Elements analyzed for total concentration in waste rock samples are summarized in **Table 3.1-4**.

TABLE 3.1-3
AVERAGE ACID-BASE ACCOUNTING VALUES FOR OVERBURDEN

	Alluvium	Rex Chert	Hanging Wall Mud	Center Waste Shale	Footwall Mud	Limestone	Run of Mine
Historical and Active Overburden Dumps							
Number of Samples	1	4	2	17	5	3	--
ANP, T $CaCO_3$/kt	18	186	100	63	148	488	198
AGP, T $CaCO_3$/kt	1	4	3	31	9	0.33	9
ANP/AGP	18	53	40	2	16	1,464	23
Proposed Overburden							
Number of Samples	20	20	20	20	20	20	--
ANP, T $CaCO_3$/kt	53	53	131	139	399	798	257
AGP, T $CaCO_3$/kt	1	14	31	36	9	2	15
ANP/AGP	46	4	4	4	42	470	17

Notes: ANP = Acid-Neutralizing Potential
AGP = Acid-Generating Potential
T C_aCO_3/kt = Tons of calcium carbonate per 1,000 tons

Results of testing indicate that concentrations of cadmium, nickel, antimony, selenium, and zinc are elevated in overburden rocks above normal crustal abundances (Rose et al 1979) (**Table 3.1-5**). Cadmium concentrations are highest in Footwall Mud followed by limestone, Center Waste Shale, and Hanging Wall Mud. Nickel concentrations are highest in the Footwall Mud. Footwall Mud also has high concentrations of antimony and zinc. Selenium concentrations are highest in the Hanging Wall Mud, followed by the Center Waste Shale, Footwall Mud, and Rex Chert.

The geochemical characterization program also included 11 column leaching tests to evaluate the potential for release of metals in water that may contact overburden rocks (Maxim 2002a). Leaching tests were performed on columns containing a single rock type and used distilled water as the leaching agent. A total of 10 pore volumes of distilled water was passed through each column and then collected for analysis. Humidified air and occasionally dry air was circulated

TABLE 3.1-4
ELEMENTS ANALYZED FOR TOTAL CONCENTRATION IN WASTE ROCK SAMPLES

Silver	Cobalt	Potassium	Lead	Tellurium
Aluminum	Chromium	Lanthanum	Rubidium	Thorium
Arsenic	Cesium	Lithium	Rhenium	Titanium
Boron	Copper	Magnesium	Sulfur	Thallium
Barium	Iron	Manganese	Antimony	Uranium
Beryllium	Gallium	Molybdenum	Scandium	Vanadium
Bismuth	Germanium	Sodium	Selenium	Tungsten
Calcium	Hafnium	Niobium	Tin	Yttrium
Cadmium	Mercury	Nickel	Strontium	Zinc
Cerium	Indium	Phosphorous	Tantalum	Zirconium

TABLE 3.1-5
AVERAGE TOTAL CONTENT OF SELECTED METAL IN OVERBURDEN

	Number of Samples	Aluminum %	Cadmium ppm	Iron %	Manganese Ppm	Nickel ppm	Antimony ppm	Selenium ppm	Zinc ppm
Historic and Active Overburden Dumps									
Alluvium	1	0.87	29.40	1.35	180	94.0	0.85	3.6	970
Rex Chert	4	1.02	14.78	1.36	154	91.6	2.45	8.9	617
Hanging Wall Mud	2	1.99	25.46	2.53	3,850	426.3	3.43	10.4	2,857
Center Waste Shale	17	1.36	17.24	2.17	615	145.8	1.59	41.1	673
Footwall Mud	5	1.54	27.30	2.14	2,658	153.3	0.95	5.2	1,223
Limestone	3	0.74	23.75	0.92	287	127.7	0.98	1.1	1,075
Run of Mine Average	--	1.07	20.51	1.51	538	132.2	1.69	14	926
Average Crustal Abundance									
	--	8.1	0.1	4.7	1,000	75	0.1	0.1	80
Proposed Overburden									
Alluvium	20	1.85	4.88	2.51	2,625	75.4	1.47	6.5	280
Rex Chert	20	1.07	3.13	2.08	723	111.8	0.87	16.6	342
Hanging Wall Mud	20	1.40	22.89	1.60	179	155.0	1.70	76.0	559
Center Waste Shale	20	1.27	29.77	1.48	108	186.8	4.59	51.6	926
Footwall Mud	19	1.24	92.17	1.29	1,387	557.7	7.49	26.4	3,489
Limestone	20	0.28	43.24	0.64	643	184.6	1.96	4.1	1,736
Run of Mine Average	--	1.07	21.34	1.63	842	149.7	2.21	23	854

through the columns between pore volumes to promote oxidation and simulate weathering conditions. The distilled water was applied at a slow rate to prevent saturated conditions from forming. Sediment and water samples from existing waste rock dump seeps at the mine were analyzed for the presence of oxidizing bacteria to determine if the columns should be inoculated to stimulate oxiding conditions. The results of the analysis indicated that high concentrations of sulfide-reducing bacteria were present, but oxidizing bacteria were not (Maxim 2002a). Therefore, the columns were not inoculated.

Leachates from the columns were analyzed for 37 parameters. The analyses indicated that leachate concentrations generally decreased with increasing pore volumes. The pH of the column effluents were mostly above 7. The initial pH of the leachate from unweathered Center Waste Shale, however, was about 4.7 but increased to above 6 after the first pore volume. With the exception of the parameters listed in **Table 3.1-6**, all other analyses from the column test met Idaho groundwater standards. Results from the column tests also indicate that the predominant

mobile form of selenium in solution is selenate (selenium^{+6}). Selenium is also present in leachates as selenite (selenium^{+4}), but typically, concentrations of selenite are an order of magnitude smaller than concentrations of selenate.

Geochemical characterization of alluvial materials also included 19 paste extraction tests. Alluvium in the project area is clay and organic rich with a paste pH between 5.7 and 7.8. Selenium concentrations in 14 of the 19 paste samples were below the detection limit of 0.01 mg/L. Average selenium concentrations in the remaining alluvium samples were 0.028 mg/L. Electrical conductivity of paste extracts ranged between 1.10 and 0.23 milliohms per centimeter (mmhos/cm). The low values for electrical conductivity and selenium in paste extracts indicate that alluvium has low potential to increase solute loads and release selenium in contact with water.

3.1.4.3 Conceptual Geochemical Model

Selenium and other constituents of concern occur naturally in overburden rocks associated with phosphatic ore. Leaching of these rocks when placed in waste rock dump facilities or used as backfill has the potential to release contaminants into receiving groundwater and surface water. Subsequent uptake of contaminated water by vegetation can affect other biological receptors. Agrium has been cooperating with state and federal regulatory agencies since 1996 to identify sources of contamination and to develop measures to mitigate impacts.

Several factors will affect leaching and mobilization of trace metals from overburden. These factors include increases in the reactive surface area of the rocks caused by mining, weathering of the material under atmospheric conditions, and the volume of runoff or infiltration in contact with the overburden. Under atmospheric weathering conditions, the relatively insoluble forms of selenium (selenium^{-2}), and (selenium^{0}) which make up the majority of selenium in overburden rocks are oxidized to selenite and selenate. Oxidation reactions can be bacterially mediated, and selenide (selenium^{+2}) (the most common form of selenium in unweathered shales of the Phosphoria Formation) can be oxidized directly to selenite without forming native selenium (selenium^{0}). Oxidizing bacteria, however, have not been identified in seeps and sediments associated with historical waste rock dumps at Rasmussen Ridge.

The principal reservoirs of selenium and other metals in overburden rocks include the lattices of sulfide minerals and as adsorbed complexes on clay and oxyhydroxides of iron, aluminum, and possibly manganese. Native selenium is also known to be present in overburden. Oxidation of sulfide minerals and infiltration or runoff of water through backfill can mobilize selenium and other metals.

TABLE 3.1-6
PARAMETERS THAT EXCEED GROUNDWATER STANDARDS IN COLUMN TEST LEACHATES

		Alluvium	Rex Chert	Hanging Wall Mud	Reduced Center Waste Shale	Weathered Center Waste Shale	Footwall Mud	Shallow Limestone	Deep Limestone	Idaho Groundwater Standards	
										MCL	SMCL
Sulfate	n_e/n_s Range, mg/L		7/7 623 – 2,700	7/7 440 – 2,180	11/14 165 – 2,240		1/7 52 – 855				250
TDS	n_e/n_s Range, mg/L	1/7 88 – 517	7/7 977 – 3,920	7/7 730 – 3,350	8/14 316 – 3,290		1/7 155 – 1,410	1/7 121 – 797			500
PH	n_e/n_s Range, su				8/14 4.7 – 7.4					6.5-8.5	
Fluoride	n_e/n_s Range, mg/L				11/14 3.61 – 7.16		1/7 1.09 – 4.14			4	
Aluminum	n_e/n_s Range, mg/L		3/7 <0.1 – 0.3	3/7 <0.1 – 0.2	11/14 <0.01 – 1.5	10/14 <0.1 – 0.4					0.2
Antimony	n_e/n_s Range, mg/L	1/7 0.004 – 0.006		6/7 0.005 –0.008	14/14 0.007 – 0.015	8/14 0.005 – 0.015	7/7 0.008 – 0.014	7/7 0.007 – 0.01	8/10 0.004 – 0.011	0.006	
Cadmium	n_e/n_s Range, mg/L		7/7 0.0067 – 0.0264	4/7 0.0038 – 0.239	13/14 0.0048 – 0.0747					0.005	
Manganese	n_e/n_s Range, mg/L	3/7 <0.015 – 1.13	7/7 2.59 – 10.1	7/7 0.534 – 2.75	14/14 0.307 – 6.32	3/7 <0.015 – 0.535	7/7 0.05 – 2.04	1/7 <0.015 – 0.88	4/10 <0.02 – 0.18		0.05
Nickel	n_e/n_s Range, mg/L		7/7 1.03 – 8.15	7/7 0.37 –1.66	11/14 0.05 – 170		1/7 <0.05 – 0.17			0.1	
Selenium	n_e/n_s Range, mg/L		7/7 0.21 – 0.860	7/7 1.23 –7.13	14/14 0.092 – 0.964	14/14 0.198 – 1.20	7/7 0.072 – 0.870	5/7 0.047 – 0.172		0.05	
Zinc	n_e/n_s Range, mg/L		5/7 0.31 – 10.2								5

Notes:
mg/L = milligrams per liter
SU = standard units
TDS = total dissolved solids
MCL = maximum contaminant level
SMCL = secondary maximum contaminant level
n_e/n_s = number of samples that exceed primary or secondary groundwater standards/number of samples analyzed

Selenite in solution is toxic; however, its mobility is hindered by its tendency to form relatively stable compounds with iron and aluminum (Herring et al 1999). Continued oxidation of selenite to selenate can increase the mobility of selenium in water. Selenate is less toxic than selenite, but is the most mobile inorganic form of selenium and is the form that is most easily accumulated by plants and animals. Vegetation may also bioaccumulate other metals if they are present in solution.

Column tests indicate that aluminum, antimony, cadmium, manganese, nickel, selenium, and to a lesser extent zinc are mobile in solution and can be expected to leach from overburden rocks. Concentrations of sulfate, total dissolved solids (TDS), and fluoride are also expected to increase in waters that contact overburden.

Other organic selenium compounds (such as amino acid selenomethionine) are common in the environment but have not been identified in unweathered rocks of the Phosphoria Formation. Organo-selenium compounds are commonly formed by reactions in plant tissue and become present in soil and water by decay of seleniferous vegetation (Herring et al 1999).

3.1.5 Paleontology

Sedimentary rocks in southeastern Idaho contain paleontological resources consisting of vertebrate, invertebrate, and paleobotanical fossils, including fish and shark remains. Fossils found in the North Rasmussen Ridge Mine area are not unique to the project area or southeastern Idaho. They are found throughout the region wherever similar formations exist (BLM and USFS 2002).

Fossils in the Wells Formation are described as predominantly consisting of bryozoa and brachiopods with wide distribution. The Meade Peak Member contains abundant pelecypods, gastropods, and brachiopods, as well as ammonites, nautiloids, crinoids, bryozoa, and sponge spicules. The base of the Meade Peak Member contains a thin marker bed identified as the fish scale bed, which contains some fossil fish and shark fragments. *Heliocoprion,* a fossil shark, has been found in the ore zones and other units in the Meade Peak Member. The Rex Chert Member contains brachiopods, crinoid fragments, and sponge spicules (BLM and USFS 2002).

Unconsolidated valley fill sediments in southeastern Idaho have yielded Ice Age and older mammals including mammoths, mastodons, horses, bison, camels, ground sloths, carnivores, rodents, and other animals. These fossils are from lake, stream, or windblown deposits and consist of clay, silt, ash, sand, and gravel (BLM and USFS 2002).

3.2 AIR RESOURCES

The study area for air resources consists of the immediate area near North Rasmussen Ridge Mine and the surrounding air shed within 100 kilometers. Standard environmental practices for evaluation of impacts to air resources require consideration of the airshed (generally the surrounding air shed within 100 kilometers) as well as to the immediate area. The North Rasmussen Ridge Mine is located in southeastern Idaho on Rasmussen Ridge between the Grays

and Wooley mountain ranges. The nearest residence is over 2 miles away and the nearest sensitive area is Gray's Lake National Wildlife Refuge, which is over 10 miles to the north.

3.2.1 Climate

Major topographic features, such as the Wooley and Grays Ranges, influence the climate in the study area. Mountain ranges near the North Rasmussen Ridge Mine generally run northwest and southeast and affect local patterns of wind, precipitation, and temperature. The Blackfoot Reservoir is located about 9 miles west of the North Rasmussen Ridge Mine and may have some influence on the local climate. Valleys in the area range in elevation from about 4,500 feet to 8,300 feet. Rasmussen Ridge is at an elevation of about 7,000 feet.

The area experiences a wide annual and diurnal variation in temperature and humidity. The average annual precipitation is about 27 inches (Whetstone 2002). Normally, May is the wettest month, and July and August are the driest. Temperature extremes range from 83º F in July to 3.9º F in January. Frost or freezing conditions can be experienced in any month. The average wind velocity is 9 mph.

Data collected by the Western Regional Climate Center (WRCC), and the Natural Resources Conservation Service (NRCS) provide the general meteorological conditions in the study area. The WRCC operates weather stations at Conda, Pocatello, Soda Springs Airport, Henry, Idaho and Afton, Wyoming. The NRCS SNOTEL network monitors precipitation at Slug Creek Divide and Somsen Ranch. In addition, the Monsanto Corporation has operated a meteorological station in Enoch Valley since 1997. The location of each station, elevation, and distance from the North Rasmussen Ridge Mine area are summarized in **Table 3.2-1**.

The Enoch Valley meteorological station is located nearest to the North Rasmussen Ridge Mine (approximately 1.5 miles), however the station has a short period of record (4 years) and the data are not subjected to the same validation procedures used by the NWS and NRCS. The next closest meteorological station, the Somsen Ranch SNOTEL site, is located 4.1 miles from the mine on the northern flank of the Grays Range. The Somsen Ranch station is considered the most representative station for the North Rasmussen Ridge Mine, because it is near the mine and at approximately the same elevation (6,800 feet at the Somsen Ranch station vs. 6,905 feet at the mine shop). The next nearest meteorological station is the Henry station, located 5.5 miles east of the mine. The Henry station occurs at a lower elevation (6,140 feet) and the period of record is limited to 16 years (1971 to 1987) (Whetstone 2002).

TABLE 3.2-1
LIST OF METEOROLOGICAL STATIONS NEAR NORTH RASMUSSEN RIDGE MINE SITE

Station	Operator	Station ID	Period of Record Examined	Latitude	Longitude	Elev. (feet)	Distance From Mine (Miles)
Conda	WRCC	102071	8/2/1948 – 4/30/1978	42° 43' N	111° 33' W	6,200	14.4
Pocatello	WRCC	107211	1/3/1939 – 12/31/2001	42° 55' N	112° 36' W	4,447	60.5
Soda Springs Airport[1]	WRCC	108535	1978 – 2000	42° 39' N	111° 35' W	5,840	19
Afton, WY	WRCC	480027	5/1/1957 – 12/31/2001	42° 44' N	110° 56' W	6,210	26.6
Henry	WRCC	104230	9/23/1971 – 10/31/1987	42° 54' N	111° 31' W	6,140	5.5
Somsen Ranch	NRCS SNOTEL	S016	10/1982 – 12/2002	42° 57' 00" N	111° 22' 12" W	6,800	4.1
Slug Creek Divide	NRCS SNOTEL	S015	10/1982 – 12/2001	42° 34' 12" N	111° 18' 00" W	7,225	23.2
Enoch Valley	Monsanto	Enoch Valley	1997 – 2001	42° 52' N	111° 25' W	6,724	1.5

Source: WRCC 2002; NRCS 2002.

Table 3.2-2 shows average monthly temperature data for three monitoring locations reported by the WRCC. Average annual temperature ranges from 39°F in Henry, Idaho to 40.8 °F at Soda Springs, Idaho.

As shown in **Table 3.2-3**, precipitation records show a trend of lower precipitation at lower elevations. The mine site is at an elevation of approximately 7,000 feet. The heaviest precipitation occurs during the winter and spring months when snow and spring rains contribute to precipitation levels. Precipitation during the spring usually results from cool marine air flowing in from the south. Snow pack is influenced by the surrounding mountains and is greatest on the northeastern slopes. The least amount of precipitation occurs during the summer months. Summer precipitation is primarily associated with thunderstorm activities.

Intense heating by the sun during the daytime along with radiation cooling at night contributes to large fluctuations in diurnal temperatures. Summers are dry and winters are generally considered cold.

TABLE 3.2-2
MONTHLY AND ANNUAL TEMPERATURE DATA FOR STUDY AREA

Station	Elevation (feet)	Period of Record		Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Ann.
Temperature (degrees F)																
Henry, Idaho	6,140	1971-1987	Max	27.1	34.4	40.8	52.0	61.5	72.2	80.4	79.4	69.5	56.4	39.9	30.9	53.7
			Min	3.9	7.6	14.5	22.8	33.1	39.9	43.6	41.9	34.4	26.0	15.6	7.6	24.2
			Mean	15.5	21.0	27.9	36.9	47.3	56.1	61.7	60.6	51.7	41.2	27.4	20.3	39.0
Conda, Idaho	6,200	1948-1978	Max	29.2	33.2	38.8	49.2	62.6	71.3	81.7	81.3	71.7	58.9	41.6	31.5	54.2
			Min	8.2	9.8	14.6	25.2	33.8	39.8	45.4	43.5	35.1	27.1	18.7	10.5	26.0
			Mean	18.9	21.5	26.8	37.2	48.1	55.6	63.7	62.4	53.4	43.2	30.1	21.0	40.1
Soda Spring Airport, Idaho	5,840	1978-2000	Max	30.2	32.7	41.7	53.8	63.3	73.5	83.0	82.4	71.9	58.8	41.1	30.8	55.3
			Min	8.6	10.6	18.9	26.2	34.2	39.7	44.3	44.0	35.7	26.3	18.2	7.9	26.2
			Mean	19.4	21.6	30.3	40.0	48.7	56.6	63.5	63.1	53.9	42.5	30.1	19.3	40.8

Source: Western Regional Climate Center 2002.

TABLE 3.2-3
AVERAGE MONTHLY PRECIPITATION (IN INCHES) AT NEARBY METEOROLOGICAL STATIONS

Station	Elev	Period of Record (years)	Dates	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Sum
Conda	6200	30	8/2/1948 – 4/30/1978	2.05	1.58	1.55	1.60	2.00	1.72	0.90	1.08	1.37	1.33	1.74	2	18.91
Conda	6200	29	1971-2000	2.25	1.97	2.06	1.74	1.86	1.41	1.21	1.42	1.47	1.7	1.82	2.26	21.17
Pocatello	4447	62	1/3/1939 - 12/31/2001	1.11	0.92	1.21	1.11	1.36	1.07	0.53	0.62	0.79	0.87	1.07	1.04	11.71
Afton	6210	37	5/1/1957 - 12/31/2001	1.47	1.29	1.29	1.66	2.08	1.79	1.25	1.24	1.52	1.4	1.48	1.43	17.89
Henry	6140	16	9/23/1971 - 10/31/1987	1.95	1.72	1.64	1.03	2.44	1.33	1.65	1.35	1.7	1.59	1.87	2.13	20.38
Slug Ck Divide	7225	19	Oct 1982 - Sept 2000	3.83	3.52	3.43	3.11	3.08	1.64	1.38	1.25	1.81	2.22	3.85	3.99	33.11
Somsen Ranch	6800	20	Oct 1982 - April 2002	1.81	3.20	3.13	3.19	2.65	2.54	2.43	2.72	1.47	1.23	1.14	1.29	26.88
Enoch Valley	6724	3	Jan 1997- Dec 1999	3.03	1.55	1.24	1.20	2.25	2.36	0.94	1.30	1.02	0.86	0.56	0.91	17.25

Source: NRCS 2002a; NRCS 2002b.

3.2.2 Air Quality

The federal government has established National Ambient Air Quality Standards (NAAQS) for criteria air pollutants. The criteria pollutants are carbon monoxide (CO), lead (Pb), sulfur dioxide (SO_2), particulate matter less the 10 microns in diameter (PM_{10}), ozone (O_3) and nitrogen dioxide (NO_2). The NAAQS are absolute allowable concentration limits for criteria air pollutants that apply to areas where the public has access. **Table 3.2-4** shows the NAAQS and State of Idaho Air Quality Standards.

The North Rasmussen Ridge Mine site is located within the portion of Air Quality Control Region 61, designated as an unclassified area. Air quality in the study area is therefore designated as unclassified for all pollutants. The unclassified designation means that existing concentrations of the criteria air pollutants are within the NAAQS.

Air quality in the study area is generally considered good. Current mining operations in the area include the Central Rasmussen Ridge Mine, Monsanto's (formerly Solutia) Enoch Valley Mine, and Monsanto's South Rasmussen Ridge Mine. The Central Rasmussen Ridge Mine is located south of the North Rasmussen Ridge Mine site, and the Enoch Valley Mine is located about one-half mile west. The nearest human dwelling is about 2 miles to the west.

Air quality monitoring data have been collected by the Idaho Division/Department of Environmental Quality at the Norton Site on State Highway 34 near Soda Springs, Idaho. Soda Springs is 19 miles southwest from the North Rasmussen Ridge Mine site. Data for PM_{10} have been collected at the site from 1989 through 2000. The annual average concentration has ranged from 20.1 to 38.3 micrograms per cubic meter ($\mu g/m^3$) during this time. The NAAQS for PM_{10} is 50 $\mu g/m^3$ and has not been exceeded during this time. The 24-hour maximum for PM_{10} (150 $\mu g/m^3$) was exceeded once in 1992 (**Table 3.2-5)**. It is assumed that concentrations of PM_{10} at the North Rasmussen Ridge Mine site are less than were measured in Soda Springs, given that Soda Springs is a relatively urban area in comparison to the mine area and because Soda Springs is 19 miles distant.

Data on the concentration of SO_2 have also been collected at two sites near Soda Springs, Idaho, from 1984 to 1990 and 1997 to 2000 and in Conda from 1982 to 1985 (**Table 3.2-6**). The annual average concentration of SO_2 in 1988 was 23 $\mu g/m^3$, well below the NAAQS of 80 $\mu g/m^3$. The 3-hour and 24-hour maximum concentrations recorded during this period were also well below the NAAQS. The SO_2 standards was not exceeded during these years.

TABLE 3.2-4
NATIONAL AMBIENT AIR QUALITY STANDARDS AND STATE OF IDAHO AIR QUALITY STANDARDS

Pollutant/ Averaging Time	State of Idaho and National Ambient Air Quality Standards ($\mu g/m^3$)
Particulate matter (PM_{10}) 24-hour Annual	150 50
Carbon monoxide (CO) 1-hour 8-hour	40,000 10,000
Sulfur dioxide (SO_2) 3-hour (National) 24-hour Annual	1,300 365 80
Nitrogen dioxide (NO_2) Annual	100
Ozone (O_3) 1-hour	235
Lead (Pb) Quarterly	1.5

Note: $\mu g/m^3$ = micrograms per cubic meter.
Source: 40 CFR Part 50.

TABLE 3.2-5
AMBIENT AIR QUALITY DATA FOR PM_{10} COLLECTED AT THE NORTON SITE SODA SPRINGS, IDAHO

Year	Annual Average ($\mu g/m^3$)	24-Hour Maximum ($\mu g/m^3$)	Number of Times Exceeded
2000	20.7	63	0
1999	24.2	90	0
1998	26.8	108	0
1997	21.1	63	0
1996	22.6	78	0
1995	20.1	73	0
1994	25.5	80	0
1993	24.7	55	0
1992	33.0	153	1
1991	24.3	59	0
1990	27.0	96	0
1989	38.3	74	0

Note: $\mu g/m^3$ = micrograms per cubic meter.
Source: EPA, AIR*Data* 2002.

TABLE 3.2-6
MONITORING DATA FOR SO_2 COLLECTED IN SODA SPRINGS AND CONDA, IDAHO

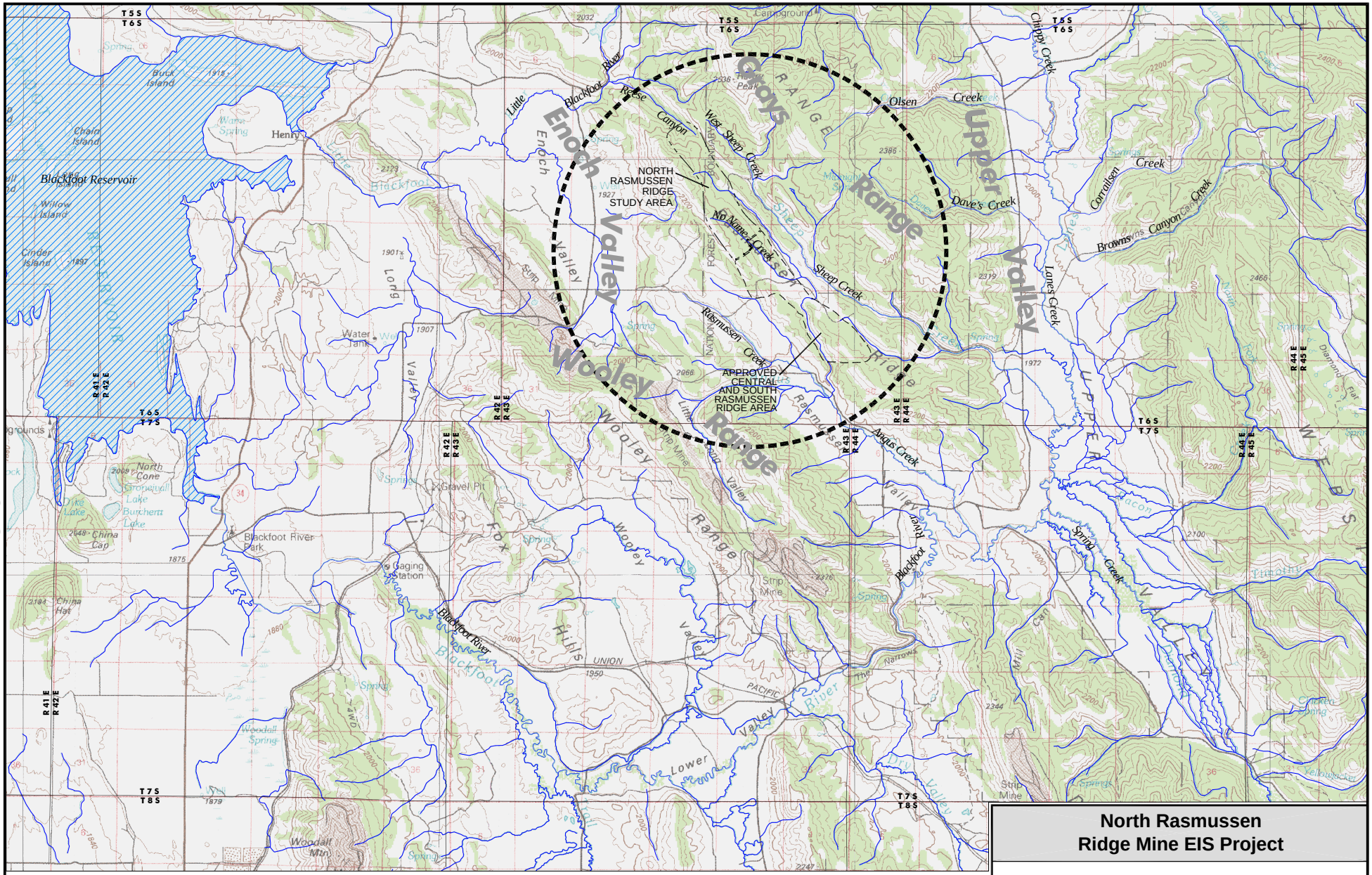
Site	Year	1-Hour Maximum (µg/m³)	Average 1-Hour Maximum (µg/m³)	24-Hour Block Average (µg/m³)	3-HOUR Block Average (µg/m³)
#0003 Soda Springs High School Soda Springs, Idaho	1997	0.175	0.0033	0.028	0.119
	1998	0.147	0.0042	0.028	0.067
	1999	0.327	0.0041	0.055	0.160
	2000	0.196	0.0036	0.043	0.136
#0027 Conda Road 1.2 miles east of State Hwy 34 Soda Springs, Idaho	1984	0.321	0.0068	0.063	0.175
	1985	0.370	0.0102	0.099	0.242
	1986	0.182	0.0065	0.063	0.129
	1987	0.143	0.0051	0.023	0.056
	1988	0.493	0.0090	0.064	0.231
	1989	0.425	0.0093	0.097	0.268
	1990	0.249	0.0089	0.055	0.169
#0015 Conda Post Office Conda, Idaho	1982	0.410	0.0062	0.046	0.203
	1983	0.620	0.0081	0.093	0.373
	1984	0.940	0.0104	0.105	0.487
	1985	0.640	0.0157	0.188	0.440

Note: µg/m³ = micrograms per cubic meter.
Source: EPA, AIR*Data* 2002.

3.3 WATER RESOURCES

The study area for water resources at the North Rasmussen Ridge Mine site consists of 20 square miles, as shown in **Figure 3.3-1**. The area encompasses the Grays Range to the north, the Wooley Range to the south, Enoch Valley on the west, and Upper Valley on the east. The primary focus of the investigation of water resources is the Rasmussen Ridge area, where the proposed mine expansion would be located. Water resources in the study area include surface streams, springs and seeps, shallow groundwater, and deep groundwater.

Three streams occur in the area of the proposed North Rasmussen Ridge Mine (**Figure 3.3-1**). These streams include the West Fork of Sheep Creek, which is tributary to Sheep Creek in the project area; No Name Creek; and the stream in Reese Canyon. Sheep Creek and its West Fork flow southeast and are tributary to Lanes Creek. Lanes Creek is tributary to the Blackfoot River. No Name Creek flows southeast and is tributary to Angus Creek. Angus Creek is tributary to the



Source: USGS 100k Quadrangle; Soda Springs, ID

LEGEND

- Study Area
- Approved Central and South Rasmussen Ridge Area
- Waterways

NORTH

0 2 4

Scale in Miles

North Rasmussen Ridge Mine EIS Project

FIGURE 3.3-1
WATER RESOURCES
STUDY AREA

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 water.dwg
Scale: As Noted	Drawn By: ETC

Blackfoot River downstream of the confluence with Lanes Creek. The stream in Reese Canyon flows to the northwest and is tributary to the Little Blackfoot River.

Groundwater in the project area occurs in alluvium and bedrock and can be divided into three distinct flow systems: an upper shallow groundwater system occurs in alluvium: a shallow intermediate groundwater system occurs in the Rex Chert and Upper Meade Peak members of the Phosphoria Formation; and a deeper regional groundwater flow system occurs in the underlying Wells Formation. The intermediate groundwater system is typically under unconfined conditions and occurs at depths ranging from 100 to 170 feet. The regional groundwater system occurs at greater depths ranging from 300 to 500 feet near the mine.

Within the project area and surrounding region, shallow alluvial groundwater, localized flow systems, and surface water are interrelated. Streams and shallow groundwater may also provide limited seepage to the regional groundwater flow system.

3.3.1 Surface Water Resources

The project area is located within the Blackfoot River Subbasin, which encompasses an area of just over 1,000 square miles. Primary land use activities in the watershed include agriculture, livestock grazing, and phosphate mining. Waterbodies within the Blackfoot River Subbasin have historically sustained several beneficial uses. All streams support cold-water aquatic life and agricultural water supply as well as secondary-contact recreation, with the larger streams supporting primary-contact recreation. Most perennial streams have also maintained spawning populations of salmonids. Domestic water supply is also a designated use of the Blackfoot River above the reservoir.

Three streams occur within the study area. These streams include No Name Creek, Reese Canyon Creek, and Sheep Creek. A drainage divide occurs in the northwestern portion of the project area that separates surface water tributary to the Little Blackfoot River from water tributary to the Blackfoot River. Reese Canyon Creek flows to the northwest and is tributary to the Little Blackfoot River. No Name Creek and Sheep Creek flow southeast to Angus Creek and Lanes Creek, which are tributary to the Blackfoot River (**Figure 3.3-1**). The Little Blackfoot River and the Blackfoot River both discharge into the Blackfoot Reservoir.

Streamflow regimes in the project area are regulated by periods of snowmelt, direct precipitation, surface runoff, and groundwater discharge from seeps and springs. Beaver dams in the low gradient reaches of Sheep Creek and Reese Canyon provide additional flow alteration and some water retention during periods of low flow. Stream gradients in the vicinity of the project area are generally low with high potential for flooding in spring and early summer. Base or low flows occur during the winter.

No streams within the project area are designated as Outstanding Resource Waters or as Special Resource Waters according to Idaho Administrative Procedures Act (IDAPA) 58.01.02. Likewise, no streams are designated under the Wild and Scenic River System or listed in the Nationwide Rivers Inventory as having “outstandingly remarkable values” that could make them eligible for inclusion in the system (National Park Service 2003).

Sheep Creek, Angus Creek, Lanes Creek, and the Blackfoot River below the confluence with Lanes Creek are listed as water quality limited waterbodies under Section 303(d) of the Clean Water Act (CWA) (IDEQ 2001). Sheep Creek occurs within the project area and is tributary to Lanes Creek, which is tributary to the Blackfoot River. Angus Creek is within the cumulative effects area and receives water from No Name Creek before it discharges into the Blackfoot River below Lanes Creek. Section 303(d) of the CWA requires states to identify waterbodies that do not meet water quality standards for the designated beneficial use. Designated beneficial uses for streams in the project area and the cumulative effects area are summarized in Table 3.3-1. In addition, states are required to establish Total Maximum Daily Loads (TMDLs) for pollutants to meet water quality standards for the designated use.

TABLE 3.3-1
DESIGNATED BENEFICIAL USES AND 303(D) LISTINGS FOR STREAMS IN THE CUMULATIVE EFFECTS AREA

Waterbody	303(d) Listed Segment		303(d) Listed Pollutants	Designated Beneficial Uses									
	Lower	Upper		Cold Water Biota	Warm Water Biota	Salmonid Spawning	Primary Recreation	Secondary Recreation	Domestic	Agricultural	Industrial	Wildlife Habitat	Aesthetics
Angus Creek	Blackfoot River	Headwaters	Sediment	Y		Y	Y			Y	Y	Y	Y
Blackfoot River	Blackfoot Reservoir	Headwaters	Sediment Nutrients	Y		Y	Y	Y	Y	Y	Y	Y	Y
Lanes Creek	Blackfoot River	Headwater	Sediment	Y		Y					Y	Y	Y
Little Blackfoot River	None	None	None										
No Name Creek	None	None	None										
Reese Canyon Creek	None	None	None										
Sheep Creek	Lanes Creek	Headwater	Sediment	Y		Y				Y	Y	Y	Y

Sources: IDAPA 58.01.02 and Blackfoot River TMDL Waterbody Assessment and Total Maximum Daily Load (IDEQ 2001)

No Name Creek

No Name Creek is a small, intermittent stream that flows south through a narrow fault block canyon and enters Angus Creek west of Rasmussen Ridge, above its confluence with the Blackfoot River. The flow in No Name Creek is charged primarily by precipitation and snowmelt. No Name Creek originates near the headwaters of Sheep Creek east of the existing mine and drains the immediate area of the mine. No Name Creek is an undesignated surface water body and, as such, cold water aquatic life and primary or secondary contact recreation criteria apply (IDAPA 58.01.02.101.01.a).

Flow in the West Fork of No Name Creek is currently diverted through a channel to provide continuous drainage during existing mine operations. The main stem of No Name Creek is not affected by this diversion. Overall, the No Name Creek drainage appear to lose flow; although there is evidence for minor discharge related to seeps and springs in the upper reaches (Maxim 2001a).

Upstream of the Central Rasmussen Mine, C3/C4 channel types are prevalent (channel descriptions and definitions are presented in **Table 3.3-2**). Stream gradients are relatively shallow, about 3 percent, and stream widths range between 3 and 6 feet. Below the mine, channels in No Name Creek can be generally characterized as A3/A4. The floodplain broadens as the stream exits the canyon, and B3 channel types are evident (Maxim 2001a). E4 channel types predominate above the confluence with Angus Creek.

Sheep Creek

Sheep Creek is an intermittent stream in its upper reaches, and perennial in its lower reaches, with flows maintained by springs and seeps and augmented with precipitation and snowmelt. Designated beneficial uses include cold water biota, salmonid spawning, agricultural and industrial water supply, wildlife habitat, and aesthetics. From its confluence with Lanes Creek to its headwaters, Sheep Creek is a 303(d) water quality limited stream listed for sediment. Beneficial uses affected are cold water aquatic life and salmonid spawning, with livestock grazing a likely source of pollutants (IDEQ 2001).

Sheep Creek meanders through the length of the drainage and flows southeasterly to its confluence with Lanes Creek. Numerous small beaver dams are located throughout the drainage, as well as short stretches of riffles, runs, and pools. Tributaries that drain the upland areas of Sheep Creek are confined or incised drainages, with some having perennial flow. Generally, streams within the Sheep Creek drainage appear to be gaining flow, although sediment traps and beaver dams alter flow locally (Maxim 2001a).

The upper portion of the West Fork of Sheep Creek is predominantly C4 channel type. Stream gradient is about 2 percent. The lower portion of the West Fork of Sheep Creek is characterized by B3/B4 channel types. Stream gradient is about 4 percent, and the channel is narrow and incised. The main stem of Sheep Creek is predominantly B4 channel type at the headwaters, with stream gradient of about 3 percent and channels widths from 3 to 6 feet. The lower reaches of the main stem exist within a broad, unconfined valley characterized by E4 channel types (Maxim 2001a). Stream gradient is lower, about 2 to 3 percent, and channels are much wider, about 10 to 20 feet.

Reese Canyon Creek

Reese Canyon Creek is an intermittent stream that flows northwesterly 1.8 miles to its confluence with the Little Blackfoot River. Reese Canyon Creek is an undesignated surface water body and, as such, cold water aquatic life and primary or secondary contact recreation criteria apply (IDAPA 58.01.02.101.01.a).

TABLE 3.3-2
CHANNEL DESCRIPTIONS

Stream Type	General Description	Entrenchment Ratio	W/D Ratio	Sinuosity	Slope	Landform/ Soils/Features
Aa+	Very steep, deeply entrenched, debris transport, torrent streams.	<1.4	< 12	1.0 to 1.1	> .10	Very high relief. Erosional, bedrock or depositional features; debris flow potential. Deeply entrenched streams. Vertical steps with deep scour pools; waterfalls.
A	Steep, entrenched, cascading, step/pool streams. High energy/debris transport associated with depositional soils. Very stable if bedrock or boulder dominated channel.	< 1.4	< 12	1.0 to 1.2	.04 to .10	High relief. Erosional or depositional and bedrock forms. Entrenched and confined streams with cascading reaches. Frequently spaced, deep pools in associated step/pool bed morphology.
B	Moderately entrenched, moderate gradient, riffle dominated channel, with infrequently spaced pools. Very stable plan and profile. Stable banks.	1.4 to 2.2	> 12	> 1.2	0.2 to 0.39	Moderate relief, colluvial deposition, and/or structural. Moderate entrenchment and width/depth ratio. Narrow, gently sloping valleys. Rapids predominate w/scour pools.
C	Low gradient, meandering, point-bar, riffle/pool, alluvial channels with broad, well defined floodplains.	> 2.2	> 12	> 1.4	< 0.2	Broad valleys w/terraces, in association with floodplains, alluvial soils. Slightly entrenched with well-defined meandering channels. Riffle/pool bed morphology.
D	Braided channel with longitudinal and transverse bars. Very wide channel with eroding banks.	n/a	> 40	n/a	< 0.4	Broad valleys with alluvium, steeper fans. Glacial debris and depositional features. Active lateral adjustment, w/abundance of sediment supply. Convergence/divergence bed features, aggradational processes, high bedload and bank erosion.
DA	Anastomosing (multiple channels) narrow and deep with extensive, well vegetated floodplains and associated wetlands. Very gentle relief with highly variable sinuosities and W/D ratios. Very stable streambanks.	> 2.2	Highly variable	Highly variable	< .005	Broad, low-gradient valleys with fine alluvium and/or lacrustine soils. Anastomosed (multiple channel) geologic control creating fine deposition w/well-vegetated bars that are laterally stable with broad wetland floodplains. Very low bedload, high wash load sediment.

TABLE 3.3-2 (CONT.)
CHANNEL DESCRIPTIONS

E	Low gradient, meandering riffle/pool stream with low W/D ratio and little deposition. Very efficient and stable. High meander/width ratio.	> 2.2	< 12	> 1.4	< .02	Broad valley/meadows. Alluvial materials with floodplains. Highly sinuous with stable, well-vegetated banks. Riffle/pool morphology with very low W/D ratios.
F	Entrenched meandering riffle/pool channel on low gradients with high W/D ratio.	< 1.4	> 12	> 1.4	< 0.2	Entrenched in highly weathered material. Gentle gradients, with a high width/depth ratio. Meandering, laterally unstable with high bank erosion rates.
G	Entrenched "gully" step/pool and low W/D ratio on moderate gradients.	< 1.4	< 12	> 1.2	.02 to .039	Gullies, step/pool morphology w/moderate slopes and low W/D ratio. Narrow valleys, or deeply incised in alluvial or colluvial materials, i.e., fans or deltas. Unstable, with grade control problems and high bank erosion rates.

Notes: C3: C stream type with 3 substrate class.
Substrates = 1 - bedrock, 2 - boulder, 3 - cobble, 4 - gravel, 5 - sand, 6 - silt/clay
Source: Rosgen 1996.

Stream gradients in channels in Reese Canyon Creek range from 10 percent and up in the headwaters, to 3 to 5 percent near the confluence with the Little Blackfoot River (Maxim 2001a). Reese Canyon Creek is a confined system with no major tributaries. The channel follows the high-gradient, confined walls of Reese Canyon. Flow is fed by several perennial seeps and small springs along its length. The channel is dry in most reaches by late summer. Overall, Reese Canyon Creek appears to be gaining flow, though groundwater influence and beaver dams alter flow locally (Maxim 2001a).

The channels in the upper reaches of Reese Canyon are characterized as A4 stream types because of the higher stream gradient, whereas the middle reaches are C4 stream types. The lower reaches of Reese Canyon are also best characterized by C4 stream types, although the gradients are slightly steeper than are typical of C4 stream types and are more entrenched (Maxim 2001a).

Lanes Creek

Lanes Creek is a perennial stream located 5 miles southeast the project area that receives flow from Sheep Creek. Below its confluence with Sheep Creek, Lanes Creek meanders south about 0.8 miles, where it becomes the headwater of the Blackfoot River. Designated beneficial uses of Lanes Creek include cold water biota, salmonid spawning, industrial water supply, wildlife habitat, and aesthetics.

Lanes Creek is a 303(d) water quality limited stream listed for sediment. Beneficial uses affected are cold water aquatic life and salmonid spawning, with livestock grazing a likely pollutant source (IDEQ 2001).

Angus Creek

Angus Creek is a perennial stream located 2 miles south of the project area that receives water from No Name Creek and drains Rasmussen Valley. Below its confluence with No Name Creek, Angus Creek flows southeast 2.7 miles to its confluence with the Blackfoot River. Designated beneficial uses of Angus Creek include cold water biota, salmonid spawning, secondary contact recreation, agricultural and industrial water supply, wildlife habitat, and aesthetics.

Angus Creek is a 303(d) water quality limited stream listed for sediment. Beneficial uses affected are cold water aquatic life and salmonid spawning, with livestock grazing a likely pollutant source (IDEQ 2001).

Little Blackfoot River

The Little Blackfoot River is a perennial stream located 1.5 miles northwest of the project area that receives water from Reese Canyon Creek. Below its confluence with Reese Canyon Creek, the Little Blackfoot River flows southwest 5 miles, where it discharges into the Blackfoot Reservoir. The Little Blackfoot River is a undesignated surface water body and, as such, criteria for cold water aquatic life and primary or secondary contact recreation apply (IDAPA 58.01.02.101.01.a).

Blackfoot River

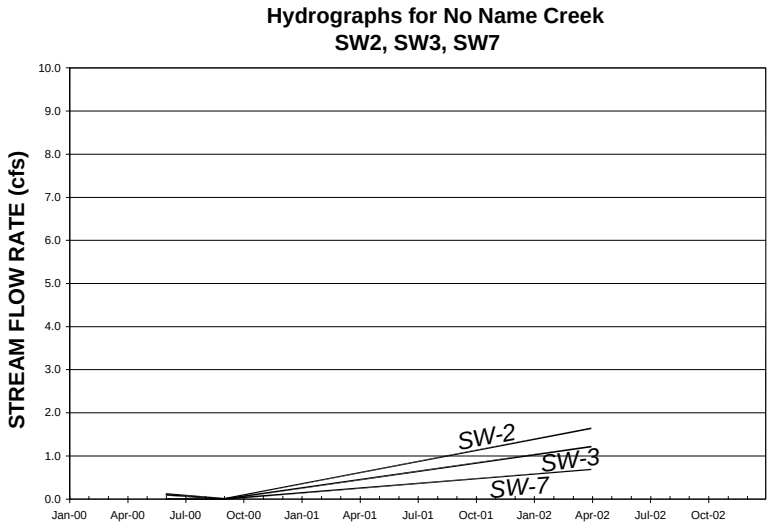
Blackfoot Reservoir impounds the Blackfoot River downstream from the project area. Principal streams in the Blackfoot River basin include Lanes Creek, Diamond Creek, Angus Creek, Dry Valley Creek, Slug Creek, and Trail Creek. The Little Blackfoot River enters the Blackfoot Reservoir at Henry, Idaho, 8 miles downstream of the confluence with Reese Canyon.

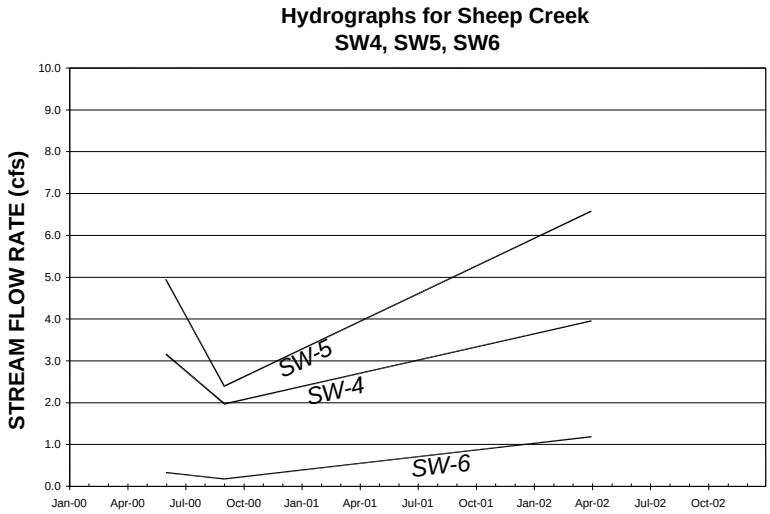
There are no permanent stream gauging stations located in the project area. Data on mean annual flow from gauging stations downstream have been compiled to represent regional perennial flow downstream of the project area. These data are summarized in **Table 3.3-3**. Streamflow hydrographs are presented in **Figure 3.3-2a** and **b**.

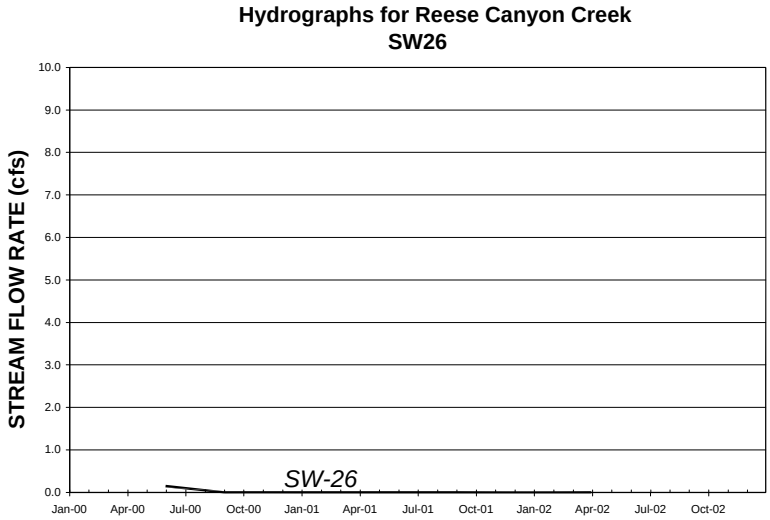
TABLE 3.3-3
ANNUAL STREAM FLOW STATISTICS IN THE BLACKFOOT RIVER BASIN

Station	Station Description	Period of Record	Mean (cfs)	Min (cfs)	Max (cfs)
13062700	Angus Creek above No Name Creek	1962-1981	n/a	n/a	1,060
13063500	Little Blackfoot River at Henry, ID	1914-1925	19	4.3	292
13063000	Blackfoot River above reservoir near Henry, ID	1915-1926; 1968-1982 2001-2002	186.6	20.5	2,150

Notes: cfs = cubic feet per second
n/a = not available
Source: USGS 2002.







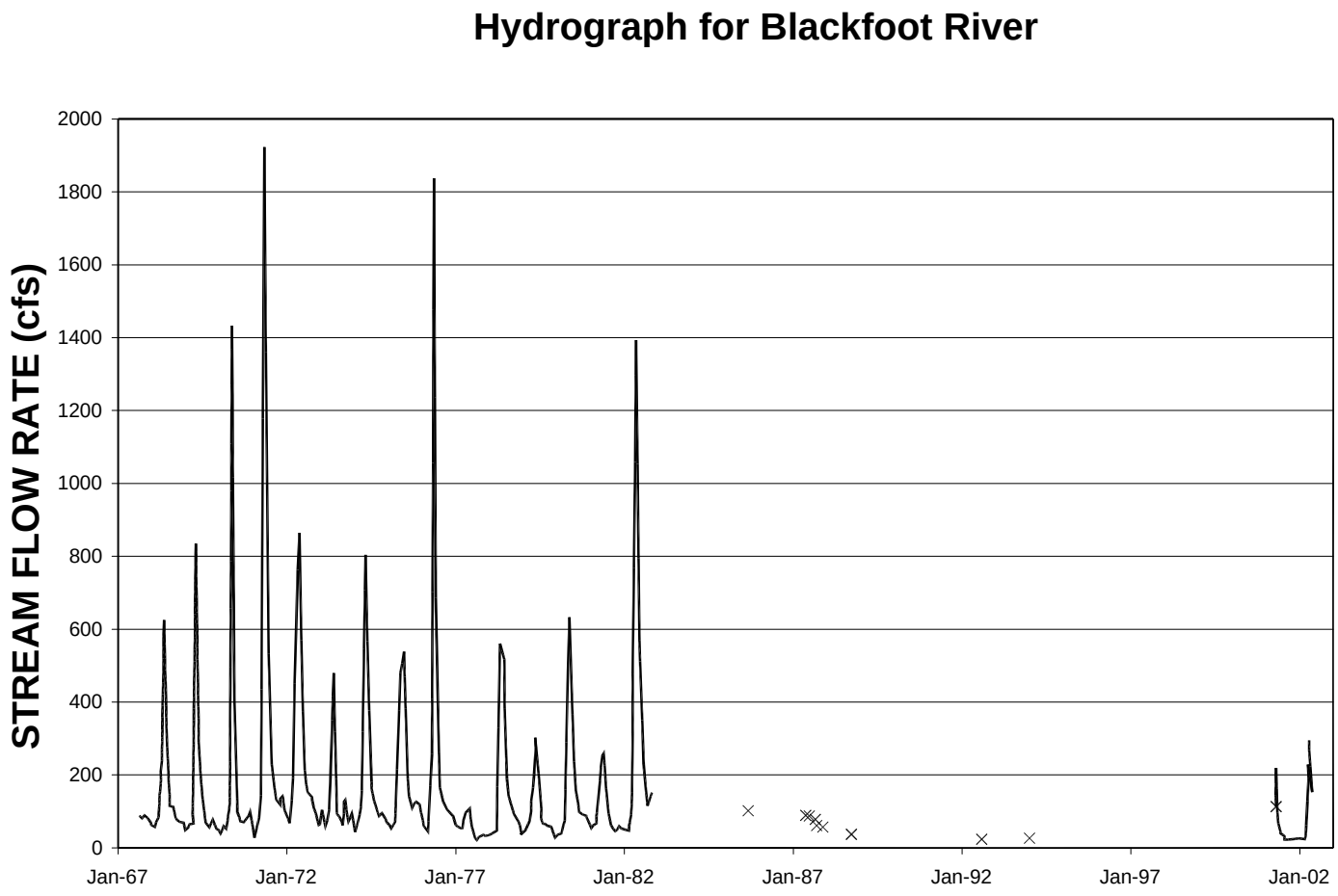
North Rasmussen Ridge Mine EIS Project

FIGURE 3.3-2a
HYDROGRAPHS FOR NO NAME, SHEEP AND REESE CANYON CREEKS

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 Hydro.dwg
Scale: NTS	Drawn By: MTM

Source: Whetstone 2002



× × × × Limited data available for water years 1983 - 2000

Source: Whetstone 2002

North Rasmussen Ridge Mine EIS Project	
FIGURE 3.3-2b HYDROGRAPH FOR BLACKFOOT RIVER	
ANALYSIS AREA: Caribou County, Idaho	
Date: 02.27.03	Drawing File: 1164 Hydro.dwg
Scale: NTS	Drawn By: MTM

Flow dynamics in the Blackfoot River basin indicate that base flow conditions occur during the winter. Spring snowmelt increases flow beginning in April, and peak flow is generally reached by the end of April. Peak flow conditions can be delayed in drier years. Peak flow generally occurs through the end of May.

Peak flow at the USGS gauging station on the Blackfoot River above Blackfoot Reservoir (13063000) have ranged between approximately 500 cfs and 2,100 cfs for the period of record 1915 through 1926, and 1968 through 1982 (Maxim 2002e). No data on peak flow are available for 1982 to 2000. The USGS defines peak flow as the annual maximum instantaneous peak stream flow. Peak flow along Angus Creek recorded at the USGS gauging station (13062700) for the period of record 1962 through 1981 ranged between 100 cfs and 1,100 cfs (Maxim 2002e). Data on continuous flow for most of the tributaries to the Blackfoot River is limited; however, flow dynamics described above are believed to be representative of flow conditions in those tributaries.

Information on baseline flow for streams near the project area was collected in 2000 and 2002. This information is summarized in **Table 3.3-4**. The monitoring entailed high- and low-flow sampling events conducted in June and September. Stream flows near the project area are minimal relative to base flow in the Blackfoot River basin downstream (Maxim 2001a).

TABLE 3.3-4
MEASURED STREAM FLOW

Site Location	Site Identification	Stream Flow Measurement (cfs)		
		June 2000	September 2000	April/June 2002
No Name Creek below mine	SW-2	0.12	Dry	1.64
No Name Creek just upstream of Angus Creek	SW-3	Dry	Dry	1.25
Sheep Creek East of office/shop	SW-4	3.16	1.98	3.96
Sheep Creek below confluence with West Fork of Sheep Creek	SW-5	4.95	2.40	6.58
West Fork of Sheep Creek just above Sheep Creek	SW-6	0.33	0.18	1.19
No Name Creek above existing mine disturbance	SW-7	0.10	Trickle	0.69
Reese Creek at first beaver dam	SW-26	0.15	Trickle	Trickle

Note: cfs = cubic feet per second
Source: Maxim 2002b

Flood flow estimates were derived for each drainage in the vicinity of the project area using the basin characteristics methodology outlined by Lowham (1988) for mountainous regions subject to snowmelt runoff. This information is summarized in **Table 3.3-5**.

TABLE 3.3-5
FLOOD FLOW ESTIMATES

Drainage	Contributing Drainage Area (mi^2)	25-Year Event (cfs)	50-Year Event (cfs)	100-Year Event (cfs)
No Name Creek	2.3	68	84	103
Sheep Creek	9.8	210	260	313
Reese Canyon	0.7	28	34	43

Notes: mi^2 = square mile
cfs = cubic feet per second
Source: Calculated using method of Lowham (1988) and basin elevation, drainage area, and precipitation from project records

3.3.2 Surface Water Quality

Water quality standards for surface water are contained in IDAPA 58.01.02. According to IDAPA 58.01.02, streams and lakes are classified by designated beneficial use. Designated beneficial use may include: cold or warm water biota; salmonid spawning; primary or secondary contact recreation; domestic, agricultural, or industrial water supply; wildlife habitat; or aesthetics. If more than one beneficial use is designated for a waterbody, the most stringent standard is applied. Criteria for cold water biota and primary or secondary contact recreational are applicable for undesignated waterbodies. All water bodies within the project area are either undesignated (No Name Creek and Reese Canyon Creek) or designated for cold water biota; salmonid spawning; agricultural water supply; industrial water supply; wildlife habitat; and aesthetics (Sheep Creek). Streams within the project area are not designated as domestic water supplies and domestic water quality standards are not applicable (**Table 3.3-1**). Water quality criteria specified in IDAPA 58.01.02 are not applicable to mine facilities such as sedimentation ponds and pit impoundments.

The water quality standards for cold water biota are typically the most stringent and are applicable to all streams and rivers in the project and cumulative effects areas (**Table 3.3-6**). Aquatic criteria are divided into two categories based on the duration of exposure. The Criteria Maximum Concentration (CMC) is the highest concentration that aquatic life can be exposed to for a 1-hour period without deleterious effects. The Criteria Continuous Concentration (CCC) is the highest concentration that aquatic life can be exposed to for an extended period of time (4 days).

Surface water quality standards for metals are based on dissolved concentrations, with the exception of the criterion for selenium, which is based on the total recoverable concentration. Cold water biota standards for cadmium, copper, lead, nickel, and zinc depend on hardness and are calculated according to the following equations:

$$CMC = WER \cdot e^{m_A \cdot \ln(H) + b_A} \cdot K_A$$
$$CCC = WER \cdot e^{m_C \cdot \ln(H) + b_C} \cdot K_C$$

where: WER= Water effect ratio
m_A = Metal-specific constant for acute toxicity
m_C = Metal-specific constant for chronic toxicity
H = Hardness (mg/L as $CaCO_3$)
b_A = Metal-specific constant for acute toxicity
b_C = Metal-specific constant for chronic toxicity
K = Freshwater conversion factor

Examples of aquatic standards calculated using hardness of 100, 225, and 400 mg/L $CaCO_3$ and a Water Effect Ratio of 1.0 are provided in **Table 3.3-6**, along with other applicable standards.

Water quality was monitored at seven surface water stations within the monitoring area (**Figure 3.3-3**) during three sampling events (June 2000, September 2000, and April 2002) to establish baseline water quality (Maxim 2002b). In addition, samples of surface water were collected from 26 sampling stations in 1999 and analyzed for a limited suite of metals (cadmium, manganese, nickel, selenium, vanadium, and zinc). The seven baseline stations and 26 previous sampling locations are shown in **Table 3.3-7**. Data on surface water quality are provided in **Table 3.3-8**.

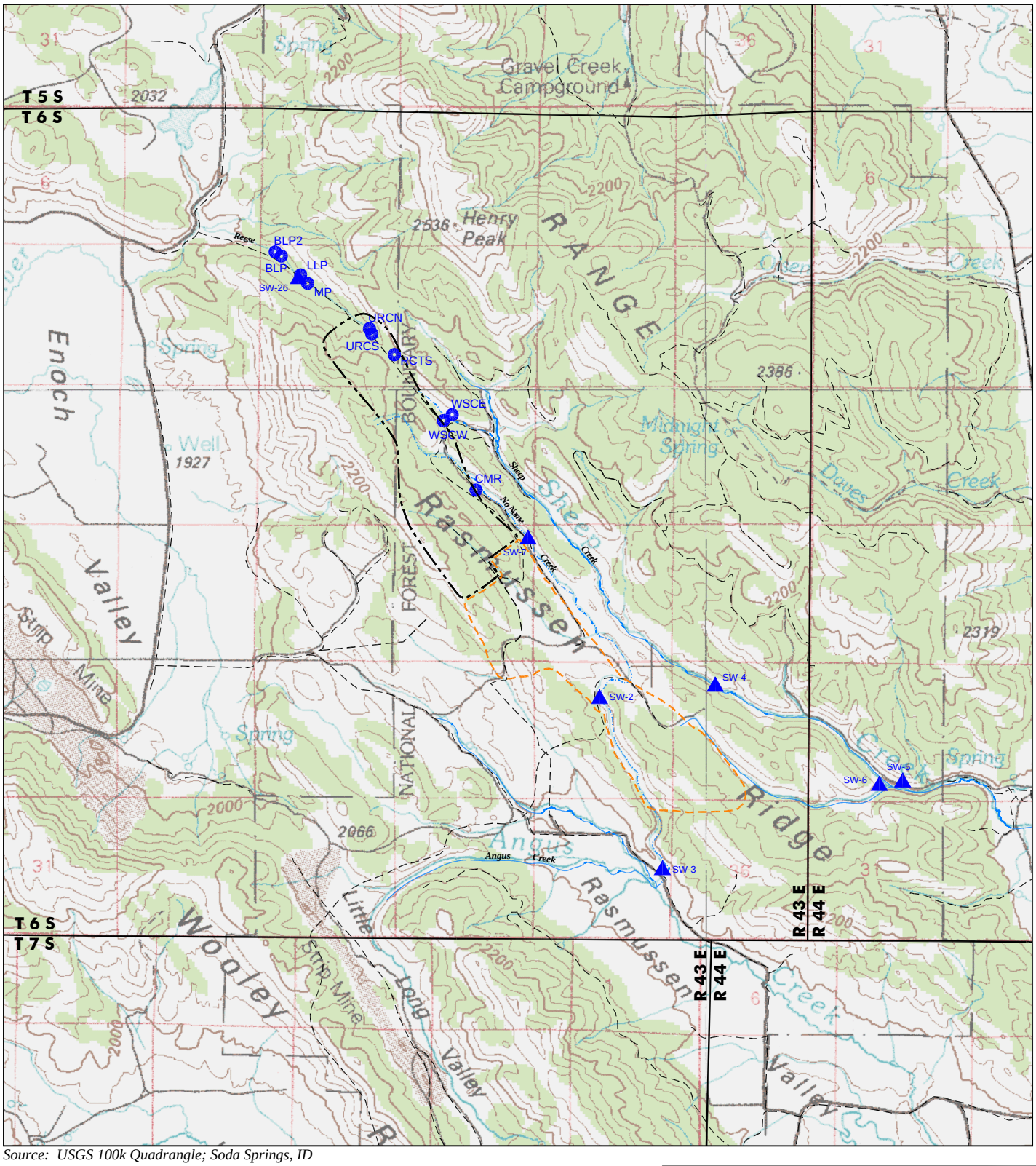
Background surface water is of near-neutral pH (6.22 to 7.84) with moderate concentrations of total dissolved solids (20 to 382 mg/L). The headwaters of No Name Creek are a calcium-bicarbonate type water, changing to a sodium-sulfate type water near the confluence with Angus Creek. Water in the West Fork of Sheep Creek is a sodium-sulfate type water, converting to a calcium-bicarbonate type water in the main stem of Sheep Creek. Water in Reese Canyon Creek is highly buffered, calcium-bicarbonate type water.

Surface waters contain few detectable dissolved metals. However, samples from stations SW-2, SW-3, and SW-6 contained total recoverable selenium in excess of applicable standards for cold water biota (**Table 3.3-8**).

TABLE 3.3-6
APPLICABLE WATER QUALITY STANDARDS FOR SURFACE WATER

Water Quality Standard	Cold Water Biota based on 100 mg/L total hardness		Cold Water Biota based on 225 mg/L total hardness		Cold Water Biota based on 400 mg/L total hardness		Recreation Use
Parameter	CMC	CCC	CMC	CCC	CMC	CCC	
Calcium (mg/L)	---	---	---	---	---	---	---
Chloride (mg/L)	---	---	---	---	---	---	---
Fluoride (mg/L)	---	---	---	---	---	---	---
Nitrogen, nitrate (mg/L)	---	---	---	---	---	---	---
Phosphorus, total (mg/L)	---	---	---	---	---	---	---
Potassium (mg/L)	---	---	---	---	---	---	---
Sodium (mg/L)	---	---	---	---	---	---	---
Sulfate (mg/L)	---	---	---	---	---	---	---
TDS (mg/L)	---	---	---	---	---	---	---
TSS (mg/L)	---	---	---	---	---	---	---
Elec. Cond. (µmhos/cm)	---	---	---	---	---	---	---
Aluminum (mg/L)	---	---	---	---	---	---	---
Antimony (mg/L)	---	---	---	---	---	---	4.3
Arsenic (mg/L)	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Barium (mg/L)	---	---	---	---	---	---	---
Cadmium (mg/L)	0.004	0.001	0.009	0.002	0.017	0.003	---
Chromium III (mg/L)	0.549	0.178	1.054	0.342	1.708	0.554	---
Copper (mg/L)	0.017	0.011	0.036	0.022	0.063	0.037	---
Iron (mg/L)	---	---	---	---	---	---	---
Lead (mg/L)	0.065	0.003	0.152	0.006	0.281	0.011	---
Magnesium (mg/L)	---	---	---	---	---	---	---
Manganese (mg/L)	---	---	---	---	---	---	---
Mercury (mg/L)	0.0021	0.000012	0.0021	0.000012	0.0021	0.000012	0.00015
Molybdenum (mg/L)	---	---	---	---	---	---	---
Nickel (mg/L)	1.415	0.157	2.779	0.309	4.573	0.508	4.6
Selenium (mg/L)	0.02	0.005	0.02	0.005	0.02	0.005	
Thallium (mg/L)	---	---	---	---	---	---	0.0063
Vanadium (mg/L)	---	---	---	---	---	---	---
Zinc (mg/L)	0.114	0.105	0.225	0.205	0.37	0.338	---
Alkalinity (mg CaCO3/l)	---	---	---	---	---	---	---
Bicarbonate (mg CaCO3/l)	---	---	---	---	---	---	---
Hardness (mg CaCO3/l)	---	---	---	---	---	---	---
pH	6.6 - 9.5						---
Dissolved Oxygen (mg/L)	>6 at all times						---
Temperature (°C)	≤22 (daily average ≤19)						---
Turbidity (NTU)	≤ 50 (10 day consecutive ≤25)						---
Nitrogen, ammonia (mg/L)	0.43/A/B/2						---

Notes: Standards from IDAPA 58.01.02
--- indicates no established standard
Cold water biota values in this table are calculated using a water effect ratio (WER) of 1.0
Numeric criteria for ammonia is 0.43/A/B/2, where A=1 if T≤20 °C, $A=10^{0.03(20-T)}$ if T<20 C, B = 1 if pH≥8, $B=(1+10^{7.4-pH})/1.25$ if pH<8
mg/L = milligrams per liter
µmhos/cm = microohmos per centimeter
NTU = Nephelometric turbidity units
Drinking water standards are not included in the table as there are no domestic wells within 2 miles.



Source: USGS 100k Quadrangle; Soda Springs, ID

LEGEND

- *Forest Road*
- *Study Area*
- *Approved Central and South Rasmussen Ridge Area*
- NAME *Spring / Seep Location*
- NAME *Surface Water Sample Location*

NORTH

0 1 2

Scale (miles)

Source: Maxim 2001a

North Rasmussen Ridge Mine EIS Project

FIGURE 3.3-3
SURFACE WATER MONITORING, SPRING, AND SEEP LOCATIONS

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 Base.dwg
Scale: As Noted	Drawn By: MTM

TABLE 3.3-7
SURFACE WATER MONITORING STATIONS

Station ID	Location Description
Baseline Surface Water Monitoring Stations	
SW-7	No Name Above Mining
SW-2	No Name Below Mining
SW-3	No Name Creek Before Angus
SW-4	Sheep Creek East Office/Shop
SW-5	Sheep Creek Below West Fork
SW-6	West Fork Dump Drainage
SW-26	1st Beaver Dam-Reese Canyon
Additional Surface Water Sampling Stations (1999)	
1	No Name Above Mining (same as SW-7)
2	No Name Below Mining (same as SW-2)
3	No Name Creek Before Angus (same as SW-3)
4	Sheep Creek East Office/Shop (same as SW-4)
5	Sheep Creek Below West Fork (same as SW-5)
6	West Fork Dump Drainage (same as SW-6)
7	South Pond Toe South Rasmussen Dump
8	Middle Pond Toe South Rasmussen Dump
9	North Pond Toe South Rasmussen Dump
10	Wetlands - SE Shop/Office
11	Spring & Pond S. Shop/Office
12	Rasmussen Creek Above Haulroad
13	Rasmussen Creek Below Haulroad
14	Rasmussen Creek Before Angus
15	Angus Creek Below No Name
16	Road Pond #1
17	Road Pond #2
18	Road Pond #3
19	Road Pond #4
20	Road Pond #5
21	Road Pond #6
22	Pond West of Central Haulroad
23	Angus Creek Above Rasmussen Creek
24	Spring into No Name Creek
26	1st Beaver Dam-Reese Canyon (same as SW-26)
27	2nd Beaver Dam-Reese Canyon

TABLE 3.3-8
SURFACE WATER QUALITY

Stream		No Name Creek						West Fork Sheep Creek			Surface Water Standards		
Location		SW-7	SW-7	SW-7	SW-2	SW-2	SW-3	SW-6	SW-6	SW-6	Cold Water Biota	Domestic Supply	Recreational Use
Date		6/14/00	9/12/00	4/23/02	6/14/00	4/23/02	4/23/02	6/13/00	9/12/00	4/24/02			
General Parameters													
pH (field)	Std. Units	7.29	n.m.	6.7	7.3	6.78	6.7	7.4	7.27	6.22	---	---	---
pH (lab)	Std. Units	8.2	8.4	7.2	7.9	7.7	8.1	8.3	8.3	7.8	6.6-9.5	---	---
Temp. (field)	C	20.5	n.m.	3	17	7	13	10.5	5	1	≤22	---	---
Dissolved Oxygen	mg/L	7.3	n.m.	9.09	7.1	9.5	7.5	7.99	9.4	10.1	>6	---	---
Total Alkalinity	mg/l $CaCO_3$	136	193	34	141	45	45	152	189	63	---	---	---
Bicarbonate Alkalinity	mg/l HCO_3	166	236	41	172	55	55	186	231	77	---	---	---
Carbonate Alkalinity	mg/l CO_3	0	0		0			0	0		---	---	---
Hydroxide	mg/l	0			0			0			---	---	---
Acidity	mg/l $CaCO_3$	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.	---	---	---
E.C. (field)	umhos/cm			45	474	450	442	563	288	472.2	---	---	---
E.C. (lab)	umhos/cm	239	357	88	467	486	492	536	389	530	---	---	---
TDS	mg/l	137. JFB	213	96	317. JFB	326	341	382. JFB	240. B	20	---	---	---
TSS	mg/l	14	<1.	<3.	6	<2.	8	3	<1.	7	---	---	---
SAR	--	0.11 B	0.12	0.14	0.26 B	0.2	0.2	0.13 B	0.15	0.16	---	---	---
Hardness	mg/l $CaCO_3$	130	199	38	228	229	232	276	215	276	---	---	---
Turbidity	NTU	8.9 JFB	0.2	17	1.9 JFB	3.3	11	1.9 JFB	0.3 JF	30	≤50	---	---
Major Ions													
Ca	mg/l	42	60	12	70	67	68	84	68	76	---	---	---
Cl	mg/l	2	3	<2.	25	18	20	2	3	5	---	---	---
F	mg/l	0.09	0.1	0.08	0.12	0.1	0.1	0.09	0.08	0.09	---	---	---
K	mg/l	<1.	<5.	<1.	1	1	1	<1.	<5.	1	---	---	---
Mg	mg/l	6	12	2	13	15	15	16	11	21	---	---	---
Na	mg/l	3	4	2	9	7	7	6	5	6	---	---	---
SO_4	mg/l	5	6	8	78	169	169	144	26	201	---	---	---
Nutrients													
$NO_3 + NO_2$	mg/l N	0.07	<0.05	<0.05	0.05	0.23	0.14	0.09	0.09 B	0.39	---	---	---
NO_3	mg/l N	0.07	<0.05	<0.05	0.05	0.23	0.14	0.09	0.09 B	0.39	---	---	---
NO_2	mg/l N	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	---	---	---
NH_4	mg/l N	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05		<0.05	0.43/A/B/2	---	---
PO_3	mg/l	0.14 JF	0.04	0.34	0.19 JF	0.13	0.16	0.08 JF	0.05	0.16	---	---	---
PO_3 Ortho	mg/l	0.1	0.03	0.11	0.14	0.04	0.09	0.05	0.04	0.06	---	---	---
Dissolved Metals													
Silver	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	---	---	---
Aluminum	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	---	---	---
Arsenic	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	0.05/0.05	0.05	0.05
Boron	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	---	---	---
Barium	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1	---	---	---
Beryllium	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	---	---	---
Cadmium	mg/l	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001		<0.0001	0.004/0.001	---	---
Chromium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.549/0.178	---	---
Copper	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		<0.01	0.017/0.011	---	---
Iron	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		<0.05	---	---	---
Mercury	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002		<0.0002	0.0021/0.000012	0.00014	0.00015
Manganese	mg/l	0.07	<0.02	<0.02	0.1	<0.02	<0.02	<0.02	<0.02	<0.02	---	---	---
Nickel	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		<0.02	1.415/0.157	0.61	4.6
Lead	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		<0.001	0.065/0.003	---	---
Antimony	mg/l	<0.001	<0.001	0.001	<0.001	0.001	<0.001	<0.001		<0.001	---	0.014	4.3
Selenium	mg/l	<0.001	<0.001	<0.001	0.002	0.027	0.027	0.003		0.014	---	---	---
Thallium	mg/l	<0.002	<0.0002	<0.002	<0.002	<0.002	<0.002	<0.002		<0.002	---	0.0017	0.0063
Vanadium	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		<0.005	---	---	---
Zinc	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		<0.02	0.114/0.105	---	---
Total Metals													
Silver	mg/l	<0.001	n/a	<0.001	<0.001	<0.001	<0.001J	<0.001	<0.001	<0.001	---	---	---
Aluminum	mg/l	0.8	n/a	2.6	<0.1	0.3	0.6	0.2	n/a	2.4	---	---	---
Arsenic	mg/l	0.001	n/a	<0.001	0.001	<0.001	0.001	0.001	<0.001	0.001	---	---	---
Boron	mg/l	<0.1	n/a	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	---	---	---
Barium	mg/l	<0.1	n/a	<0.1	<0.1	<0.1	<0.1	<0.01	<0.1	<0.1	---	---	---
Beryllium	mg/l	<0.001	n/a	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	---	---
Cadmium	mg/l	0.0002	n/a	<0.0001	0.0002	<0.0001	0.0002	0.0001	0.0001B	<0.0001	---	---	---
Chromium	mg/l	<0.01	n/a	<0.01	<0.01	<0.01	<0.01	<0.01	n/a	<0.01	---	---	---
Copper	mg/l	<0.01	n/a	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	---	---	---
Iron	mg/l	<0.05	n/a	1.4	0.18	0.2	0.44	0.14	<0.05	1.6	---	---	---
Mercury	mg/l	<0.0002	n/a	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	---	---	---
Manganese	mg/l	0.06	n/a	<0.02	0.25	<0.02	<0.02	<0.02	n/a	<0.02	---	---	---
Nickel	mg/l	<0.02	n/a	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	---	---	---
Lead	mg/l	0.012 B	n/a	<0.001	0.005 B	<0.001	<0.001	0.003 B	<0.001	<0.001	---	---	---
Antimony	mg/l	<0.001	n/a	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	---	---
Selenium	mg/l	<0.001	n/a	<0.001	0.002 JF	**0.032**	**0.033**	0.004 JF	<0.001	**0.017**	0.02/0.005	---	---
Thallium	mg/l	<0.002	n/a	<0.002	<0.002	<0.002	<0.002	<0.002	<0.0002	<0.002	---	---	---
Vanadium	mg/l	<0.005	n/a	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	---	---	---
Zinc	mg/l	0.02	n/a	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	---	---	---

Notes: Cold water biota values in this table are calculated using a hardness of 100 and water effect ratio (WER) of 1.0
< indicates parameter was not detected above the listed practical quantitation limit (PQL);
J = estimated concentration;
UJ = Reported PQL for sample is approximate
F = field duplicate results exceeded acceptable limits;
B = value between PQL and method detection limit (MDL);
Bolded values exceed applicable standards

TABLE 3.3-8 (CONT.)
SURFACE WATER QUALITY

Stream		Sheep Creek						Reese Canyon		Surface Water Standards		
Location		SW-4	SW-4	SW-4	SW-5	SW-5	SW-5	SW-26	SW-26	Cold Water Biota	Domestic Supply	Recreational Use
Date		6/14/00	9/12/00	4/23/02	6/13/00	9/12/00	4/24/02	6/14/00	6/13/02			
General Parameters												
pH (field)	Std. Units	7.28	7.66	6.69	7.84	7.25	6.91	6.84	6.9	---	---	---
pH (lab)	Std. Units	8.5	8.7	8.3	8.6	8.4	8.1	8.1	8.1	6.6-9.5	---	---
Temp. (field)	C	9.5	13	4	12	6	2	14	12.7	≤22	---	---
Dissolved Oxygen	mg/L	8.46	6.9	9.3	7.94	9	10.3	7.2	**4.36**	>6	---	---
Total Alkalinity	mg/l $CaCO_3$	184	173	144	173	193	122	168	142	---	---	---
Bicarbonate Alkalinity	mg/l HCO_3	225	191	176	211	236	149	205	173	---	---	---
Carbonate Alkalinity	mg/l CO_3	0	10		0	0		0	0	---	---	---
Hydroxide	mg/l	0			0			0	0	---	---	---
Acidity	mg/l $CaCO_3$	<2.	<2.	<2.	<2.	<2.	<2.		<2.	---	---	---
E.C. (field)	umhos/cm	475	348	234	366	403	282.4	524	350	---	---	---
E.C. (lab)	umhos/cm	326	317	297	330	357	346	290	316	---	---	---
TDS	mg/l	195. JFB	127. B	177	213. JFB	213. B	223	167. JFB	185	---	---	---
TSS	mg/l	3	3	5	5	<1.	12	10		---	---	---
SAR	--	0.1 B	0.1	0.11	0.1 B	0.12	0.13	0.14 B		---	---	---
Hardness	mg/l $CaCO_3$	184	183	153	183	199	180	154	190	---	---	---
Turbidity	NTU	2.4 JFB	0.5 JF	4.3	1.5 JFB	0.2 JF	13	4.5 JFB		≤50	---	---
Major Ions												
Ca	mg/l	57	55	48	55	60	54	50	58	---	---	---
Cl	mg/l	3	2	2	2	3	2	2	<4.	---	---	---
F	mg/l	0.09	0.08	0.07	0.09	0.1	0.09	0.1	0.13	---	---	---
K	mg/l	<1.	<5.	<1.	<1.	<5.	<1.	<1.	<1.	---	---	---
Mg	mg/l	10	11	8	11	12	11	7	11	---	---	---
Na	mg/l	3	3	3	3	4	4	4	5	---	---	---
SO_4	mg/l	8	6	8	20	6	53	7	14	---	---	---
Nutrients												
$NO_3 + NO_2$	mg/l N	0.09	<0.05	0.09	0.05	<0.05	0.22	<0.05	<0.05	---	---	---
NO_3	mg/l N	0.09	<0.05	0.09	0.05	<0.05	0.22	<0.05	<0.05	---	---	---
NO_2	mg/l N	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	---	---	---
NH_4	mg/l N	<0.05		0.09	<0.05		0.1	<0.05	<0.05	0.43/A/B/2	---	---
PO_3	mg/l	0.07 JF	0.05	0.12	0.08 JF	0.04	0.14	0.19 JF	0.06	---	---	---
PO_3 Ortho	mg/l	0.03	0.03	0.02	0.03	0.03	0.05	0.08	0.03	---	---	---
Dissolved Metals												
Silver	mg/l	<0.001		<0.001	<0.001		<0.001	<0.001	<0.001	---	---	---
Aluminum	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	---	---	---
Arsenic	mg/l	<0.001		<0.001	<0.001		<0.001	<0.001	0.002	0.05/0.05	0.05	0.05
Boron	mg/l	<0.1		<0.1	<0.1		<0.1	<0.1	<0.1	---	---	---
Barium	mg/l	<0.1		<0.1	<0.1		<0.1	<0.1	<0.03	---	---	---
Beryllium	mg/l	<0.001		<0.001	<0.001		<0.001	<0.001	<0.001	---	---	---
Cadmium	mg/l	<0.0001		<0.0001	<0.0001		<0.0001	<0.0001	<0.0001	0.004/0.001	---	---
Chromium	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.549/0.178	---	---
Copper	mg/l	<0.01		<0.01	<0.01		<0.01	<0.01	<0.01	0.017/0.011	---	---
Iron	mg/l	<0.05		<0.05	<0.05		<0.05	<0.05	<0.05	---	---	---
Mercury	mg/l	<0.0002		<0.0002	<0.0002		<0.0002	<0.0002	<0.0002	0.0021/0.000012	0.00014	0.00015
Manganese	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.08	<0.02	---	---	---
Nickel	mg/l	<0.02		<0.02	<0.02		<0.02	<0.02	<0.02	1.415/0.157	0.61	4.6
Lead	mg/l	<0.001		<0.001	<0.001		<0.001	<0.001	<0.001	0.065/0.003	---	---
Antimony	mg/l	<0.001		0.001	<0.001		<0.001	<0.001	<0.001	---	0.014	4.3
Selenium	mg/l	<0.001		<0.001	<0.001		0.003	<0.001	<0.001	---	---	---
Thallium	mg/l	<0.002		<0.002	<0.002		<0.002	<0.002	<0.002	---	0.0017	0.0063
Vanadium	mg/l	<0.005		<0.005	<0.005		<0.005	<0.005	<0.005	---	---	---
Zinc	mg/l	<0.02		<0.02	<0.02		<0.02	<0.02	<0.03	0.114/0.105	---	---
Total Metals												
Silver	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	---	---
Aluminum	mg/l	<0.1	n/a	0.3	<0.1	n/a	0.9	0.2	0.2	---	---	---
Arsenic	mg/l	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	0.012	---	---	---
Boron	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	---	---	---
Barium	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.03	---	---	---
Beryllium	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	---	---
Cadmium	mg/l	<0.0001	0.0001 B	<0.0001	<0.0001	0.0001 B	<0.0001	0.0002	0.0003	---	---	---
Chromium	mg/l	<0.01	n/a	<0.01	<0.01	n/a	<0.01	<0.01	<0.01	---	---	---
Copper	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	---	---	---
Iron	mg/l	0.1	<0.05	0.25	0.17	<0.05	0.71	0.51	0.73	---	---	---
Mercury	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0004	---	---	---
Manganese	mg/l	0.6	n/a	<0.02	<0.02	n/a	<0.02	0.13	0.02	---	---	---
Nickel	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	---	---	---
Lead	mg/l	0.002 B	<0.001	<0.001	0.004 B	<0.001	<0.001	0.005 B	<0.001	---	---	---
Antimony	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	---	---	---
Selenium	mg/l	0.001	<0.001	<0.001	0.001	<0.001	0.004	<0.001	<0.001	0.02/0.005	---	---
Thallium	mg/l	<0.002	<0.0002	<0.002	<0.002	<0.0002	<0.002	<0.002	<0.002	---	---	---
Vanadium	mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	---	---	---
Zinc	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	0.09	---	---	---

Notes: Cold water biota values in this table are calculated using a hardness of 100 and water effect ratio (WER) of 1.0
< indicates parameter was not detected above the listed practical quantitation limit (PQL);
J = estimated concentration;
UJ = Reported PQL for sample is approximate
F = field duplicate results exceeded acceptable limits;
B = value between PQL and method detection limit (MDL);
Bolded values exceed applicable standards

3.3.3 Surface Water Use

Water usage in the State of Idaho is administered by the Idaho Department of Water Resources (IDWR) through a system of water rights. A water right (or "appropriation") is the right to divert the public waters of the State of Idaho and put them to beneficial use.

Surface water rights listed with IDWR are listed in **Table 3.3-9** and are shown in **Figure 3.3-4**. The project is located in State Water District 27.

TABLE 3.3-9
SURFACE WATER RIGHTS IN THE VICINITY OF NORTH RASMUSSEN RIDGE MINE EXPANSION

Water Right Number	Owner Name	Point of Diversion	Source & Tributary	Diversion Rate (cfs)	Water Uses
27-4093	Rich Sheep Co, R C (Current)	T5S R43E Sec. 32 SWSE T6S R43E Sec. 05 NWSE	Unnamed Stream tributary to Little Blackfoot River	0.02	S
27-7159	U.S. Dept. of Agriculture	T6S R43E Sec. 22 SESE	Unnamed Stream tributary to Angus Creek	0.02	S, SFS, SS
27-7161	U.S. Dept. of Agriculture	T6S R43E Sec. 27 NESE	Unnamed Stream tributary to Angus Creek	0.02	S, SFS, SS
27-7162	U.S. Dept. of Agriculture	T6S R43E Sec. 26 NWSW	Unnamed Stream tributary to Angus Creek	0.02	S, SFS, SS
27-7163	U.S. Dept. of Agriculture	T6S R43E Sec. 35 SESE	Unnamed Stream tributary to Angus Creek	0.02	S, SFS, SS
27-7208	U.S. Dept. of Agriculture	T6S R43E Sec. 14 NWNW	Unnamed Stream tributary to Sheep Creek	0.02	S, SFS, SS
27-7210	U.S. Dept. of Agriculture	T6S R43E Sec. 11 SESE	Unnamed Stream tributary to Olsen Creek	0.02	S, SFS, SS
27-7214	U.S. Dept. of Agriculture	T6S R43E Sec. 23 SWNW	Unnamed Stream tributary to Angus Creek	0.02	S, SFS, SS
27-7215	U.S. Dept. of Agriculture	T6S R43E Sec. 25 SWNW	Unnamed Stream tributary to Sheep Creek	0.02	S, SFS, SS
27-7216	U.S. Dept. of Agriculture	T6S R43E Sec. 15 SESW	Unnamed Stream tributary to Angus Creek	0.02	S, SFS, SS
27-7374	Reese, E L	T6S R43E Sec. 05 SWSE	Unnamed Stream tributary to Little Blackfoot River	0.02	G
27-11385	Vassar Revocable Trust, Donna Lue	T6S R43E Sec. 35 SWSWNW T6S R43E Sec. 35 SENESE	Angus Creek tributary to Blackfoot River	0.05	S
27-11386	Vassar Revocable Trust, Donna Lue	T6S R43E Sec. 35 NESENE T6S R43E Sec. 35 NENESE	Unnamed Stream tributary to Angus Creek	0.02	S
27-11387	Vassar Revocable Trust, Donna Lue	T6S R43E Sec. 35 NENESE T6S R43E Sec. 35 SWNWSE	Unnamed Stream tributary to Angus Creek	0.05	S
27-11414	U.S. Dept. of Agriculture; USFS	T6S R43E Sec. 27 SENW	Unnamed Stream tributary to Sinks	0.02	S
27-11415	U.S. Dept. of Agriculture; USFS	T6S R43E Sec. 27 SWNW	Unnamed Stream tributary to Sinks	0.02	S
27-11416	U.S. Dept. of Agriculture; USFS	T6S R43E Sec. 27 NWSW	Unnamed Stream tributary to Sinks	0.02	S
27-11506	U.S. Dept. of Agriculture; USFS	T6S R43E Sec. 34 SENE	Angus Creek tributary to Blackfoot River	0.02	S
27-11509	U.S. Dept. of Agriculture; USFS	T6S R43E Sec. 15 SWNE T6S R44E Sec. 30 SESE	Sheep Creek tributary to Lanes Creek	0.02	S
27-11510	U.S. Dept. of Agriculture; USFS	T6S R43E Sec. 10 SENW T6S R43E Sec. 15 SWNE	Sheep Creek tributary to Lanes Creek	0.02	S
27-11549	U.S. Dept. of Agriculture; USFS	T6S R43E Sec. 25 SWSE	Unnamed Stream tributary to Sheep Creek	0.02	S
27-11550	U.S. Dept. of Agriculture; USFS	T6S R43E Sec. 25 NESW	Unnamed Stream tributary to Sheep Creek	0.02	S
27-11743	U.S. Dept. of Agriculture; USFS	T6S R43E Sec. 25 SWSE	Unnamed Stream tributary to Sheep Creek	0.02	S

TABLE 3.3-9 (CONT.)
SURFACE WATER RIGHTS IN THE VICINITY OF NORTH RASMUSSEN RIDGE MINE EXPANSION

27-11787	U.S. Dept. of Agriculture; USFS	T6S R43E Sec. 27 SESW	Unnamed Stream tributary to Sinks	0.02	S
27-11788	U.S. Dept. of Agriculture; USFS	T6S R43E Sec. 35 SESE	Unnamed Stream tributary to Sinks	0.02	S
27-11824	U.S. Dept. of Agriculture; USFS	T6S R43E Sec. 25 SWNW	Unnamed Stream tributary to Sheep Creek	0.02	S
27-11825	U.S. Dept. of Agriculture; USFS	T6S R43E Sec. 15 SESW	Unnamed Stream tributary to Angus Creek	0.02	S

Notes:
T = township, R = range, Sec = Section, N = North, E = east, S = south, W = west, cfs = cubic feet per second
The following sections are included in the water rights database search: T6S, R43E, Sections 3,4,5,8,9,10,11,13,14,15,16,17,21,22,23,25,26,27,28
Water use categories are: S = stockwater, SS = stockwater storage, SFS = stockwater from storage, G = irrigation

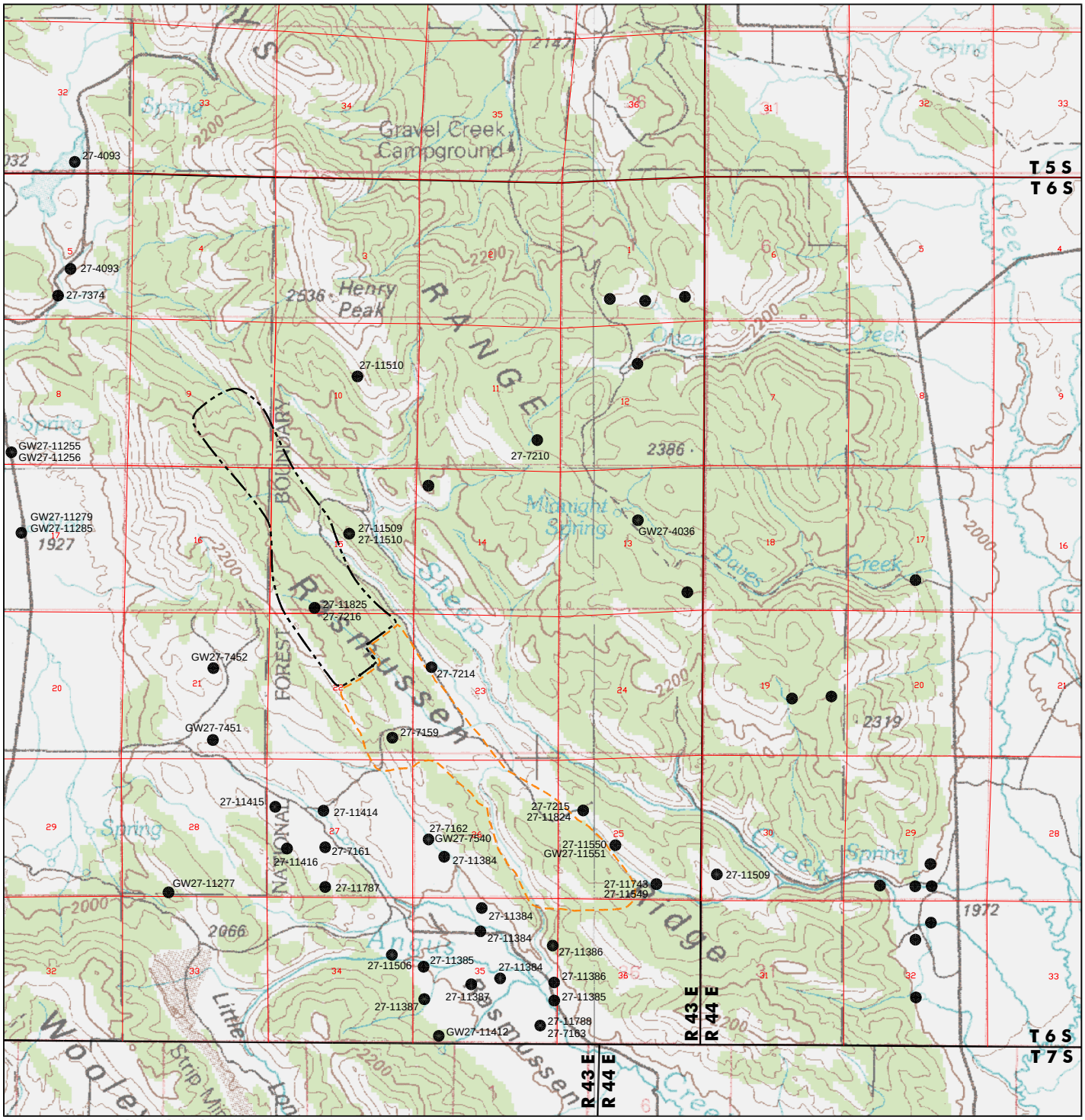
3.3.4 Groundwater Flow Systems

Groundwater flow at the proposed North Rasmussen Ridge Mine has been investigated through monitoring wells, exploration borings, and published hydrogeologic reports. The locations of monitoring wells and selected exploration borings are shown in **Figure 3.3-5**. Well completion data are listed in **Table 3.3-10**.

Three distinct groundwater systems occur at Rasmussen Ridge: an upper shallow groundwater system occurs in alluvium; a shallow local to intermediate groundwater system occurs in the Rex Chert and Upper Meade Peak Members of the Phosphoria Formation; and a deeper regional groundwater flow system occurs in the underlying Wells Formation. The intermediate groundwater system is typically under unconfined conditions and occurs at depths ranging from 100 to 170 feet. The regional groundwater system occurs at greater depths ranging from 300 to 500 feet in the vicinity of the mine.

3.3.4.1 Hydrostratigraphic Units

Major hydrostratigraphic units (in descending order) in the project area consist of alluvial deposits (associated with Sheep Creek, No Name Creek, and Reese Canyon Creek), the Thaynes Formation, the Dinwoody Formation, the Phosphoria Formation, and the Wells Formation. A number of studies have described the general hydrostratigraphy of the southeastern phosphate area. In general, these sources have concluded that the Wells, Dinwoody and Thaynes formations are aquifers, while the Meade Peak Member of the Phosphoria Formation is an aquitard (Ralston et al 1980; BLM and USFS 2002).



Source: USGS 100k Quadrangle; Soda Springs, ID
Source: Idaho Department of Water Resources On-line Water Rights Database

LEGEND

- *Study Area*
- *Approved Central and South Rasmussen Ridge Area*
- *Water Rights (27-=Surface) (GW=Groundwater)*

Note: See Tables 3.3-9 and 3.3-16 for water right information

NORTH

0 1 2

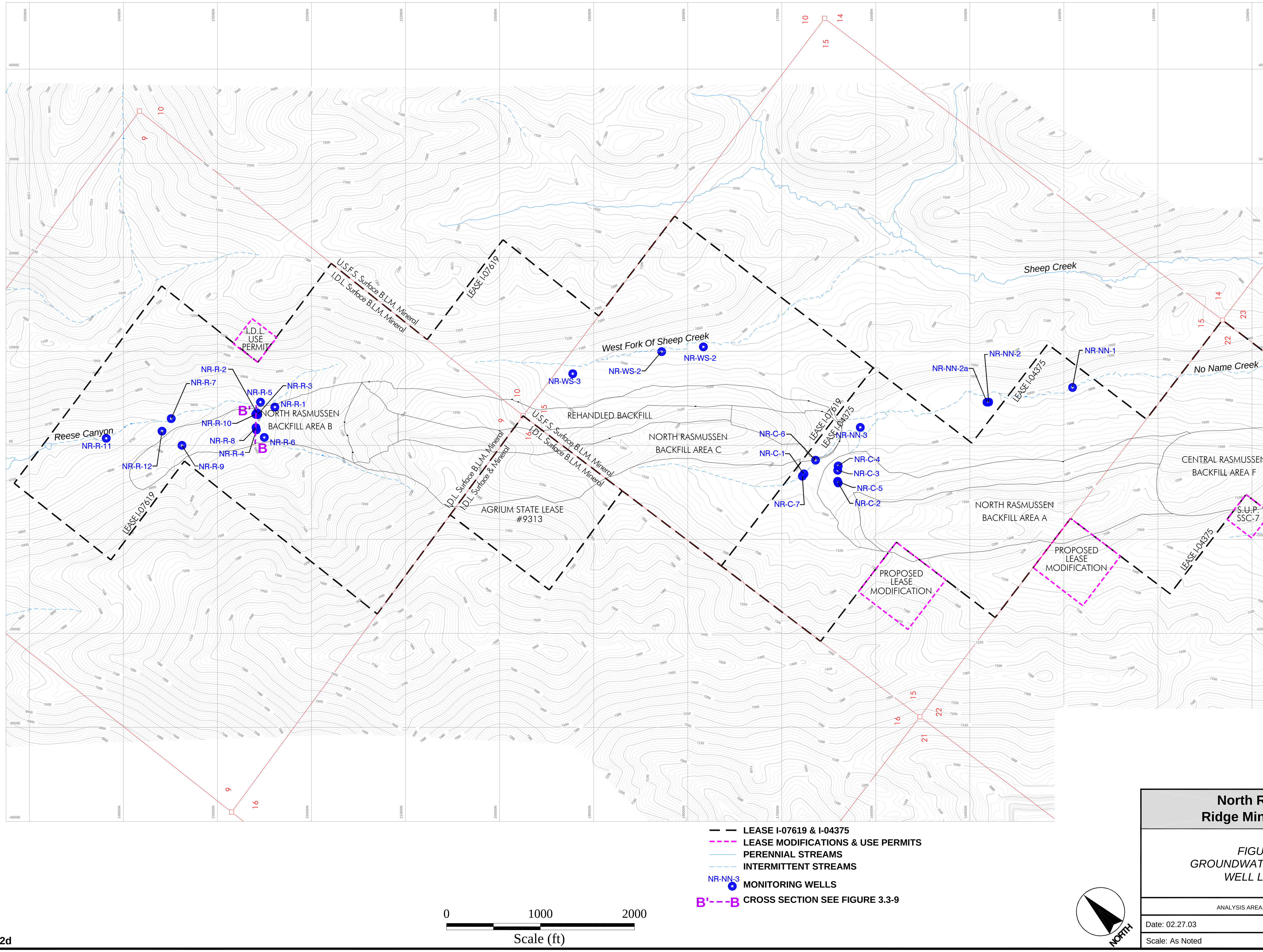
Scale in Miles

North Rasmussen Ridge Mine EIS Project

FIGURE 3.3-4
LOCATION OF SURFACE WATER RIGHTS AND GROUNDWATER RIGHTS

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 Base.dwg
Scale: As Noted	Drawn By: ETC



Source: Maxim 2002d

North Rasmussen Ridge Mine EIS Project

FIGURE 3.3-5
GROUNDWATER MONITORING WELL LOCATIONS

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 GW Map.dwg
Scale: As Noted	Drawn By: ETC

TABLE 3.3-10
MONITORING WELL LOCATION AND COMPLETION DATA

WELL ID	Geologic Unit	Location				Location Description	Date Completed	Screen Depth	Total Depth	Measuring Point Elevation	10/19/2001	
		T	R	S	1/4 1/4				(ft)	(feet amsl)	Depth to Water (ft)	Groundwater Elevation (feet amsl)
NR-C-1	Alluvium	6S	43E	15	NENWSW	Center Area, Upper No Name Creek	8/29/2001	55-65	69.2	7026.77	68.73	<6957.57
NR-NN-1	Alluvium	6S	43E	15	NESWSE	No Name Creek	8/29/2001	25.5-35.5	38.4	6936.11	18.56	6917.55
NR-NN-2	Alluvium	6S	43E	15	SWNWSE	No Name Creek	8/30/2001	21-31	31.1	6956.71	6.45	6950.26
NR-NN-2A	Alluvium	6S	43E	15	SWNWSE	No Name Creek	9/12/2001	8-18	20.4	6955.88	5.9	6949.98
NR-NN-3	Alluvium	6S	43E	15	NENESW	No Name Creek	8/30/2001	14.5-24.5	28.6	6995.54	22.3	6973.24
NR-R-1	Alluvium	6S	43E	9	NENWSE	Reese Canyon	8/30/2001	12-22	24.8	6873.28	24.41	<6848.48
NR-R-5	Alluvium	6S	43E	9	NENWSE	Reese Canyon	9/4/2001	15.5-25.5	28.3	6842.88	28.01	<6814.58
NR-R-6	Alluvium	6S	43E	9	NENWSE	Reese Canyon	8/31/2001	13-23	25.5	6847.72	25.11	<6822.22
NR-R-7	Alluvium	6S	43E	9	SWSWNE	Reese Canyon	9/4/2001	9-19	23.0	6762.83	21.16	6741.67
NR-R-11	Alluvium	6S	43E	9	NESENW	Reese Canyon	9/23/2001	12-22	24.9	6711.58	21.9	6689.68
NR-WS-1	Alluvium	6S	43E	15	SWNENW	West Sheep Creek drainage near delineated wetlands	9/5/2001	5-12	12.0	7019.02	8.3	7010.72
NR-WS-2	Alluvium	6S	43E	15	SWNENW	West Sheep Creek drainage near delineated wetlands	9/5/2001	9-14	15.3	7027.78	13.34	7014.44
NR-WS-3	Alluvium	6S	43E	15	NENWNW	West Sheep Creek drainage near delineated wetlands	9/5/2001	13-23	23.0	7067.49	Dry	<7044.49
NR-C-4	Rex Chert	6S	43E	15	NWNESW	Center Area	9/12/2001	140-160	164.5	7011.82	158.58	6853.24
NR-R-2	Rex Chert	6S	43E	9	NENWSE	Reese Canyon	9/15/2001	97-117	119.3	6849.61	116.06	6733.55
NR-R-12	Rex Chert	6S	43E	9	SWSWNE	Reese Canyon, near NR-00-89	10/2/2001	91-121	124.0	6768.08	102.67	6665.41
NR-C-3	Upper Meade Peak	6S	43E	15	NWNESW	Center Area	9/11/2001	175-195	197.5	7011.97	170.38	6841.59
NR-R-3	Upper Meade Peak	6S	43E	9	NENWSE	Reese Canyon	9/14/2001	136-156	158.9	6849.08	158.44	<6690.18
NR-C-5	Lower Meade Peak	6S	43E	15	NWNESW	Center Area	9/27/2001	194-214	217.0	7018.76	Dry	<6801.76
NR-R-8	Lower Meade Peak	6S	43E	9	NENWSE	Reese Canyon near NR-00-73	9/22/2001	117-137	139.4	6869.63	Dry	<6730.23
NR-C-2	Wells Formation	6S	43E	15	NWNESW	Center Area	9/25/2001	216.6-236.6	239.7	7019.33	Dry	<6779.63
NR-C-6	Wells Formation	6S	43E	15	NWNESW	Center Area	9/29/2001	167-299	301.7	7022.53	Dry	<6720.83
NR-C-7	Wells Formation	6S	43E	15	NENENW	Center Area	10/4/2001	478.5-498.5	501.0	7028.16	Dry	<6527.16
NR-R-4	Wells Formation	6S	43E	9	NENWSE	Reese Canyon	9/21/2001	165-185	187.5	6869.81	Dry	<6682.31
NR-R-9	Wells Formation	6S	43E	9	SWSWNE	Reese Canyon near NR-00-87	9/23/2001	180-200	203.9	6825.08	Dry	<6621.18
NR-R-10	Wells Formation	6S	43E	9	NENWSE	Reese Canyon	9/19/2001	315-335	340.0	6850.68	Dry	<6510.68

Note: amsl = above mean sea level

Alluvium exists in areas of Reese Canyon Creek, No Name Creek, and the West Fork of Sheep Creek. The alluvium encountered while monitoring wells were drilled in Reese Canyon consisted of a gravelly silt and clay to gravel ranging from 5 to 25 feet thick. Alluvium in the No Name Creek area consisted of primarily gravelly silt with some clayey silt and silty sand, with thicknesses ranging from 24 to 32 feet. In the area of the West Fork of Sheep Creek, the alluvium is described as silt and clay with some gravelly intervals. The alluvium in this area ranged from

11 to 24 feet thick (Maxim 2002b). The alluvium described above exists unconformably on the underlying bedrock.

The Thaynes Formation occurs outside the proposed pit area, but within the hydrologic study area. The Thaynes Formation overlies the Dinwoody Formation and is approximately 2,200 to 2,800 feet thick. It can be divided into five members that include, from top to bottom, the Portneuf Limestone, Nodular Siltstone, Black Shale, Platy Siltstone, and Black Limestone (Ralston et al 1980). Hydrologic data for the Thaynes Formation have not been developed for the project area and are not reported in any documents reviewed to date. Hydrologic studies by Robinette (1977) and Mohammad (1976) concluded that the Thaynes Formation represents an intermediate flow system in the Idaho phosphate region and can be classified as an aquifer throughout its thickness.

The Dinwoody Formation overlies the Phosphoria Formation and is approximately 900 feet thick. It is composed of interbedded limestone and siltstone with discontinuous shaley zones in the upper portion of the formation, and calcareous shale and siltstone with thin limestone beds in the lower portion of the formation. Hydrologic studies by Robinette (1977), Edwards (1977), and Mohammad (1976) concluded that the Dinwoody Formation represents an intermediate flow system in the Idaho phosphate region, with the upper section acting as an aquifer and the lower section acting as an aquitard.

The Phosphoria Formation in the area of the proposed North Rasmussen Ridge Mine ranges from approximately 250 to 450 feet and consists of the Rex Chert member and the Meade Peak Member.

The Rex Chert is the uppermost member of the Phosphoria Formation and occurs below the Dinwoody Formation. In the project area, the Rex Chert is 100 to 200 feet thick and is composed of dark gray to reddish brown cherty mudstone and limestone. The Rex Chert is described in on-site boring NR-R-3 as gray-black claystone, dark gray siltstone, gray-black mudstone with dark gray to brown gray chert, gray black to brown mudstone with some chert, and gray-black hard mudstone with minor chert, and the total thickness was 120 feet (Maxim 2002a). Hydrologic studies by Robinette (1977), Edwards (1977), and Mohammad (1976) concluded that the Rex Chert constitutes an intermediate flow system in the Idaho phosphate region and classified the unit as an aquifer.

The Meade Peak Member of the Phosphoria Formation is generally characterized as relatively impermeable and consists of phosphatic shale and limestone. The Meade Peak member is 140 feet thick in the area and contains two separate ore zones (the upper and lower ore) separated by 60 to 100 feet of shales. The phosphate deposit generally strikes north 44 degrees west and is normally bedded to the east with dips ranging from 33 to 78 degrees. The upper ore of the Meade Peak Member was characterized by the on-site borings as consisting of reddish brown to black shale, siltstone, and chert, with olitic grain texture present in the ore bearing siltstone. The center waste shales of the Meade Peak are described as gray to black shale and mudstone and gray to black hard mudstone interbedded with soft clay (Maxim 2002a).

The Grandeur Member of the Park City Formation is present below the Phosphoria Formation in the general area of the mine. Rocks of the Grandeur Member are thick to massively bedded gray dolomite that is occasionally sandy or argillaceous and may be recrystallized in its upper portion. Regionally, the unit is about 100 feet thick (Ralston et al 1980) and has been mapped as part of the Wells Formation (Mansfield 1927).

The Wells Formation is considered a regional aquifer that is responsible for interbasin flow along bedding (Ralston et al 1980). The upper member of the Wells Formation typically ranges from 1,000 to 1,400 feet thick and is composed of buff-colored sandy limestone, gray to reddish brown sandstone and interbedded gray limestone and dolomite (Ralston et al 1980). The lower member ranges from 500 to 950 feet thick and consists of medium bedded gray cherty limestone with some interbedded sandstone (Ralston et al 1980). In the area of the mine, the combined thickness of the Wells Formation (including the Grandeur Member of the Park City Formation) is mapped as about 2,400 feet (Mansfield 1927). The Wells Formation as characterized by the on-site borings is gray to light gray limestone interbedded with sandstone. The sandstone is described as yellow-brown to orange to gray to brown, calcareous, and fine to very fine-grained (Maxim 2002a). None of the monitoring wells on site are completed in the saturated portion of the Wells Formation. However, Dust Control Well #2 and exploration drill holes (NR00-53, NR00-77, NR00-81, NR00-99, NR00-102, and NR00-109) have provided information about the hydraulic characteristics of the Wells Formation.

3.3.4.2 Hydraulic Characteristics

The hydraulic characteristics of the alluvial and bedrock aquifers were investigated by pumping tests and slug tests in on-site monitoring wells. Additional data were compiled from wells outside the immediate project area. These tests provide estimates of hydraulic conductivity, transmissivity, and storativity. Hydraulic conductivity and transmissivity are measures of the ease water flows through an aquifer; higher values indicate that more water can be transmitted through the aquifer. Storativity is the volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head.

The alluvial aquifers on site were characterized by slug-in and slug-out tests. These tests consist of the removal of a known volume of water (slug-out) or the introduction of a known volume of water (slug-in) and subsequent monitoring of the water levels in the well over time. Three wells were tested in the No Name Creek alluvium, two wells in the Reese Canyon Creek alluvium, and one well in the West Sheep Creek alluvium. The results of the on-site testing are shown in **Table 3.3-11**. The results from alluvial wells in the region were also compiled and combined with the site-specific data (**Table 3.3-12**). The geometric average hydraulic conductivity for the alluvium, based on all available data, is 0.31 feet per day (ft/day), with a median (middle value) of 0.13 ft/day.

Hydrologic data were not collected for the Dinwoody Formation in the project area. However, slug tests in the Little Long Valley indicate that values for hydraulic conductivity range from 83 to 620 ft/day (Ralston et al 1980).

TABLE 3.3-11
SUMMARY OF ON-SITE AQUIFER TESTING RESULTS

Slug Tests				
Well Tested	**Type of Test**	**Formation Screened**	**Hydraulic (ft/day)**	**Conductivity (cm/sec)**
NR-NN-1	Slug In	Alluvium	0.15	5.3E-05
NR-NN-1	Slug Out	Alluvium	0.12	4.2E-05
NR-NN-2	Slug In	Alluvium	2.12	7.5E-04
NR-NN-2	Slug Out	Alluvium	3.71	1.3E-03
NR-NN-2A	Slug In	Alluvium	0.02	7.1E-06
NR-NN-2A	Slug Out	Alluvium	0.01	3.5E-06
NR-R-7	Slug In	Alluvium	0.02	7.1E-06
NR-WS-1	Slug Out	Alluvium	0.04	1.4E-05
NR-R-11	Baildown-Recovery	Alluvium	1.28	4.5E-04
NR-C-4	Slug In	Rex Chert	0.10	3.5E-05
NR-R-2	Slug In	Rex Chert	0.16	5.6E-05
NR-C-3	Slug In	Upper Meade Peak	0.08	2.8E-05
NR-R-12 Pumping Test				
Observation Well	Analytical Method	Formation Tested	Hydraulic (ft/day)	Conductivity (cm/sec)
NR-R-12	Cooper & Jacob (1946)	Rex Chert	7.26	2.6E-03
NR-R-12	Theis Unconfined (1935)	Rex Chert	5.37	1.9E-03
NR-R-12	Theis Recovery (1946)	Rex Chert	14.9	5.3E-03
NR-00-89	Cooper & Jacob (1946)	Rex Chert	8.49	3.0E-03
NR-00-89	Theis Unconfined (1935)	Rex Chert	6.19	2.2E-03
NR-00-89	Theis Recovery (1946)	Rex Chert	7.23	2.6E-03

Notes: ft/day = feet per day
cm/sec = centimeters per second

The Rex Chert Member has been described as a potential aquifer of moderate hydraulic conductivity. Both slug and pump tests were conducted on the Rex Chert in the project area (**Table 3.3-11**) and additional data were compiled from outside the project area, including Dry Valley and Diamond Creek (**Table 3.3-12**). The site-specific data varied from a low value of 0.1 ft/day from a slug test on well NR-C-4 to a high of 14.9 ft/day from a pumping test on well NR-R-12 at Rasmussen Ridge. Values from the Rasmussen Ridge data were typically higher for pump tests than for slug tests and higher than the values from surrounding sites. A statistical analysis of available data indicates that the geometric mean hydraulic conductivity of the Rex Chert is 1.5 ft/day and the mean storage value is 0.014. Fracturing may increase hydraulic conductivity locally, with reported values in fracture Rex Chert ranging from 28 to 75 ft/day. Observed storage values in fractured Rex Chert vary from 0.0003 to 0.001.

TABLE 3.3-12
SUMMARY OF ALL AVAILABLE AQUIFER HYDRAULIC CHARACTERISTICS

Unit	Aquifer Property	Min.	Max.	Mean	Geometric Mean	Median	Std. Dev.	Number of tests
Alluvium	K (ft/day)	0.014	55.0	8.47	0.314	0.134	20.54	7
Alluvium	T (ft2/day)	3200	3200	3200	3200	3200	N/A	1
Alluvium	S (/ft)	N/A	N/A	N/A	N/A	N/A	N/A	0
Dinwoody	K (ft/day)	N/A	N/A	N/A	N/A	N/A	N/A	0
Dinwoody	T (ft^2/day)	83	620	351.5	226.8	379.7	351.5	2
Dinwoody	S (/ft)	N/A	N/A	N/A	N/A	N/A	N/A	0
Rex Chert (Unfractured)	K (ft/day)	0.1	8.3	2.8	1.52	2.3	2.6	13
Rex Chert (Unfractured)	T (ft^2/day)	153.7	1200	514.7	394.0	423.4	380.4	8
Rex Chert (Unfractured)	S (/ft)	0.007	0.028	0.014	0.0111	0.007	0.012	3
Rex Chert (N.Ras. Ridge)	K (ft/day)	0.1	8.34	3.96	0.99	3.70	4.45	4
Rex Chert (N.Ras. Ridge)	T (ft^2/day)	153.7	177.0	165.4	165.0	165.4	16.5	2
Rex Chert (N.Ras. Ridge)	S (/ft)	0.028	0.028	0.028	0.028	0.028	N/A	1
Rex Chert (Fractured)	K (ft/day)	28	75	51.5	45.8	51.5	33.23402	2
Rex Chert (Fractured)	T (ft^2/day)	2300	12000	7150	5253.6	7150	6858.936	2
Rex Chert (Fractured)	S (/ft)	0.0003	0.001	0.00065	0.0005477	0.00065	0.000495	2
Meade Peak (Unfractured)	K (ft/day)	0.03	11.5	2.39	0.80	1.30	3.15	17
Meade Peak (Unfractured)	T (ft^2/day)	6.0	300	79	36	23	105	11
Meade Peak (Unfractured)	S (/ft)	0.001	0.002	0.002	0.002	0.002	0.001	2
Meade Peak (Fractured)	K (ft/day)	25	25	25	25	25	N/A	1
Meade Peak (Fractured)	T (ft^2/day)	2000	2000	2000	2000	2000	N/A	1
Meade Peak (Fractured)	S (/ft)	0.001	0.001	0.001	0.001	0.001	N/A	1
Wells Formation	K (ft/day)	0.08	9.94	1.82	0.65	0.64	3.33	8
Wells Formation	T (ft^2/day)	4	3600	523	85	70	1245	8
Wells Formation	S (/ft)	0.0016	0.0078	0.0047	0.0035	0.0047	0.0044	2

Notes:
k = hydraulic conductivity
T = transmissivity
S = storage coefficient
ft/day = feet per day
ft^2/day = square feet per day

The Grandeur Member of the Park City Formation is generally mapped as part of the Wells Formation. Local hydrologic data are not available for the Grandeur Member; however, a pumping test indicated a hydraulic conductivity less than 108 ft/day in the area of the Gay Mine (Geraghty and Miller 1990).

No hydrologic data for the Wells Formation are available from the project area. Data are available, however, from pumping tests in wells at the Smoky Canyon and Dry Valley Mines and from well records in the general area. A hydraulic conductivity of 0.56 ft/day for the Wells Formation was derived from a pumping test in well GW6D at the Dry Valley Mine. Transmissivities ranging from 33 to 689 ft^2/day were also calculated for four pumping tests in the Wells Formation at the mine during 1990 (Raviv and Patricio 1990). Semi-confined storage values for the 1990 pumping tests were calculated to range from 0.00276 to 0.00352. Based on a screened interval of 50 feet for the pumped wells, hydraulic conductivities for the 1990 Dry Valley pumping tests are calculated to vary from 0.67 to 13.8 ft/day.

Data from a pumping test in the Culinary Well at Smoky Canyon indicated a transmissivity of 3,600 square feet per day (ft^2/day) for a screened interval of 610 feet (Ralston et al 1980). Assuming that transmissivity equals hydraulic conductivity multiplied by the length of the screened interval, a hydraulic conductivity of 0.79 ft/day for the Wells Formation can be calculated.

A specific capacity analysis for hydraulic conductivity was also performed for other wells in the general area that are completed in the Wells Formation. Hydraulic conductivity was calculated from specific capacity using a Jacob Straight Line analysis as described in Driscoll (1995) and Freeze and Cherry (1979). The Wooley Valley Wash Plant # 1 well, 0.34 ft/day for the Donna Vasser Well, and 9.94 ft/day for the Gail Gentry well were identified as completed in the Wells Formation and were used for the analysis. Assuming a storage value of 0.001, hydraulic conductivities were calculated at 0.19 ft/day for the Wooley Valley Wash Plant # 1 well, Donna Vasser well, and Gail Gentry well.

Statistical analysis of data for the Wells Formation provides a mean hydraulic conductivity of 1.82 ft/day and a mean storage value of 0.0047. Fracturing may increase hydraulic conductivity locally. Hydrologic studies by Robinette (1977), Edwards (1977), and Mohammad (1976) concluded that the Wells Formation is an aquifer and may be part of a regional groundwater flow system.

3.3.4.3 Groundwater Flow Directions, Recharge, and Discharge

Groundwater generally flows from areas of recharge to areas of discharge. This flow can occur in local-, intermediate-, or regional-scale systems, depending on topography, geologic structure, and continuity of formations.

The structure and topography of Rasmussen Ridge play an important role in controlling the direction of groundwater flow. Rasmussen Ridge is formed as a result of the Snowdrift anticline, a northwest-southeast trending structure (**Figure 3.1-1**). At the north end of Rasmussen Ridge, the anticline is part of the upthrown block of a horst and graben structure. The Enoch Valley Fault lies along and on the south side of the length of Rasmussen Ridge. Rasmussen Ridge is the upthrown side of the fault; the Georgetown syncline is on the downthrown side of the fault (**Figure 3.1-1**). Two minor faults exist on the north side of Rasmussen Ridge, one in the area of No Name Creek and the other near the top of Reese Canyon. A map depicting the geologic

features in the area and cross-sections through the northern and central portions of Rasmussen Ridge (Mansfield 1927) are shown in **Figure 3.1-1**.

Groundwater in the alluvium forms local flow systems that generally follow topography and flow downgradient parallel to drainages (**Figure 3.3-6**). Groundwater in the alluvium is often perched above the local and intermediate bedrock flow systems and feeds local seeps and springs (Maxim 2002c, Whetstone 2002). Water levels in the alluvial monitoring wells vary seasonally, as shown in **Table 3.3-13**.

Groundwater in the Dinwoody Formation and Rex Chert typically form local to intermediate flow systems that are isolated from the regional flow system by shales of the Meade Peak Member of the Phosphoria Formation (**Figure 3.3-7**). Based on water levels in wells installed by Maxim (2002d), a differential of more than 225 feet exists between the local and intermediate flow system in the Rex Chert and the regional flow system in the Wells Formation in the vicinity of Reese Canyon. Water levels in the Rex Chert vary seasonally, with as much as 60 feet of seasonal change in water level measured in Reese Canyon well NR-R-2 (**Figure 3.3-8**). Groundwater in the Rex Chert originates in recharge areas along the axis of Rasmussen Ridge and other topographic high points where the Rex Chert outcrops. Data from the three monitoring wells and one water supply well installed in the Rex Chert indicate that groundwater follows topography and flows downstrike westward in the valley of No Name Creek and eastward in Reese Canyon under steep hydraulic gradients (0.68 ft/ft). Bedding in the Rex Chert dips 35 to 75 degrees toward the northeast in the project area, and data are not available to indicate a downdip component of flow.

The Meade Peak Member of the Phosphoria Formation acts as a low-permeability barrier to groundwater flow, resulting in several hundred feet of difference in water level elevation between the local/intermediate flow systems in the Dinwoody and Rex Chert and the regional flow system in the Wells Formation (**Figure 3.3-9**). Two monitoring wells completed in the Upper Meade Peak Member (NR-C-3 and NR-R-3) show significant seasonal variation in water levels)172.8 and 158.5, respectively, Maxim 2002d).

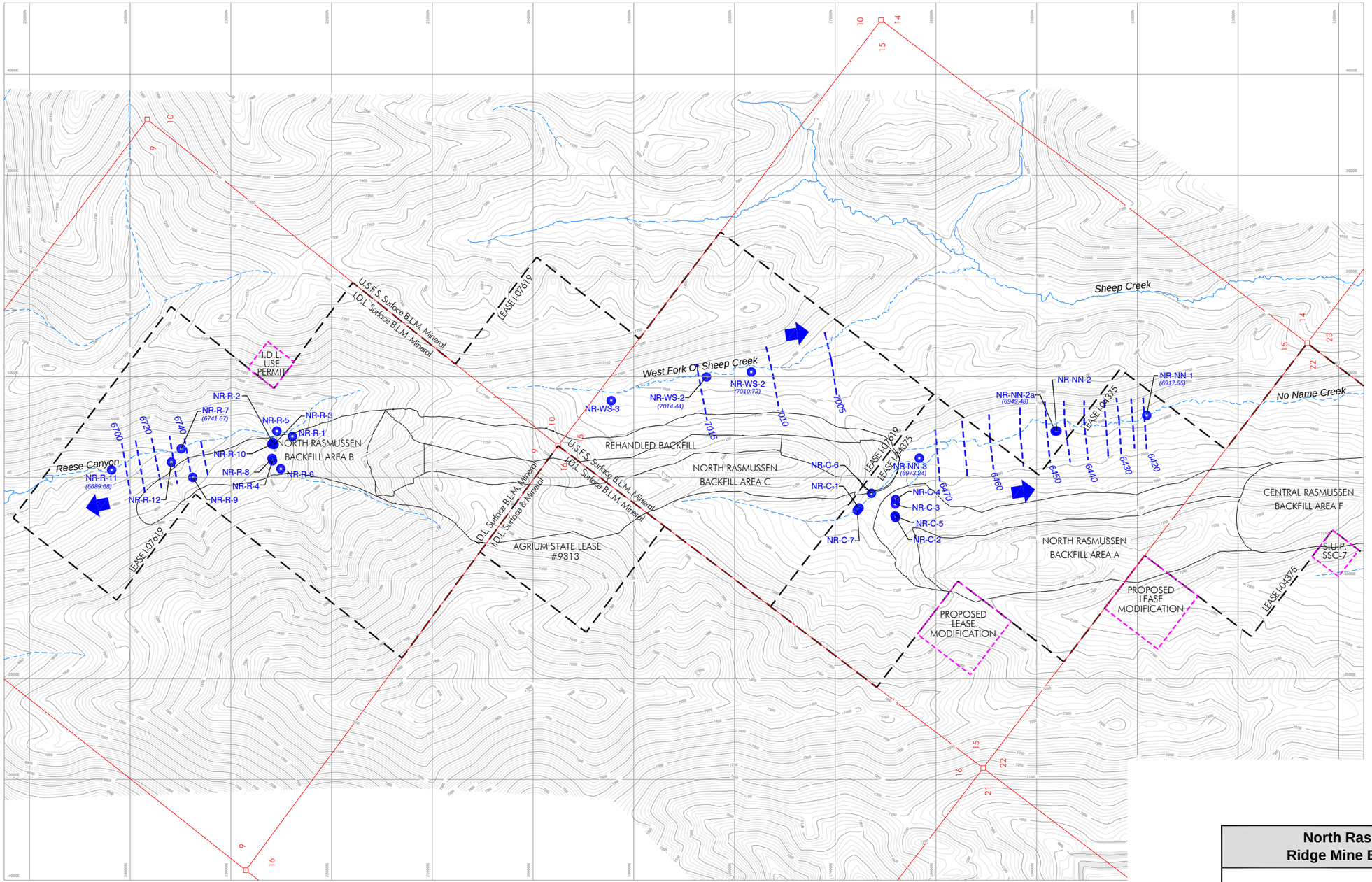
Groundwater in the Wells Formation is part of the regional groundwater flow system. Recharge to the Wells Formation occurs along anticlinal axes (such as Rasmussen Ridge) or other areas where the Wells Formation is elevated relative to the discharge area. Maxim (2002d) compiled data on regional water levels for the Wells Formation aquifer (**Figure 3.3-10**), which indicate that groundwater in the regional bedrock aquifer flows from southeast to northwest, generally toward the discharge area at the northern Blackfoot Reservoir with a gradient of 0.0059 ft/ft.

TABLE 3.3-13
WATER LEVEL DATA MEASURED IN MONITORING WELLS AT THE NORTH RASMUSSEN RIDGE MINE SITE

	Total Depth		October 29, 2001		November 20, 2001		January 11, 2002		April 26, 2002		May 6, 2002		May 14, 2002		May 29, 2002		May 31, 2002		June 10 - 13, 2002	
Well	MPE	BMP	DTW	GWE	DTW	GWE	DTW	GWE	DTW	GWE	DTW	GWE	DTW	GWE	DTW	GWE	DTW	GWE	DTW	GWE
NR-NN-1	6936.11	38.40	18.56	6917.55	19.29	6916.82	20.78	6915.33	8.18	6927.93	6.54	6929.57	5.90	6930.21	NM		5.42	6930.69	5.33	6930.78
NR-NN-2	6956.71	31.05	6.45	6950.26	6.76	6949.95	8.11	6948.60	1.22	6955.49	1.52	6955.19	1.39	6955.32	NM		1.31	6955.40	1.34	6955.37
NR-NN-2A	6955.88	20.39	5.90	6949.98	6.16	6949.72	7.51	6948.37	1.76	6954.12	1.06	6954.82	0.94	6954.94	NM		0.94	6954.94	1.03	6954.85
NR-NN-3	6995.54	28.57	22.30	6973.24	26.12	6969.42	28.32	6967.22	9.98	6985.56	18.26	6977.28	17.38	6978.16	NM		16.33	6979.21	16.94	6978.6
NR-C-1	7026.77	69.15	68.73	--	68.78	--	68.76	--	68.77	--	67.93	6958.84	65.31	6961.46	NM		62.92	6963.85	63.64	6963.13
NR-C-2	7019.33	239.70	239.90	--	--	--	240.07	--	239.89	--	--	--	--	--	NM		239.9	--	--	--
NR-C-3	7011.97	197.50	170.38	6841.59	175.16	6836.81	180.98	6830.99	133.63	6878.34	144.41	6867.56	144.39	6867.58	NM		143.02	6868.95	143.72	6868.25
NR-C-4	7011.82	164.50	158.58	6853.24	159.98	6851.84	161.71	6850.11	155.84	6855.98	154.35	6857.47	154.19	6857.63	NM		154.59	6857.23	153.32	6858.5
NR-C-5	7018.76	216.95	216.69	--	--	--	--	--	--	--	--	--	--	--	NM		216.79	--	--	--
NR-C-6	7022.53	301.65	--	--	--	--	--	--	--	--	--	--	--	--	NM		--	--	--	--
NR-C-7	7028.16	501.00	--	--	--	--	--	--	--	--	--	--	--	--	NM		--	--	--	--
NR-WS-1	7019.02	12.00	8.30	7010.72	8.51	7010.51	8.91	7010.11	NM		3.36	7015.66	3.21	7015.81	3.62	7015.4	NM		3.85	7015.17
NR-WS-2	7027.78	14.00	13.34	7014.44	13.91	7013.87	--	--	NM		4.30	7023.48	3.59	7024.19	3.61	7024.17	NM		3.78	7024
NR-WS-3	7067.49	23.00	--	--	--	--	--	--	NM		24.16	7043.33	22.60	7044.89	20.57	7046.92	NM		20.39	7047.1
NR-R-1	6873.28	24.80	24.41	--	24.42	--	NM		NM		NM		10.08	6863.2	11.76	6861.52	NM		18.99	6854.29
NR-R-2	6849.61	119.25	116.06	6733.55	100.89	6748.72	NM		NM		NM		60.36	6789.25	61.29	6788.32	NM		79.39	6770.22
NR-R-3	6849.08	158.90	158.44	--	158.54	--	NM		NM		NM		158.12	6690.96	--	--	NM		158.12	--
NR-R-4	6869.81	187.45	186.88	--	187.30	--	NM		NM		NM		187.23	--	187.26	--	NM		--	--
NR-R-5	6842.88	28.25	28.01	--	28.01	--	NM		NM		NM		10.40	6832.48	12.81	6830.07	NM		14.91	6827.97
NR-R-6	6847.72	25.50	25.11	--	25.11	--	NM		NM		NM		10.13	6837.59	14.09	6833.63	NM		17.24	6830.48
NR-R-7	6762.83	23.00	21.16	6741.67	21.06	6741.77	NM		NM		NM		NM		9.45	6753.38	NM		13.74	6749.09
NR-R-8	6869.63	139.40	--	--	--	--	NM		NM		NM		--	--	--	--	NM		139.35	--
NR-R-9	6825.98	204.02	203.56	203.57	--	--	NM		NM		NM		--	--	203.76	--	NM		203.72	--
NR-R-10	6850.68	340.00	339.42	--	--	--	NM		NM		NM		--	--	--	--	NM		--	--
NR-R-11	6711.58	24.93	21.90	6689.68	22.38	6689.2	NM		NM		NM		NM		10.55	6701.03	NM		15.36	6696.22
NR-R-12	6768.08	124.00	102.67	6665.41	103.68	6664.4	NM		NM		NM		107.05	6661.03	106.12	6661.96	NM		106.37	6661.71

Notes: MPE = measuring point elevation
BMP = below measuring point
DTW = depth to water in feet
GWE = groundwater elevation in feet above mean sea level
NM = not measured
-- = well was either dry or water measured interpreted to be in end cap

Source: Maxim 2002d



LEASE I-07619 & I-04375
LEASE MODIFICATIONS & USE PERMITS
PERENNIAL STREAMS
INTERMITTENT STREAMS
POTENTIOMETRIC CONTOURS
NR-NN-3 MONITORING WELLS
ALLUVIAL GROUNDWATER FLOW DIRECTIONS

0 1000 2000
Scale (ft)

NORTH

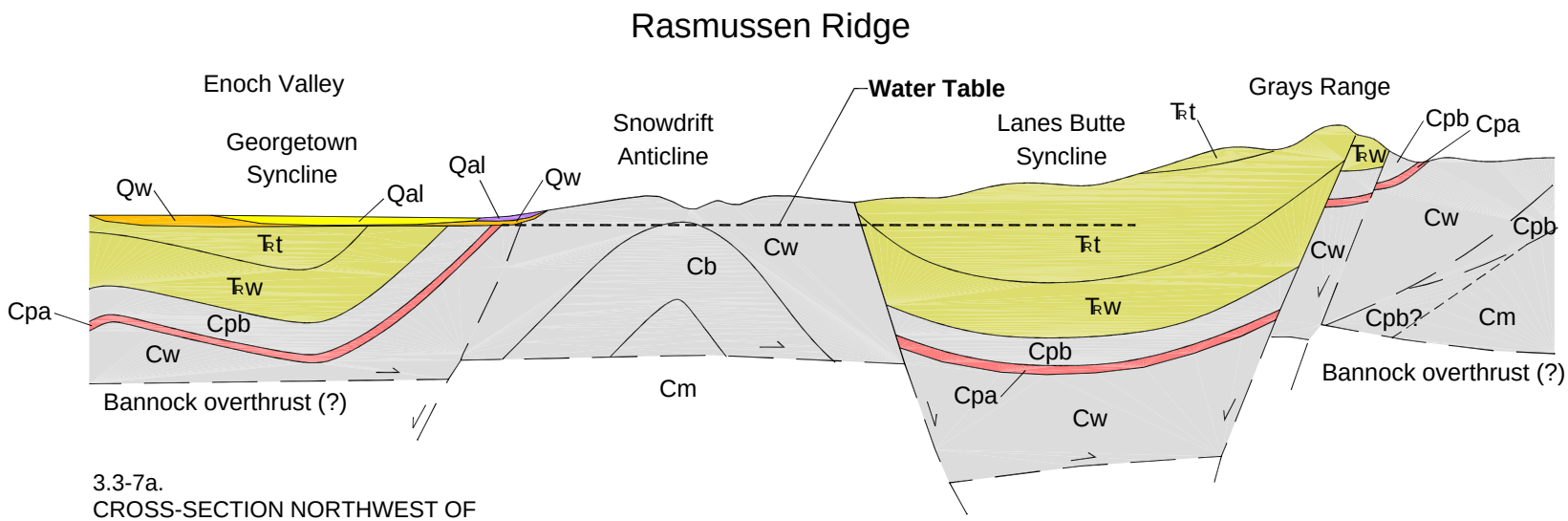
Source: Maxim 2002d

North Rasmussen Ridge Mine EIS Project

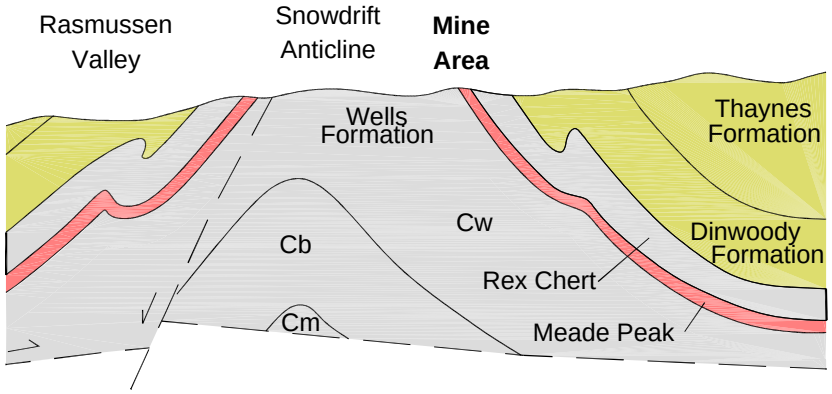
FIGURE 3.3-6
WATER LEVELS AND FLOW DIRECTIONS IN ALLUVIUM

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 Surface Map.dwg
Scale: As Noted	Drawn By: ETC



3.3-7a.
CROSS-SECTION NORTHWEST OF
PROPOSED MINE SITE, LOOKING NORTHWEST
SEE FIGURE 3.1-1 FOR LOCATION



3.3-7b.
REGIONAL CROSS-SECTION NEAR
PROPOSED MINE SITE, LOOKING NORTHWEST
SEE FIGURE 3.1-1 FOR LOCATION

LEGEND

Qal	Alluvium
Qw	Hill wash and older alluvium
Ŧt	Thaynes group
Ŧw	Woodside Shale / Dinwoody Formation
Cpb	Rex Chert
Cpa	Meade Peak
Cw	Wells Formation
Cb	Brazer Limestone
Cm	Madison Limestone

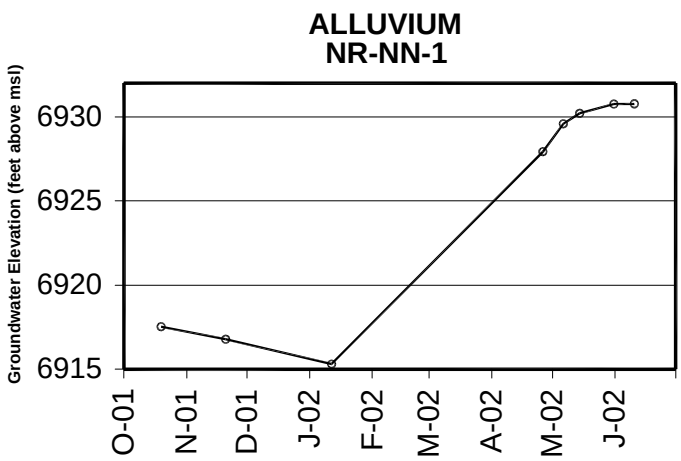
Source: Mansfield 1927

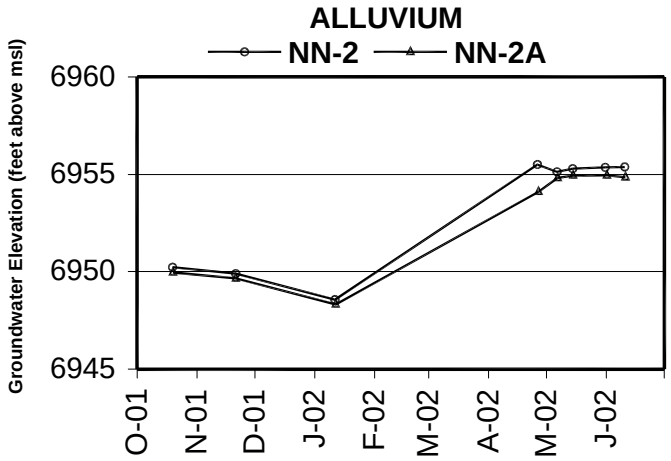
North Rasmussen Ridge Mine EIS Project

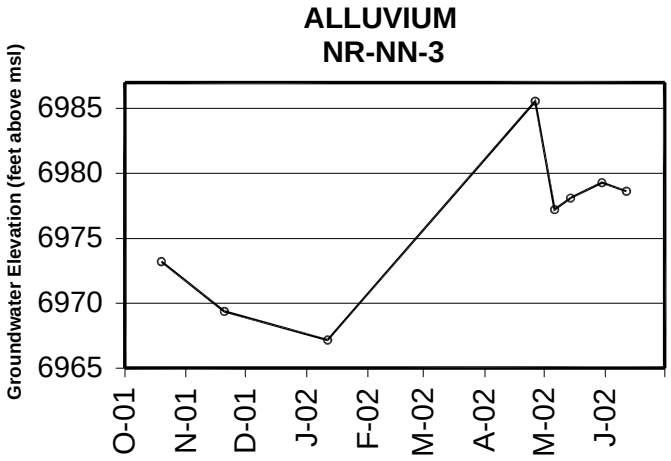
FIGURE 3.3-7
CROSS-SECTIONS SHOWING GEOLOGIC FEATURES

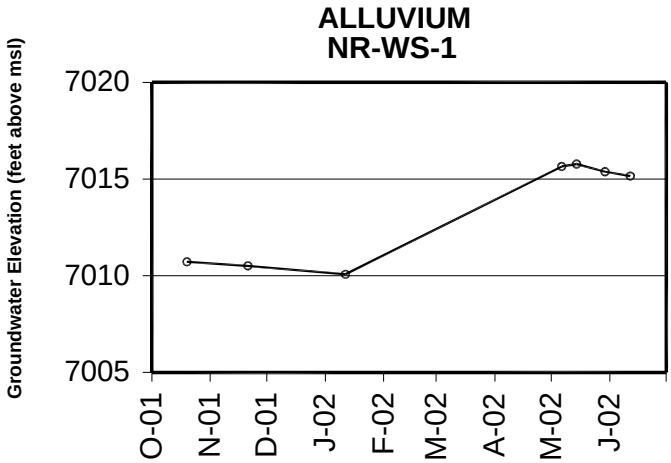
ANALYSIS AREA: Caribou County, Idaho

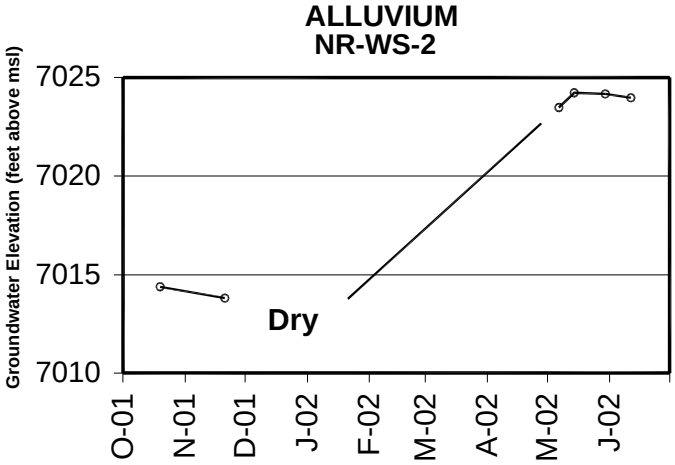
Date: 02.27.03	Drawing File: 1164 Geo X-sects.dwg
Scale: NTS	Drawn By: ETC

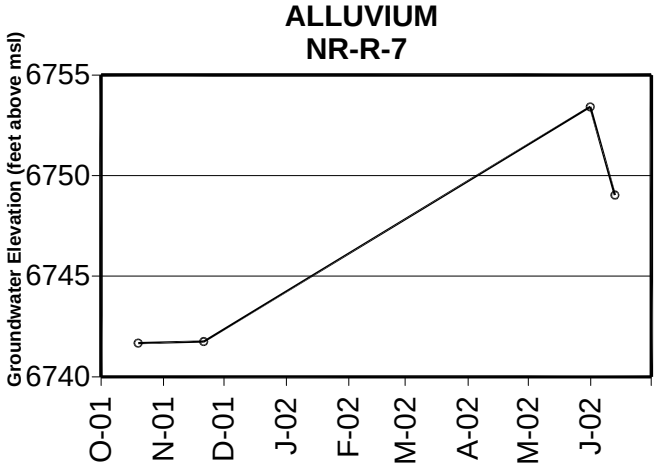






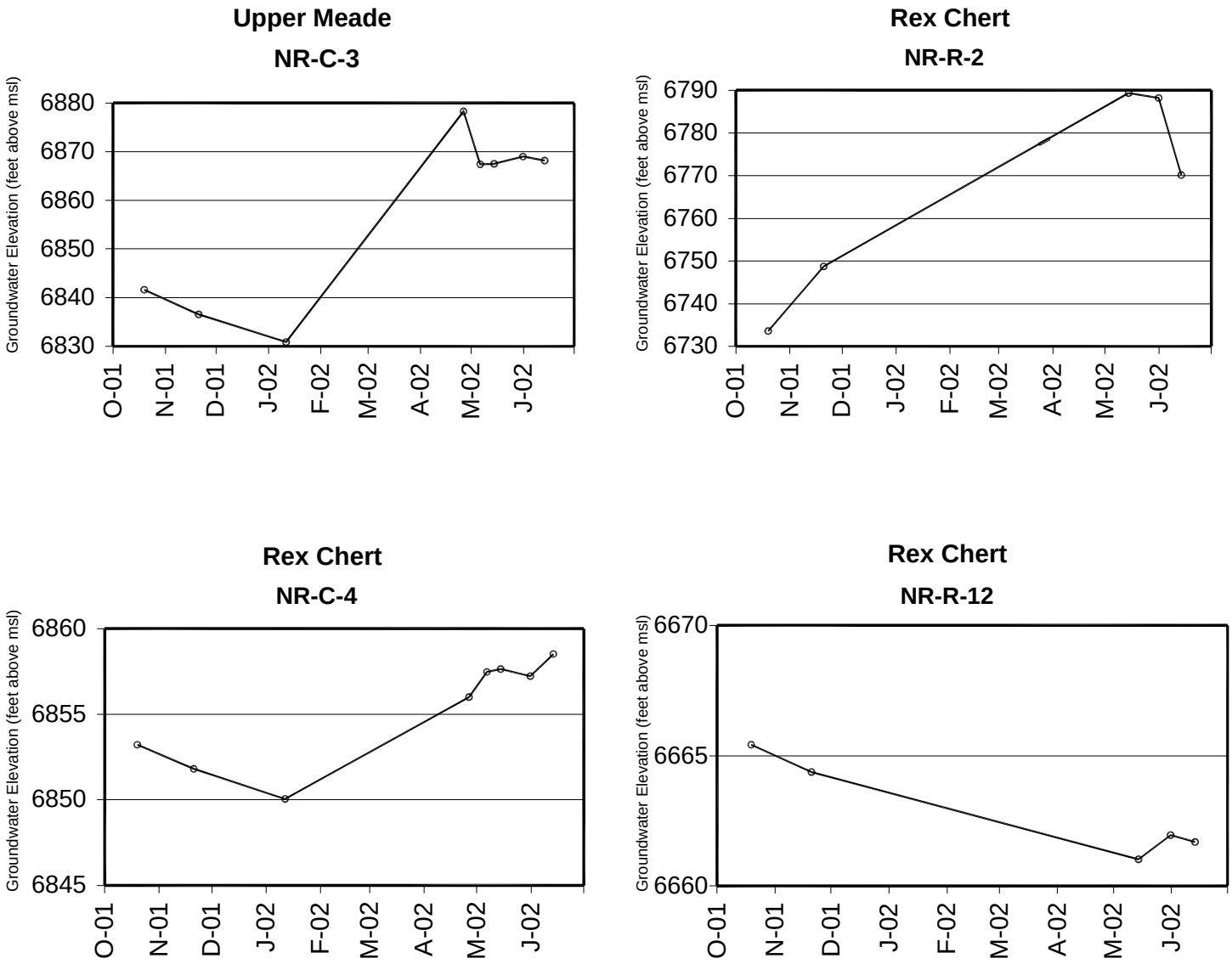






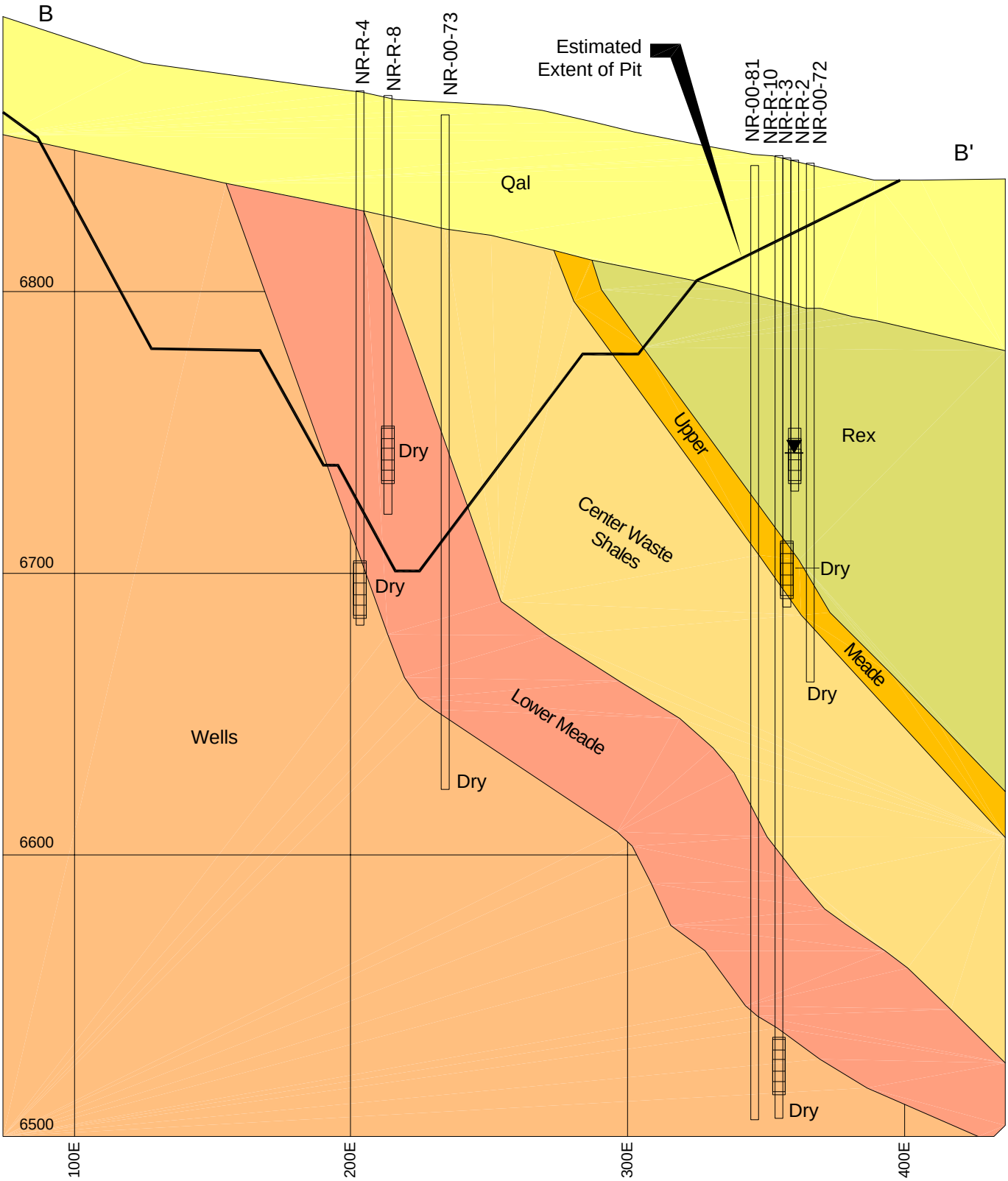
Source: Whetstone 2002

North Rasmussen Ridge Mine EIS Project	
FIGURE 3.3-8 HYDROGRAPHS FOR SELECTED MONITORING WELLS	
ANALYSIS AREA: Caribou County, Idaho	
Date: 02.27.03	Drawing File: 1164 Hydro.dwg
Scale: NTS	Drawn By: MTM



Source: Whetstone 2002

North Rasmussen Ridge Mine EIS Project	
FIGURE 3.3-8 HYDROGRAPHS FOR SELECTED MONITORING WELLS	
ANALYSIS AREA: Caribou County, Idaho	
Date: 02.27.03	Drawing File: 1164 Hydro.dwg
Scale: NTS	Drawn By: MTM



LEGEND

Water Level

Exploratory Boring

Monitoring Well with Screened Interval

Cross Section Location
Shown on Figure 3.3-5

0 50 100
Scale (ft)

Source: Maxim 2002d

North Rasmussen Ridge Mine EIS Project

FIGURE 3.3-9
CROSS SECTION SHOWING
MONITORING WELLS IN REESE CANYON AREA

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 Wells X-sect.dwg
Scale: As Noted	Drawn By: MTM

LEGEND

Qal	*Quaternary Alluvium*
Qc	*Quaternary Colluvium*
Qb	*Gem Valley Basalt*
Qbc	*Quaternary Basalt Cinders*
Ŧt	*Thaynes Formation*
Ŧd	*Dinwoody Formation*
Pp	*Phosphoria Formation*
PPw	*Wells Formation*
Mm	*Mission Canyon Limestone*
- - 6340 - -	*Groundwater Contour Elevation*
19 ●	*Groundwater Well*
———	*Highway*
———	*Roads*

Source: Maxim 2002d

North Rasmussen Ridge Mine EIS Project

FIGURE 3.3-10
REGIONAL BEDROCK
GROUNDWATER LEVEL ELEVATIONS

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 BR GW EL.dwg
Scale: NTS	Drawn By: MTM

3.3.5 Groundwater Quality

Groundwater samples were collected from 13 monitoring wells in the alluvium, 3 monitoring wells in the Rex Chert Member, 1 monitoring well in the Upper Meade Peak Member, and one production well in the Wells Formation. The wells were sampled in Fall 2001 and late Spring 2002, although five of the alluvial wells were dry in 2001 and could not be sampled. Samples collected for the baseline characterization program had a high degree of turbidity and suspended sediment (Maxim 2002d and 2002f), and turbid or cloudy samples may not be representative of in-situ groundwater conditions. Samples for dissolved constituents were field filtered to remove suspended material and preserved according to generally accepted sampling methodology (Maxim 2002d and 2002f). Because the samples were filtered, laboratory analyses for dissolved constituents in groundwater are considered to be representative of in-situ conditions. Samples that were analyzed for total recoverable concentrations, however, were not filtered (which is standard sampling protocol), and laboratory analyses are considered to overestimate total concentrations for in-situ groundwater because of the high suspended sediment content. Thus, the following discussion is based on results of the dissolved analyses from the baseline sampling.

Groundwater in the alluvium is a calcium-bicarbonate type, generally well-buffered, with moderate concentrations of total dissolved solids (116 to 506 mg/L) and neutral to slightly acidic pH (5.39 to 7.8). Median TDS concentrations are lower in No Name Creek (168 mg/L) than in Reese Canyon Creek (242 mg/L) or the West Fork of Sheep Creek (246 mg/L). The alluvial groundwater samples showed eight of 21 samples were high in dissolved manganese and results for 2 of 21 samples exceeded standards for dissolved aluminum and iron. No other dissolved metals were detected at concentrations that exceeded groundwater standards (**Table 3.3-14**).

Groundwater in the Rex Chert is a calcium-bicarbonate type with moderately high concentrations of total dissolved solids (98 to 421 mg/L) and neutral to slightly acidic pH (5.21 to 7.1). Groundwater from wells NR-C-4 and NR-R-12 is strongly buffered, while groundwater from well NR-R-2 is weakly buffered. Dissolved concentrations of manganese, cadmium, and nickel were detected at concentrations that exceeded groundwater standards in 33 to 83 percent of the samples. Dissolved iron and aluminum were detected at concentrations exceeding standards in 17 percent of samples. No other results for dissolved metals exceeded standards (**Table 3.3-15**).

Groundwater in the Upper Meade Peak Member is a calcium-bicarbonate type, moderately well buffered, with moderate concentrations of total dissolved solids (176 to 288 mg/L). The result from one of the two groundwater samples from the Upper Meade Peak exceeded groundwater standards for dissolved selenium (0.082 mg/L) and manganese (0.06 mg/L). No other results for dissolved metals exceeded groundwater standards (**Table 3.3-15**).

Groundwater from Dust Control Well #2 is a mixture of water from the Wells Formation and the Rex Chert and was analyzed for a limited suite of parameters in May 2002. The water is a moderately well buffered calcium-bicarbonate type. Cadmium and selenium were not detected (**Table 3.3-15**). Site-specific water quality data for the Wells Formation are not available, but in the region, water quality in the Wells Formation generally meets applicable standards. Naturally occurring elevated manganese concentrations (up to 1.1 mg/L) in Wells Formation water have been observed, however, at the nearby Dry Valley Mine (Whetstone 2002).

Table 3.3-14 GROUNDWATER QUALITY IN ALLUVIAL MONITORING WELLS

Location		No Name Creek Drainage									Reese Canyon							West Sheep Creek Drainage					Ground Water Standards	
Sample Station		NR-C-1	NR-NN-1	NR-NN-1	NR-NN-2	NR-NN-2	NR-NN-2A	NR-NN-2A	NR-NN-3	NR-NN-3	NR-R-1	NR-R-5	NR-R-6	NR-R-7	NR-R-7	NR-R-11	NR-R-11	NR-WS-1	NR-WS-1	NR-WS-2	NR-WS-2	NR-WS-3		
Date		6/13/02	9/18/01	6/10/02	9/18/01	6/10/02	9/18/01	6/10/02	9/18/01	6/11/02	6/12/02	6/12/02	6/12/02	9/19/01	6/12/02	10/2/01	6/12/02	9/18/01	6/11/02	9/18/01	6/11/02	6/11/02	Primary	Secondary
General Parameters																								
pH (field)	Std. Units	6.71	7.1	**6.2**	7.5	**6.26**	6.9	**5.39**	7.8	**5.98**	**5.61**	6.35	6.72	7.3	**6.25**	6.6	**6.35**	6.7	**6.19**	7.1	**6.43**	6.9	6.5 - 8.5	
pH (lab)	Std. Units	8.3	8.2	8.0	8.2	8	7.7	7.4	7.6	7.7	7.1	7.6	7.4	7.8	7.7	7.6	7.8	7.1	7	7.9	8	8	6.5 - 8.5	
Temp. (field)	C	10.5	7.3	8.6	7.1	6.2	8	4.8	6.8	5.2	5.8	5.0	6.3	7.3	5.7	7.0	5.2	9.1	5.6	9	6.4	6.5		
Total Alkalinity	mg/l $CaCO_3$	90	102	212	146. J	396. J	93	101	49	60	35	176	387	208	189	221	153	177	162	159	171	149		
Bicarbonate Alkalinity	mg/l HCO_3	110. F	124	259. F	178. J	483. JF	114	123. F	60	73. F	43. F	215. F	472. F	254	231. F	270	187. F	216	198. F	194	209. F	182. F		
Carbonate Alkalinity	mg/l CO_3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Hydroxide	mg/l	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Acidity	mg/l $CaCO_3$	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.	<2.		
E.C. (field)	uS/cm	172	223	208	296	240	425	212	1211	342	171	361	619	476	404	441	346	426	326	353	367	302		
E.C. (lab)	uS/cm	162	219	202	1285	252	1231	217	109	310	127	346	687	437	394	325	306	359	334	353	339	264		
TDS	mg/l	124	188	116	247	169	229	158	154	**506**	231	205	413	300	242	254	231	267	248	246	198	161		500
Hardness	mg/l $CaCO_3$	85	89	103	151	136	85	125	40	125	45	203	467	208	235	191	176	159	162	152	201	142		
Major Ions																								
Ca	mg/l	21	29	33	44	33	27	32	11	8	13	63	93	65	71	60	54	44	40	41	49	47		
Cl	mg/l	<4.	<4.	7	5	6	6	6	<4.	5	<4.	5	<4.	5	5	<4.	<4.	<4.	<4.	4	<4.	5		250
F	mg/l	**9.85**	0.13	0.19	0.19	0.16	0.2	0.19	0.12	0.18	0.23	0.25	0.9	0.16	0.17	0.13	0.21	0.2	0.18	0.23	0.23	0.43	4	
K	mg/l	2	1	<1.	2	1	5	<1.	2	<1.	2	1	2	4	2	3	<1.	3	1	7	2	2		
Mg	mg/l	8	4	5	10	13	7	11	3	4	3	11	57	11	14	10	10	12	15	12	19	6		
Na	mg/l	3	5	6	7	6	7	6	3	45	6	5	6	6	5	4	4	10	12	7	6	4		
SO_4	mg/l	6	6	5	12	9	13	8	8	95	31	15	13	13	23	13	16	6	27	7	17	10		250
Nutrients																								
$NO_3 + NO_2$	mg/l N	0.63	0.20	0.58	0.16	0.41	0.32	0.16	0.33	1.09	1.39	0.38	0.44	0.09	0.73	0.42	0.12 J	<0.05	0.46	0.32	0.68	0.37		
NO_3	mg/l N	0.44	0.20	0.49	0.16	0.29	0.32	0.16	0.09	0.74	1.23	0.13	0.44	0.09	0.5	0.36	<0.05	<0.05	0.33	0.32	0.63	0.29	10	
NO_2	mg/l N	0.19	<0.05	0.09	<0.05	0.12	<0.05	<0.05	0.24	0.35	0.16	0.25	<0.05	<0.05	0.23	0.06	0.24 J	<0.05	0.13	<0.05	0.05	0.08	1	
NH_4	mg/l N	<0.05	<0.05	0.12	<0.05	0.06	<0.05	<0.05	<0.05	0.26	0.35	0.11	0.05	<0.05	0.11	<0.05	0.12	0.09	0.24	<0.05	0.08	0.51		
PO_3	mg/l	5.4	13. J	6.4	29. J	11	2.5 J	0.46	5.3 J	9.3	5.8	0.76	1.8	0.11 J	0.3	18	0.6	3.1 J	0.09	0.44 J	0.48	0.71		
PO_3 Ortho	mg/l	0.17	0.10 J	0.07	0.12 J	0.14	0.17 J	0.07	0.29 J	0.12	0.18	0.03	0.25	0.02 J	0.03	0.08	0.07	0.04 J	0.04	0.03 J	0.03	0.02		
Dissolved Metals																								
Ag	mg/l	<0.001	<0.0005	<0.001	<0.0005	<0.001	<0.0005	<0.001	<0.0005	<0.001	<0.001	<0.001	<0.001	<0.0005	<0.001	<0.001	<0.001	<0.0005	<0.001	<0.0005	<0.001	<0.001		0.1
Al	mg/l	<0.1	<0.1	<0.1	**1.3 J**	<0.1	<0.1	<0.1	**1.1 J**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		0.2
As	mg/l	0.002	<0.003	0.002	<0.003	0.003	<0.003	0.002	<0.003	0.003	0.002	0.002	0.003	<0.003	0.002	<0.003	0.003	<0.003	0.003	<0.003	0.003	0.003	0.05	
B	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
Ba	mg/l	0.01	<0.02	<0.01	0.04	0.01	0.06	0.04	0.05	0.01	0.02	0.04	0.12	0.1	0.08	<0.1	0.02	0.12	0.11	0.08	0.04	0.03	2	
Be	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0004	
Cd	mg/l	<0.0001 F	<0.0001	<0.0001 F	<0.0001	<0.0001 F	<0.0001	0.0001 F	<0.0001	<0.0001 F	<0.0001 F	<0.0001 F	0.0014 F	<0.0001	<0.0001 F	<0.0001	0.0007 F	0.0008	0.0012 F	<0.0001	<0.0001 F	0.0004 F	0.005	
Cr	mg/l	<0.01	<0.001	<0.01	<0.001	<0.01	<0.001	<0.01	<0.001	<0.01	<0.01	<0.01	<0.01	0.015	<0.01	<0.01	<0.01	<0.001	<0.01	0.002	0.02	0.02	0.1	
Cu	mg/l	<0.01	<0.001	<0.01	0.001	<0.01	<0.001	<0.01	0.002	<0.01	<0.01	<0.01	<0.01	<0.001	<0.01	<0.01	<0.01	<0.001	<0.01	0.006	<0.01	<0.01	1.3	
Fe	mg/l	<0.05	0.11	<0.05	**1.97 J**	<0.05	0.07	<0.05	**1.57 J**	<0.05	<0.05	<0.05	<0.05	0.16 J	<0.05	0.17	<0.05	0.11 J	<0.05	0.11 J	<0.05	<0.05		0.3
Hg	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.002	
Mn	mg/l	<0.02	<0.005	<0.02	**0.27**	0.03	0.042	0.03	**0.072**	0.03	**0.25**	**0.12**	<0.02	**0.1**	<0.02	<0.02	<0.02	**4.21**	**7.34**	**0.06**	<0.02	<0.02		0.05
Ni	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.1	
Pb	mg/l	<0.001	<0.003	<0.001	<0.003	<0.001	<0.003	<0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.003	<0.001	<0.001	<0.001	<0.003	<0.001	<0.003	<0.001	<0.001	0.015	
Sb	mg/l	0.004	<0.003	<0.001	<0.003	0.005	<0.003	0.002	<0.003	0.005	<0.001	<0.001	<0.001	<0.003	<0.001	<0.003	0.006	<0.003	0.003	<0.003	0.005	0.001	0.006	
Se	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.003	0.003	0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	0.002	<0.001	0.001	0.005	0.05	
Tl	mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.002	
V	mg/l	<0.005	<0.05	<0.005	<0.05	<0.005	<0.05	<0.005	<0.05	<0.005	<0.005	<0.005	<0.005	<0.05	<0.005	<0.05	<0.005	<0.05	<0.005	<0.05	<0.005	<0.005		
Zn	mg/l	<0.02	<0.01	<0.02	0.02	<0.02	0.02	0.1	0.02	<0.02	<0.02	0.16	0.04	0.03	0.02	<0.02	<0.02	0.01	<0.02	0.02	<0.02	<0.02		5
Total Metals																								
Ag	mg/l	<0.001 UJF	n/a	<0.001 UJF	n/a	<0.001 UJF	n/a	<0.001 UJF	n/a	<0.001 UJF	<0.001 UJF	<0.001 UJF	<0.001 UJF	n/a	<0.001 UJF	n/a	<0.001 UJF	n/a	<0.001 UJF	n/a	<0.001 UJF	<0.001 UJF		0.1
Al	mg/l	**176. F**	n/a	**95.2 F**	n/a	**246. F**	n/a	**12.6 F**	n/a	**213. F**	**89.8 F**	**13.3 F**	**5.1 F**	n/a	**6.1 F**	n/a	**11.1 F**	n/a	**57.3 F**	n/a	**11.2 F**	**24.5 F**		0.2
As	mg/l	0.022 F	n/a	0.021 F	n/a	0.034 F	n/a	0.011 F	n/a	0.036 F	0.03 F	0.015 F	0.013 F	n/a	0.011 F	n/a	0.014 F	n/a	0.017 F	n/a	0.012 F	0.012 F	0.05	
B	mg/l	<0.1	n/a	<0.1	n/a	<0.1	n/a	<0.1	n/a	<0.1	<0.1	<0.1	<0.1	n/a	<0.1	n/a	<0.1	n/a	<0.1	n/a	<0.1	<0.1		
Ba	mg/l	0.66 F	n/a	0.79 F	n/a	1.7 F	n/a	0.13 F	n/a	1.98 F	0.54 F	0.22 F	0.18 F	n/a	0.2 F	n/a	0.14 F	n/a	0.59 F	n/a	0.16 F	0.24 F	2	
Be	mg/l	**0.007**	n/a	0.004	n/a	**0.008**	n/a	<0.001	n/a	**0.015**	**0.005**	0.001	<0.001	n/a	<0.001	n/a	<0.001	n/a	0.002	n/a	<0.001	0.001	0.004	
Cd	mg/l	**0.0082**	n/a	0.0027	n/a	0.0034	n/a	0.0007	n/a	**0.0058**	0.0035	0.0014	**0.026**	n/a	0.0007	n/a	0.0007	n/a	**0.01**	n/a	0.0004	0.0005	0.005	
Cr	mg/l	**0.15 F**	n/a	0.06 F	n/a	**0.18 F**	n/a	<0.01 F	n/a	**0.11 F**	**0.24 F**	0.02 F	0.03 F	n/a	0.02 F	n/a	0.01 F	n/a	0.05 F	n/a	0.03 F	0.05 F	0.1	
Cu	mg/l	0.05	n/a	0.08	n/a	0.09	n/a	<0.01	n/a	0.08	0.13	0.02	0.01	n/a	0.01	n/a	<0.01	n/a	0.09	n/a	0.02	0.01	1.3	
Fe	mg/l	**259. F**	n/a	**106. F**	n/a	**314. F**	n/a	**10.2 F**	n/a	**233. F**	**115. F**	**26.4 F**	**4.87 F**	n/a	**8.18 F**	n/a	**12. F**	n/a	**56.2 F**	n/a	**12.9 F**	**32.3 F**		0.3
Hg	mg/l	<0.0004 F	n/a	<0.0004 F	n/a	<0.0004 F	n/a	<0.0004 F	n/a	<0.0004 F	0.0004 F	<0.0004 F	<0.0004 F	n/a	<0.0004 F	n/a	**0.0118 F**	n/a	<0.0004 F	n/a	<0.0004 F	<0.0004 F	0.002	
Mn	mg/l	**4.51 F**	n/a	**20.8 F**	n/a	**42.7 F**	n/a	**0.24 F**	n/a	**5.13 F**	**1.29 F**	**1.78 F**	**0.21 F**	n/a	**2.05 F**	n/a	**2.86 F**	n/a	**10.8 F**	n/a	**0.71 F**	**3.41 F**		0.05
Ni	mg/l	**0.2 F**	n/a	0.07 F	n/a	**0.2 F**	n/a	<0.02 F	n/a	**0.11 F**	**0.19 F**	0.04 F	**0.15 F**	n/a	<0.02 F	n/a	<0.02 F	n/a	0.06 F	n/a	<0.02 F	0.03 F	0.1	
Pb	mg/l	**0.063**	n/a	**0.051**	n/a	**0.19**	n/a	0.014	n/a	**0.24**	**0.058**	**0.024**	0.008	n/a	0.015	n/a	**0.017**	n/a	**0.028**	n/a	0.01	**0.024**	0.015	
Sb	mg/l	<0.001 UJ	n/a	0.002 J	n/a	<0.001 UJ	n/a	0.002	n/a	<0.001 UJ	<0.001 UJ	<0.001 UJ	<0.001 UJ	n/a	<0.001 UJ	n/a	<0.001 UJ	n/a	<0.001 UJ	n/a	<0.001 UJ	<0.001 UJ	0.006	
Se	mg/l	<0.001	n/a	<0.001	n/a	<0.001	n/a	<0.001	n/a	0.006	0.006	<0.001	<0.001	n/a	<0.001	n/a	<0.001	n/a	<0.001	n/a	<0.001	<0.001	0.05	
Tl	mg/l	**0.005**	n/a	<0.002	n/a	<0.002	n/a	<0.002	n/a	<0.002	<0.002	<0.002	<0.002	n/a	<0.002	n/a	<0.002	n/a	<0.002	n/a	<0.002	<0.002	0.002	
V	mg/l	0.29 F	n/a	0.063 F	n/a	0.13 F	n/a	0.008 F	n/a	0.14 F	0.049 F	0.017 F	0.015 F	n/a	0.007 F	n/a	0.014 F	n/a	0.051 F	n/a	0.011 F	0.021 F		
Zn	mg/l	0.78 F	n/a	0.65 F	n/a	1.01 F	n/a	0.35 F	n/a	1.25 F	1.09 F	0.43 F	1.09 F	n/a	0.11 F	n/a	0.14 F	n/a	0.22 F	n/a	0.07 F	0.16 F		5

Notes: All concentrations reported in milligrams per liter (mg/l)
< indicates parameter was not detected above the listed practical quantitation limit (PQL),
J = estimated concentration,
UJ = Reported PQL for sample is approximate
F = field duplicate results exceeded acceptable limits, Bold and shaded values exceeds ground water standard listed in IDAPA 58.01.11 (IDAPA, 2002b),
Results for total metals are not considered to be representative of in-situ conditions because of high sample turbidity

TABLE 3.3-15
GROUNDWATER QUALITY IN BEDROCK MONITORING WELLS

Hydrostratigraphic Unit		Rex Chert						Upper Meade Peak			Wells / RC.	Ground Water Standard	
Sample Station		NR-C-4	NR-C-4	NR-R-2	NR-R-2	NR-R-12	NR-R-12	NR-C-3	NR-C-3	NR-C-3	DC # 2		
Date		10/4/01	6/13/02	10/3/01	6/13/02	10/6/01	6/13/02	10/5/01	6/13/02	6/13/02	5/20/02	Primary	Secondary
General Parameters													
pH (field)	Std. Units	n/a	6.74	**5.9**	**5.21**	7.1	6.75	6.5	**6.23**	**6.23**		6.5 - 8.5	
pH (lab)	Std. Units	n/a	7.6	6.7	7	7.8	7.6	7.6	7.8	7.8	7.2	6.5 - 8.5	
Temp. (field)	C	n/a	10.2	7.6	6.4	7.7	7.7	7.2	9.6	9.6			
Total Alkalinity	mg/l $CaCO_3$	n/a	210	62	43	168	176	194	131	131	157		
Bicarbonate Alkalinity	mg/l HCO_3	n/a	256. F	76	52. F	205	215. F	237	160. F	160. F	157		
Carbonate Alkalinity	mg/l CO_3	n/a	0	0	0	0	0	0	0	0	<2.		
Hydroxide	mg/l	n/a	0	0	0	0	0	0	0	0	<2.		
Acidity	mg/l $CaCO_3$	n/a	<2.	<2.	41	<2.	<2.	<2.	<2.	<2.			
E.C. (field)	umhos/cm	n/a	512	213	148	314	553	450	296	296			
E.C. (lab)	umhos/cm	n/a	610	187	134	348	572	324	277	278	403		
TDS	mg/l	n/a	421	278	405	98	398	288	176	215			500
Hardness	mg/l $CaCO_3$	n/a	381	42	53	182	354	213	158	162	193		
Major Ions													
Ca	mg/l	n/a	113	12	13	45	79	59	45	45	46.9		
Cl	mg/l	n/a	<4.	4	<4.	6	6	<4.	<4.	<4.	5		250
F	mg/l	n/a	0.58	0.15	0.31	0.17	0.17	0.24	0.94	0.87	n/a	4	
K	mg/l	n/a	2	1	<1.	<1.	<1.	1	<1.	<1.	n/a		
Mg	mg/l	n/a	24	3	5	17	38	16	11	12	18.4		
Na	mg/l	n/a	7	35	7	5	5	10	6	6	12.9		
SO_4	mg/l	n/a	135	44	26	25	141	43	21	24	20		250
Nutrients													
$NO_3 + NO_2$	mg/l N	n/a	<0.05	0.90	1.23	<0.05	0.08	0.91	0.34	0.29			
NO_3	mg/l N	n/a	<0.05	0.25	1.05	<0.05	<0.05	0.91	0.16	0.11		10	
NO_2	mg/l N	n/a	0.12 J	0.65	0.18	<0.05	<0.05	<0.05	0.18	0.18		1	
NH_4	mg/l N	n/a	0.1	<0.05	0.1	<0.05	0.07	0.1	0.12	0.11			
PO_3	mg/l	n/a	2.3	5.4	2	0.13	0.07	20	2.9	3.7			
PO_3 Ortho	mg/l	n/a	0.02	0.04	0.56	0.02	0.04	0.13	0.19	0.19			
Dissolved Metals													
Ag	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001			0.1
Al	mg/l	<0.1	<0.1	**0.5**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			0.2
As	mg/l	<0.001	0.004	0.001	0.003	<0.001	0.003	0.004	0.007	0.007		0.05	
B	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Ba	mg/l	<0.1	0.03	0.2	0.05	<0.1	0.02	<0.1	<0.01	<0.01		2	
Be	mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		0.0004	
Cd	mg/l	**0.0057**	**0.008 F**	0.0013	0.0006 F	<0.0001	<0.0001 F	0.0019	0.0004 F	0.0005 F	<0.008	0.005	
Cr	mg/l	<0.01	<0.01	0.03	<0.01	<0.01	<0.01	0.02	<0.01	<0.01		0.1	
Cu	mg/l	<0.01	<0.01	<0.01	<0.01	0.04	<0.01	<0.01	<0.01	<0.01		1.3	
Fe	mg/l	0.19	<0.05	**0.77**	<0.05	0.1	<0.05	0.15	<0.05	<0.05			0.3
Hg	mg/l	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002		0.002	
Mn	mg/l	**0.32**	**0.32**	**0.08**	<0.02	**0.09**	**0.89**	**0.06**	<0.02	<0.02			0.05
Ni	mg/l	**0.36**	**0.55**	0.04	0.02	0.02	**0.39**	0.08	0.06	0.05			
Pb	mg/l	<0.001	<0.001	0.009	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		0.015	
Sb	mg/l	0.005	0.002	<0.001	0.005	0.001	0.005	<0.001	0.002	0.002		0.006	
Se	mg/l	0.021	0.001	0.005	0.005	<0.001	0.002	**0.082**	0.02	0.02	<0.001	0.05	
Tl	mg/l	0.002	<0.002	0.002	<0.002	0.002	<0.002	<0.002	<0.002	<0.002		0.002	
V	mg/l	0.018	<0.005	0.02	<0.005	<0.005	<0.005	0.014	<0.005	0.009			
Zn	mg/l	0.37	1.3	0.17	0.04	0.1	0.5	0.2	0.13	0.13			5
Total Metals													
Ag	mg/l	n/a	<0.001 UJF	n/a	<0.001 UJF	n/a	<0.001 UJF	n/a	0.004 JF	<0.001 UJF			0.1
Al	mg/l	n/a	**1. F**	n/a	**53.9 F**	n/a	<0.1 F	n/a	**5.3 F**	**3.9 F**			0.2
As	mg/l	n/a	0.018 F	n/a	0.026 F	n/a	0.015 F	n/a	0.038 F	0.032 F		0.05	
B	mg/l	n/a	<0.1	n/a	<0.1	n/a	<0.1	n/a	<0.1	<0.1			
Ba	mg/l	n/a	0.05 F	n/a	1.01 F	n/a	0.04 F	n/a	0.05 F	0.03 F		2	
Be	mg/l	n/a	<0.001	n/a	**0.008**	n/a	<0.001	n/a	<0.001	<0.001		0.004	
Cd	mg/l	n/a	**0.016**	n/a	**0.008**	n/a	0.0006	n/a	**0.0064**	0.0044		0.005	
Cr	mg/l	n/a	0.02 F	n/a	0.07 F	n/a	<0.01 F	n/a	**0.13 F**	0.09 F		0.1	
Cu	mg/l	n/a	0.01	n/a	0.05	n/a	<0.01	n/a	0.04	0.03		1.3	
Fe	mg/l	n/a	**1.89 F**	n/a	**47.1 F**	n/a	**0.7 F**	n/a	**10.8 F**	**6.93 F**			0.3
Hg	mg/l	n/a	<0.0004 F	n/a	<0.0004 F	n/a	<0.0004 F	n/a	**0.0055 F**	<0.0004 F		0.002	
Mn	mg/l	n/a	**0.34 F**	n/a	**0.57 F**	n/a	**0.96 F**	n/a	**0.32 F**	**0.18 F**			0.05
Ni	mg/l	n/a	**0.73 F**	n/a	**0.29 F**	n/a	**0.5 F**	n/a	**0.28 F**	**0.22 F**		0.1	
Pb	mg/l	n/a	0.004	n/a	**0.095**	n/a	<0.001	n/a	**0.029**	**0.026**		0.015	
Sb	mg/l	n/a	0.002	n/a	<0.001 UJ	n/a	<0.001 UJ	n/a	0.003 J	0.002		0.006	
Se	mg/l	n/a	0.005	n/a	0.012	n/a	<0.001	n/a	0.036	0.03		0.05	
Tl	mg/l	n/a	<0.002	n/a	<0.002	n/a	<0.002	n/a	<0.002	<0.002		0.002	
V	mg/l	n/a	0.016 F	n/a	0.071 F	n/a	<0.005 F	n/a	0.062 F	0.048 F			
Zn	mg/l	n/a	1.43 F	n/a	1.25 F	n/a	0.53 F	n/a	1.18 F	0.81 F			5

Notes:
< indicates parameter was not detected above the listed practical quantitation limit (PQL),
J = estimated concentration,
UJ = Reported PQL for sample is approximate
F = field duplicate results exceeded acceptable limits,
Bold and shaded values exceeds ground water standard listed in IDAPA 58.01.11 (IDAPA, 2002b), Results for total metals are not considered to be representative of in-situ conditions because of high sample turbidity

3.3.6 Groundwater Use

Water rights registered with IDWR are listed in **Table 3.3-16** and are shown in **Figure 3.3-4**. The project is located in State Water District 27.

TABLE 3.3-16
WATER RIGHTS FOR WELLS AND SPRINGS IN THE VICINITY OF NORTH RASMUSSEN RIDGE MINE

Water Right Number	Owner Name	Point of Diversion	Source	Diversion Rate (cfs)	Water Uses	Distance from Proposed Action (miles)
27-11279	Taylor, Ray N	T6S R43E Sec. 17 SWSENW	Groundwater	0.03	S	2.0
27-11285	Nuffer, Phyllis and Tod	T6S R43E Sec. 17 SWSENW	Groundwater	0.03	S	2.0
27-11255	Thompson, Cheryl H and Sidney G	T6S R43E Sec. 08 SESWSW	Groundwater	0.07	D, S	2.0
27-11256	Thompson, Cheryl H and Sidney G	T6S R43E Sec. 08 SESWSW	Groundwater	0.09	S	2.0
27-7540	Nu-West Industries Inc	T6S R43E Sec. 26 NWSW	Groundwater	0.89	I	1.75
27-7452	P4 Production LLC (Current); Monsanto Co (Original)	T6S R43E Sec. 21 SWNE	Groundwater	0.3	M	1.0
27-7451	P4 Production LLC (Current); Monsanto Co (Original)	T6S R43E Sec. 21 SWSE	Groundwater	0.1	D, I	1.25
27-11412	US Dept of Agriculture; USFS	T6S R43E Sec. 35 SWSW	Spring	0.02	S	2.75
27-11277	Idaho Citizens Grazing Assoc (Current)	T6S R43E Sec. 28 SWSESW	Spring	0.05	S	1.75
27-4036	Us Dept Of Agriculture	T6S R43E Sec. 13 NWNW	Midnight Spring	0.02	S	2.25
27-11551	US Dept of Agriculture; USFS	T6S R43E Sec. 25 NESW	Spring	0.02	S	2.25

Notes:
T = Township, R = Range, Sec = Section, N = North, E = East, S = South, W = West, cfs = cubic feet per second
The following sections are included in the water rights database search: T6S, R43E, Sections 3,4,5,8,9,10,11,13,14,15,16,17,21,22,23,25,26,27,28
Water use categories are: D = Domestic, S = Stockwater, C = Commercial, I = Industrial, M = Mining

3.3.7 Seeps and Springs

Ten seeps and springs have been identified in Reese Canyon, West Fork of Sheep Creek, and along the Central Rasmussen Mine access road (**Figure 3.3-3**). Flow rates were measured at these seeps and springs in June 2002 and August 2002 (**Table 3.3-17**). Water quality parameters (temperature, pH, and electrical conductivity) were also measured in the field in August 2002 (**Table 3.3-17**).

Spring CMR is located on the southwest side of the Central Rasmussen Mine access road in the No Name Creek Drainage at an elevation of 7,020 feet above mean sea level (amsl) (170 feet above the local bedrock groundwater level). Spring CMR flows throughout the year and issues

from colluvium on the northeast flank of a ridge that contains outcrops of Rex Chert. Based on the spring's location above the local bedrock groundwater level and the low electrical conductivity of the spring water (92 microsiemens per centimeter [µS/cm]), the origin of the spring is believed to be shallow infiltration of precipitation into alluvium and colluvium and the outcropping Rex Chert bedrock located directly above the spring (Whetstone 2002).

TABLE 3.3-17
FLOW RATES AND FIELD WATER QUALITY PARAMETERS FOR SPRING AND SEEPS IN THE VICINITY OF NORTH RASMUSSEN RIDGE MINE

Station	Location	Occurrence	Flow Rate June 10-11 & July 15, 2002	Flow Rate August 13, 2002	Temp	PH	EC
			(gpm)	(gpm)	(°F)	(su)	(µS/cm)
CMR	Haul Road	Flowing Seep	<1	<0.10	55.0	6.10	92.0
WSCE	West Sheep Creek	Seep associated with wetland area	1	Diffuse flow/not measurable	54.3	6.46	677
WSCW	West Sheep Creek	Seep associated with wetland area	<1	Damp/no open water	--	--	--
RCTS	Upper Reese Canyon	Seep associated with wetland area	<1	No outflow/not measurable	52.9	6.33	239
URCN	Upper Reese Canyon	Seep associated with wetland area	<1	≈0.5	51.3	7.68	336
URCS	Upper Reese Canyon	Seep associated with wetland area	<1	No outflow/not measurable	52.6	7.12	204
MP	Lower Reese Canyon	Spring pond with associated wetland	<1	No outflow/not measurable	61.2	7.05	387
LLP	Lower Reese Canyon	Spring pond with associated wetland	<1	≈0.75 at pond outflow	56.5	6.81	437
BLLP	Lower Reese Canyon	Spring pond with associated wetland	<1	Diffuse outflow/not measurable	66.6	9.85	138
BLLP2	Lower Reese Canyon	Spring pond with associated wetland	<1	Not observed	61.1	7.73	288

Notes: EC = electrical conductivity
gpm = gallons per minute
SU = standard units
µS/cm = microsiemens per centimeter

Springs WSCE and WSCW are located in the West Fork of Sheep Creek on the margins of a wetland area in the center of the drainage. WSCE and WSCW flow or are damp throughout the year and issue from alluvium and colluvium in the drainage.

Seven springs occur in Reese Canyon Creek, where the bedrock strikes northwest parallel to the canyon and dips steeply to the northeast. The geologic section, moving from east to west, includes Rex Chert, Meade Peak, and Wells Limestone. A fault has also been mapped in Reese Canyon that extends from the divide between the West Fork of Sheep Creek to the Little Blackfoot River. Alluvial cover in the drainage can be several tens of feet thick. Near the springs in Reese Canyon, the elevation of the regional groundwater flow system is estimated at 6,260 feet amsl (about 300 to 500 feet below the ultimate pit floor) (Whetstone 2002).

Spring RCTS is located near the head of Reese Canyon and is associated with two small wetland areas in the bottom of the drainage. The spring is located in a depression in alluvium and colluvium along the valley floor and is wet throughout the year. Probable sources of water for

the spring flow include the alluvium and colluvium associated with drainage in Reese Canyon and possibly water from the local bedrock groundwater flow system on the east side of the canyon.

Springs URCN and URCS are located in the upper reach of Reese Canyon near the center of the drainage and are associated with a small wetland area. The two springs issue from alluvium and colluvium in the valley floor bottom and are near each other. The springs are perennial and remain wet throughout the year. Probable sources of water for the spring flows include the alluvium and colluvium associated with drainage in Reese Canyon, perched shallow groundwater, and water from the local bedrock groundwater flow system on the east side of the canyon (Whetstone 2002).

Stations MP, LLP, BLP, and BLP2 are located in the lower portion of Reese Canyon and consist of a series of shallow spring ponds that were constructed along the valley floor. Pond MP occurs within an enclosed depression. Ponds LLP, BLP, and BLP2 are associated with an extensive wetland area common to the three stations. The spring ponds contain water throughout the year and are probably supplied by the alluvium and colluvium associated with drainage in Reese Canyon and water from the local bedrock groundwater flow system on the east side of the canyon (Whetstone 2002).

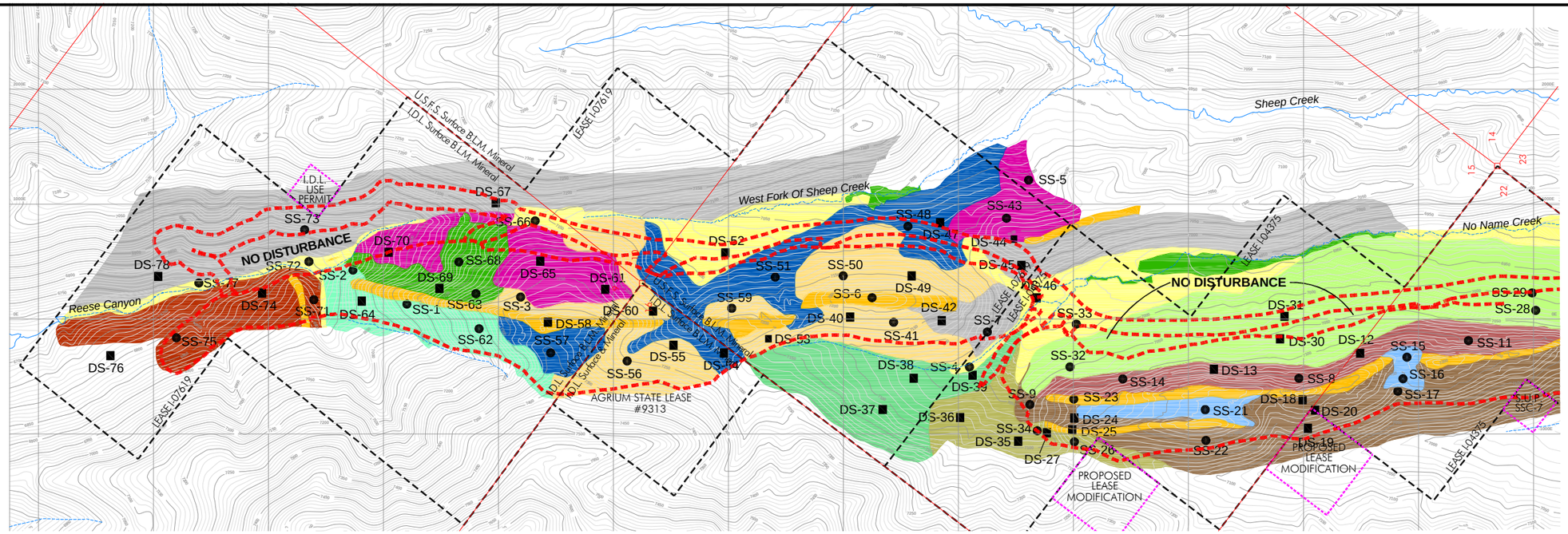
3.4 WATERSHED AND SOILS

Marine sedimentary rocks characterize the study area, which includes the Phosphoria Formation, one of the world's largest known reserves of phosphate and the target formation for the mine. The region lies within the middle Rock Mountain Basin and Range physiographic provinces. Topographic and structural features resulted from folding and thrusting of sediments during the Laramide Orogeny.

3.4.1 Soil Resources

Agrium conducted an Order II baseline soil inventory on 250 acres within the project area (Maxim 2001c). This area has also been mapped on the Order III level by the Soil Survey of the Caribou National Forest, Idaho (USFS 1990). Soil classifications and other data used for this analysis were extracted from these two reports. Soil units are mapped in **Figure 3.4-1**. **Table 3.4-1** contains a summary of characteristics of the soil, including two categories for describing current areas of concern for soils, and constraints on reclamation and construction. The **Reason Soil is Marginal** category explains the chemical or physical characteristics of a soil that might affect soil productivity currently and during reclamation. **Table 3.4-2** explains the process for rating suitability of topsoil for reclamation (Maxim 2001c).

Soil on ridges and plateaus in the project area has developed from residuum from sandstone, shale, and siltstone. Soil on slopes has developed from colluvium from the same parent material, while alluvial materials form soil in the drainages and swales. Depth of soils in the project area ranges from very deep (> 60 inches) in valleys and sideslopes to shallow (< 11 inches) on ridgetops, and all soils are well-drained.



Map Unit	Component	% of Unit	% Slope
A complex	Typic Haplocryolls	50	40-50
	Pachic Argicryolls	35	
	Pachic Palecryolls	15	
	Disturbance Area		
	Mollic Haplocryalfs	15	
	Rock Outcrops		
B complex	Typic Argicryolls	45	15-25
	Mollic Haplocryalfs	20	
	Typic Haplocryolls	20	
	Pachic Haplocryolls	15	
	Disturbance Area		
C complex	Pachic Haplocryolls	65	0-10
	Pachic Palecryolls	20	
	Pachic Argicryolls		
	Typic Haplocryolls	15	
	Typic Argicryolls		
	Disturbance Area		
D complex	Cryaquolls	100	0-10
	Cryaqualfs		
E complex	Pachic Haplocryolls	65	0-10
	Pachic Argicryolls	20	
	Typic Haplocryolls		
	Typic Argicryolls	15	
	Mollic Haplocryalfs		
	Disturbance Area		

Map Unit	Component	% of Unit	% Slope
F complex	Lithic Haplocryolls	30	0-40
	Lithic Haplocryalfs	25	
	Rock Outcrops	30	
	Typic Haplocryolls		
	Typic Haplocryalfs	15	
	Disturbance Area		
G complex	Mollic Haplocryalfs	60	10-40
	Typic Haplocryalfs	25	
	Typic Haplocryolls		
	Typic Argicryolls	15	
	Typic Argicryalfs		
	Disturbance Area		
H complex	Typic Argicryolls	50	10-30
	Typic Haplocryolls	20	
	Pachic Haplocryolls	15	
	Mollic Haplocryalfs		
	Typic Haplocryalfs	15	
	Disturbance Area		
I complex	Mollic Argicryalfs	65	0-15
	Typic Cryofluvents	20	
	Typic Haplocryalfs		
	Typic Argicryalfs	15	
	Typic Haplocryolls		
	Disturbance Area		

Map Unit	Component	% of Unit	% Slope
J complex	Typic Haplocryolls	60	10-40
	Typic Argicryolls	25	
	Mollic Haplocryalfs		
	Pachic Haplocryolls	15	
	Typic Haplocryalfs		
	Disturbance Area		
K complex	Pachic Haplocryolls	65	20-35
	Pachic Palecryolls	20	
	Typic Haplocryolls		
	Typic Argicryolls	15	
	Mollic Haplocryalfs		
	Disturbance Area		
L complex	Pachic Palecryolls	40	10-25
	Pachic Haplocryolls	30	
	Typic Argicryolls	15	
	Typic Haplocryolls		
	Pachic Argicryolls	15	
	Disturbance Area		
M complex	Typic Argicryolls	50	0-20
	Typic Haplocryolls	35	
	Pachic Haplocryolls		
	Pachic Argicryolls	15	
	Pachic Palecryolls		
	Disturbance Area		

Map Unit	Component	% of Unit	% Slope
N complex	Mollic Haplocryalfs	25	10-20
	Mollic Argicryolls	20	
	Typic Haplocryalfs	20	
	Typic Haplocryolls	20	
	Typic Argicryolls	15	
	Disturbance Area		
O complex	Mollic Haplocryalfs	80	10-25
	Mollic Argicryolls		
	Typic Haplocryolls	15	
	Typic Argicryolls		
	Disturbance Area		
P complex	Typic Argicryolls	85	10-25
	Typic Haplocryolls		
	Mollic Haplocryalfs	15	
	Disturbance Area		

- LEASE I-07619 & I-04375
- LEASE MODIFICATIONS & USE PERMITS
- PERENNIAL STREAMS
- INTERMITTENT STREAMS

SS-1● SOIL SAMPLE LOCATION
DS-1■ DESCRIPTION SITE LOCATION

DELINEATION BOUNDARY

LIMIT OF DISTURBANCE

"A" COMPLEX
"B" COMPLEX
"C" COMPLEX
"D" COMPLEX
"E" COMPLEX
"F" COMPLEX
"G" COMPLEX
"H" COMPLEX
"I" COMPLEX
"J" COMPLEX
"K" COMPLEX
"L" COMPLEX
"M" COMPLEX
"N" COMPLEX
"O" COMPLEX
"P" COMPLEX

0 1000 2000
Scale (ft)

NORTH

Source: Maxim 2001c

North Rasmussen Ridge Mine EIS Project

FIGURE 3.4-1
SOILS MAP

ANALYSIS AREA: Caribou County, Idaho.

Date: 02.27.03	Drawing File: 1164 SOILS.dwg
Scale: 1" = 1000 FEET	Drawn By: MTM

TABLE 3.4-1
MAJOR SOIL MAP UNIT CHARACTERISTICS

Map Unit	Texture	Physiographic Location	Parent Material	Area (acres)	Average Depth of Soil	Permeability[1]	Depth of Recommended Soil Salvage (inches)	Reason Soil is Marginal
A complex	Gravelly Silty Loam	Colluvial Valley Sideslopes	Sandstone Siltstone Shale	73.1	>60	S-M	40	Organic Matter Content
B complex	Gravelly Loam	Colluvial Valley Sideslopes and Toe Slopes	Sandstone Siltstone Shale	10.8	< 54	S-MS	50	Coarse Fragment Content
C complex	Silty Clay Loam	Stream Terrace	Alluvium	1.2	>60	S-M	60	Coarse Fragment Content
D complex	Wetlands	Flood Plain	Alluvium	NA	These soils are located on wetlands and have been avoided.	---	---	---
E complex	Silty Loam	Alluvial Flat	Alluvium	NA	>60	MS	60	---
F complex	Gravelly, Cobbly, Variable Loam	Ridgetop	Sandstone Siltstone Shale	10.5	<11	M	6-9	---
G complex	Gravelly, Variable Loam	Colluvial Valley Sideslopes	Sandstone Siltstone Shale	16.9	>60	S-M	40	Coarse Fragment Content
H complex	Gravelly Silty Loam	Colluvial Valley Sideslopes and Toe Slopes	Sandstone Siltstone Shale	--	> 60	S-M	50	Coarse Fragment Content
I complex	Gravelly Silty Loam	Mountain Valley Fan and Stream Terrace	Alluvium	NA	>60	M	17	Coarse Fragment Content
J complex	Gravelly Silty Loam	Colluvial Valley Sideslopes	Sandstone Siltstone Shale	25.2	> 60	S-M	24	Coarse Fragment Content

TABLE 3.4-1 (CONT.)
MAJOR SOIL MAP UNIT CHARACTERISTICS

K complex	Gravelly Loam	Colluvial Valley Sideslopes	Sandstone Siltstone Shale	34.1	35-60	S-M	34	Coarse Fragment Content
L complex	Gravelly Silty Loam	Colluvial Valley Sideslopes and Toe Slopes	Sandstone Siltstone Shale	46.2	43-60	S-M	55	Coarse Fragment Content
M complex	Gravelly Silty Loam	Benches, Colluvial Valley Sideslopes and Toe Slopes	Sandstone Siltstone Shale	1.3	>60	S-M	60	Coarse Fragment Content
N complex	Gravelly Loam	Colluvial Valley Sideslopes and Toe Slopes	Sandstone Siltstone Shale	18.4	40-60	S-M	33	Coarse Fragment Content
O complex	Gravelly Silty Loam	Colluvial Valley Sideslopes and Toe Slopes	Sandstone Siltstone Shale	--	60	S-M	28	Coarse Fragment Content
P complex	Gravelly Silty Loam	Colluvial Valley Sideslopes and Toe Slopes	Sandstone Siltstone Shale	--	60	S-M	36	Coarse Fragment Content

Note: [1] Permeability: S-M = Slow to moderately slow, MS = Moderately slow, M = Moderate.

Source: Maxim 2001c

TABLE 3.4-2
TOPSOIL SUITABILITY RATING GUIDE

Property	Good	Fair	Poor	Unsuitable
Texture (<3% organic matter)	---	loamy coarse sand, loamy sand, loamy fine sand, loamy very fine sand, sandy clay loam, clay loam, silty clay loam	Coarse sand, sand, fine sand, very fine sand, silty clay, clay, sandy clay	>60% Clay content
Texture (>3% organic matter and <35% clay)	Clay Loam, Silty Clay Loam, Sandy Clay Loam	---	---	---
Stoniness	1	2	3	4, 5
Rock Fragments (%) Volume	<15	15 to 25	25 to 35	>35
Salinity (mmhos/cm)	<4	4 to 8	8 to 15	>15
Depth to High Water Table (ft)	---	---	<1	Perennial Wetness
Sodium Adsorption Ratio (%)	0 to 4	4 to 8	8 to 16	>16
pH (su)	6 to 8	5 to 6, 8 to 8.5	4.5 to 5, 8.5 to 9.0	<4.5, >9.0
Slope (%)	<8	8 to 25	25 to 40	>40
Calcium Carbonate (%)	---	---	>15 to 40	>40
Total selenium (mg/kg)	---	<10	10-15[1]	>15

Note: [1] Soils with selenium in this range recommended for potted soil study for reclamation plantings.
Source: Maxim 2001c.

Silty clay and sandy loams dominate the soil texture with varying percentages of coarse materials and slope steepness. Generally, location dictates slope and the percentage of coarse material. Detailed information on soils is presented in the baseline study report (Maxim 2001c).

3.4.1.1 Physical Characteristics

Soil complex types F, I, J, L, and N have been identified as shallow soils. Excessive coarse fragments occur in nearly all complexes. Shallowness and coarseness are two major factors in evaluating the suitability of topsoil for reclamation (**Table 3.4-2**). Complexes D, E, F, and I are the only complexes that are not affected by low organic content. Soils also have biological surface layers that include bacteria, rhizomes and seeds, and at higher elevations, mosses and lichens. Organic matter supplies many factors, such as tilth, fertility, and permeability that are beneficial to soil productivity. Complex D is listed as frequently flooded, and Complexes C and I are only intermittently flooded. Complex D, which occurs in wetland areas, can be described as a wet soil. Slope steepness is an important component of soil suitability, as it can alter the potential for water erosion and soil movement. Complex A, located on top of Rasmussen Ridge in the southern half of the disturbed area, occurs on excessive slopes, defined as more than 40 percent (Maxim 2001c).

The stability of overburden fill slopes is attributed to a combination of factors, including water-erodibility potential (K-factor) and percent slope range of the overburden fill material and growth media soil, the reclamation slope contour of the overburden fill, the topography, seismic characteristics of the underlying excavated area, and stress resulting from shock loading or overloading. Soil Complex type A, located on top of Rasmussen Ridge in the southern half of the disturbed area, is the only soil type that occurs on excessibe slopes, defined as over 40 percent (Maxim 2001c). Introduction of excess water, snow, mud or ice can weaken overburden material strength, increasing the potential for slope instability and failure. A total of 22 sample sites contained K-factors above 0.40, which is considered high water erosion potential; however, these high K-factors occur in the subsoil, which underlies the reclamation surface growth media soil. Soils within the project area are relatively coarse, but permeability is rated slow to medium, so water infiltration through the reclamation surface into the underlying overburden would be slowed. Slopes left at the initial angle of backfill for extended periods of time are more likely to experience instability than those that are regraded immediately after construction. The Rasmussen Ridge study area lies within a Zone III seismic region and approximately 20 earthquakes capable of damaging structures (rating of 5 or greater on the Richter Scale) have occurred in the area from 1880 to 1994. Similar future earthquake activity would be expected in the study area (Section 3.1.3 Geology/Geologic Hazards). In the even of an earthquake of 5 or greater rating on the Richter Scale, the majority of any soil movement would be expected at the top of Rasmussen Ridge in the southern half of the disturbed area, in the location of Soil Complex A. Shock loading occurs when heavily loaded trucks roll to the crest of the overburden fill, while overloading occurs when too much backfill is placed on a given area of the backfill; therefore, avoiding both loading situations would decrease the potential for slope failure.

Physical characteristics of soil that may limit its use for reclamation include excessive coarse fragments (numerous large fragments impair handling soils with equipment), wetland soils, fractured rock, and location on steep slopes. No landslides or slope failures have been reported

by Agrium on Rasmussen Ridge. No slope failures in existing waste rock dumps have been reported by Agrium.

3.4.1.2 Chemical Characteristics

Numerous soils samples were collected for chemical analysis. The pH of soil ranges from very acidic to mildly alkaline but does not drop below the acceptable suitability limit of 4.5 (**Table 3.4-2**). Soil samples SS-1 (Complex G), SS-3 (Complex J), SS-7 (Complex K), and SS-1 (Complex M) all contained horizons with a pH lower than 5.0. Although these samples were collected within complexes that extend throughout the disturbance area, higher acidity seems to be confined to the higher elevations.

Sodium adsorption ratio (SAR) and electrical conductivity (EC) are signs of sodicity and salinity and indicate the production ability of a soil. High values of either can negatively affect soil productivity. Soil throughout the project area was shown to be generally non-saline and non-sodic (**Table 3.4-2**). Calcium carbonate, which can also affect productivity of soil at high concentrations, was not found in any appreciable amount in soils in the project area. Effervescence indicating the presence of calcium carbonate after hydrochloric acid had been applied was noted at sites SS-22 (G Complex) and SS-25 (H Complex).

3.4.1.3 Selenium in Soil

Due to the potentially toxic effect and presence of selenium in the geologic strata of the region, it has been identified as a constituent of concern. Selenium is found in the highest concentration in sedimentary materials or rocks, especially shales, such as the marine shales of the Meade Peak Member, where unweathered rock generally contains approximately 165 parts per million (ppm). Within these shales, selenium exists as selenide or native selenium, but exposure of the shale to surface conditions can oxidize these compounds to the more soluble and mobile selenite and selenate. The total selenium content of soil reflects the concentration in the parent materials and rock from which the soil is derived, secondary deposition or redistribution of selenium within parent materials and rocks, accumulation or deposition by plants that accumulate selenium (Williams and Schuman 1987). Because of the levels of selenium in geologic formations, soils in the project area have the potential to reach concentrations that could produce forage considered hazardous to livestock.

Total selenium levels were measured at all sample sites in the study area. Most levels in soil were found to contain concentrations of selenium above detection limits, although levels varied considerably between horizons in each soil. Concentrations of selenium are listed by sample site for the 39 samples containing selenium in **Table 3.4-3**. The BLM and USFS have created specific guidelines to simplify identification of possibly hazardous soils. USFS and BLM consider a soil or growth media that contains less than 3 ppm total selenium and 0.1 ppm extractable selenium as suitable for use in reclamation. A soil or growth media that contains between 5 ppm and 13 ppm should have vegetation growth studies conducted, and concentrations greater than 13 ppm total selenium are unsuitable for use in reclamation. Concentrations of selenium greater that 5 ppm occur at higher elevations and are primarily located in the southern portion of the proposed disturbance area. All soil samples but one in **Table 3.4-3** indicate the soil is suitable for reclamation use. Soil sample SS-62 had selenium concentrations greater than 22 ppm at depths from 23 to 60 inches. Data collected from topsoil in Central Rasmussen indicate that concentrations of extractable selenium never exceeded 0.02 ppm, even on soils with a total selenium concentration of more than 20 ppm. The amount of extractable selenium is more important in evaluating plant bioaccumulation than the amount of total selenium, but total selenium can oxidize into mobile selenium and other ionic states (Schoumacher 1999).

TABLE 3.4-3
SELENIUM VALUES PRESENTED BY SAMPLE SITE

Less Than 1 mg/kg	Between 1 and 5 mg/kg	Between 5 and 13 mg/kg	Greater Than 13 mg/kg
SS-4	SS-2	SS-1	SS-62
SS-5	SS-3	SS-7	
SS-28	SS-6	SS-14	
SS-29	SS-8	SS-15	
SS-33	SS-9	SS-17	
SS-43	SS-11	SS-21	
SS-48	SS-16	SS-41	
SS-50	SS-22		
SS-51	SS-23		
SS-56	SS-26		
SS-57	SS-32		
SS-66	SS-34		
SS-75	SS-59		
SS-77	SS-68		
	SS-71		
	SS-72		
	SS-73		

Note: mg/kg = milligrams per kilogram

By definition, toxic seleniferous soils produce forage that could be toxic to livestock. Of the numerous possible forms of selenium in soil, the selenates are the most soluble form of the element and thus, the form most readily taken up by plants. The relatively soluble selenate ion would be most stable under high oxidation potential and alkaline conditions characteristic of arid soils (Williams and Schuman 1987). In acid soils, selenium would be found in ferric selenite

precipitates. The solubility and availability to plants would be quite low. The local climate and relatively low pH of the soil would indicate that selenium in soils is more likely to be in the form of selenite, and thus explain why concentrations of extractable selenium are low. In a study of selenium in soils at Smoky Canyon Mine, column tests were used to evaluate the effects of microbial populations on selenium speciation and association with the shale and organics present in the shale (Crawford, Knotek-Smith, Moller and Henson 2002). It was found that selenium was reduced due to the presence of the specific, enriched microbial populations, but reduction was mostly due to microbial reduction of the environment followed by abiotic reduction of selenium.

However, the discontinuous nature of seleniferous materials and the ability of plants that accumulate selenium to absorb from sources deep within the soil profile indicate that the analysis of constituents in surface soil has serious limitations as a means of forecasting problems with toxicity in potential mine spoils (Williams and Schuman 1987). Thus, seleniferous soils have traditionally been identified by the presence or abundance of the selenium accumulator plant species and not the total or available selenium in soils. Plant species of the *Astragalus* and *Stanleya* genera thrive in seleniferous environments and an abundance of these plant species in an area could indicate the presence of seleniferous soils. Also, the fourwing saltbush (*Atriplex canescens*), which has been used successfully for reclamation of surface mines in the western United States, is a secondary accumulator species. Unfortunately, while these plants grow well in the presence of selenium, they also tend to concentrate selenium much faster than other plants. According to the baseline report on vegetation and wildlife, none of the plant species above exists within the project area and no vegetative samples within the project area contain concentrations of selenium above the detection limit of 1 ppm (Maxim 2001c).

A separate soil study was conducted to evaluate post-reclamation concentrations of selenium and trace metals in soils and vegetation (Greystone 2002). Soil and vegetation samples were collected from the North Dump located southwest of the Central Rasmussen Ridge pit that covers approximately 17 acres. The dump was reclaimed in 1998 and 1999 and is comprised of chert and limestone material that has been covered with two to three feet of topsoil or alluvium. The dump was re-seeded using a mixture of perennial grasses and was fertilized. The results of this study indicate that the total selenium concentrations in soils are within the range considered questionable for use in reclamation. However, extractable selenium concentrations in soil samples are considered acceptable. Concentrations of selenium in vegetation samples collected from the North Dump are also considered acceptable. The results of trace metal analyses indicate that detected concentrations fall within the ranges published in the baseline soil study. With the exception of cadmium, total concentrations of trace metals in soil samples were also within the ranges for western U.S. soils. Average concentrations of manganese, nickel, vanadium, and zinc were above averages reported for western U.S. soils.

While cadmium and zinc concentrations in soils in Greystone (2002) exceeded some ecological soil screening guidelines, they fall within the range of background concentrations published in the baseline soil survey for the North Rasmussen Ridge area (Maxim 2001c). Although Greystone (2002) did not quantify the reclamation success, vegetation appears to be well established on the North Dump. A USFS survey conducted in August 2002 estimated vegetation cover to be approximately 85 percent after the three-year growth period. Questions remain on the rate of selenium oxidation in disturbed soils.

3.4.1.4 Erosion and Permeability

Based in the relatively low levels of selenium available for plant uptake, selenium in groundwater and surface water could be more of a concern for livestock and wildlife than seleniferous plants. For this reason, erosion of soil that leads to sedimentation and leaching to groundwater is a concern. Erosion is the process of soil particles being dislodged and carried away by wind or water.

K-factor and wind erodability group (WEG) were used to evaluate the potential for wind and water erosion. K is the soil erodability factor and is a measure of how susceptible (low, medium, or high) soil particles are to being entrained in moving water and is determined by using the Universal Soil Loss Equation (Soil and Water Conservation Society 1993). The WEG is a classification in the National Soils Handbook (SCS 1999) that ranks soils from 1 to 8, with 1 and 2 representing extremely severe erosion by wind and 7 and 8 being very slightly or not subject to wind erosion. While K-factor and WEG may not affect soil suitability for reclamation, they indicate possible difficulties in handling soil to prevent erosion during mining. Erosion of soil resources, especially seleniferous soil, has the potential to affect water quality if sediment reaches local drainages.

This analysis considered K-factors greater than 0.40 as having high erosion susceptibility (Maxim 2001c). There were 19 samples above 0.40, and of those, six contained selenium concentrations considered marginal for salvaged soils. However, these high K-factors occur in the subsoil and the surface textures of all these soils, except SS-23 (F Complex), which contains coarse fragments. Coarser materials at the surface may lower the potential for erosion by water.

Soils with WEG factors of 1 to 3 show a high susceptibility to wind erosion (SCS 1994). Complexes C and D, alluvial soils found on stream terraces and flood plains in all three creeks in the project area, are the only soil types to have a high wind erosion potential, with a WEG value of 3.

Although soils within the project area are relatively coarse, they are poorly sorted and permeability is rated slow to moderate. Leaching of chemicals from the soil to subsurface strata or groundwater would be slowed, but by no means halted, by the low permeability of the soil. Currently, there is relatively little erosion from the undistributed lands on Rasmussen Ridge.

3.4.1.5 Biological Characteristics

The surface layer (0 to several inches) of most soils supports a biological community of living organisms that support soil productivity such as bacteria, fungi, microrhizae, plant seeds, etc. These organisms only exist with sufficient water, oxygen, and food sources. The presence of these organisms maintains the productivity of soils by contributing to the soil as a fertile substrate for plants. When topsoils are buried for long periods of time, they lose their biological activity due to lack of oxygen and organic matter, and become sterilized. Sterile soils are less suitable for germination of plants than are biologically active soils.

3.4.2 Watersheds

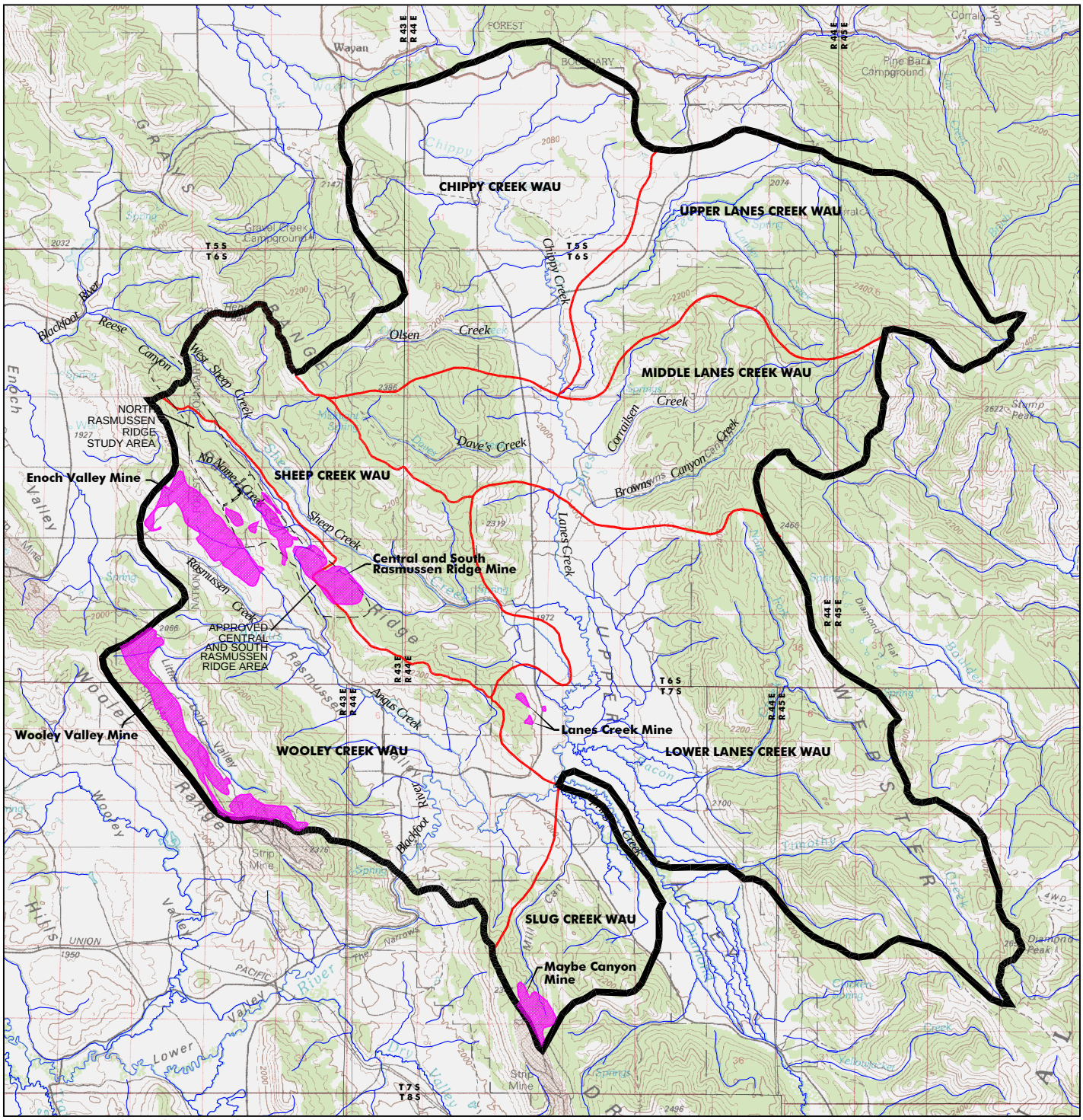
As directed by BLM for the Ecosystem Analysis at the Watershed Scale, Federal Guide for Watershed Analysis, Version 2.2 and the Inland Native Fish Strategy (INFISH), Agrium conducted a Level 1 watershed analysis on all or part of six sixth-code watersheds that comprise the portion of the fifth-code watershed above the Blackfoot Narrows (Maxim 2002e). These sixth-code watershed analysis units (WAUs) - Angus Creek, Sheep Creek, Chippy Creek, Upper Lanes Creek, Middle Lanes Creek and Lower Lanes Creek - are located within the Blackfoot River basin (**Figure 3.4-2**). The project area extends into the Reese Canyon subwatershed, but based on the minimal disturbance in this subwatershed, Reese Canyon was not analyzed. Within these subwatersheds, IDEQ has listed Angus Creek, Lanes Creek, Bacon Creek, Sheep Creek, Timothy Creek, and the Blackfoot River as water quality limited streams as a result of mainly to sediment loading. Yellowstone cutthroat trout and several non-native game fish are present in streams in the watershed.

Landforms in the area have been formed by faulting, erosion, deposition, and intrusions, and represent a variety of ages (Maxim 2002e). Faulting occurs throughout the subwatersheds, and the phosphate-bearing rock has been exposed by faults in the Angus Creek and Sheep Creek subwatersheds.

The project area receives 27 inches of precipitation annually. Perennial streams and their tributaries drain the subwatersheds, and flow consists primarily of snowmelt, rainfall, and groundwater recharge (Maxim 2002e). Peak flows usually occur in May with the snowmelt, but also can occur during summer storms. The springs and seeps that maintain flow in the dry, late summer months stem from Triassic formations in the upper elevations, but loss of surface flow is greatest in these coarse upland areas. Water quality is affected by sedimentation from erosion of soil in uplands areas and by streambank erosion. Groundwater influence is limited, except in the Lower Lanes Creek subwatershed where the Blackfoot River begins, so sediment is mostly transported by overland flow. Ponds or basins associated with mining operations, beaver ponds, and wetland areas make up most of the sediment traps in the area. These impoundments and diversions have altered streamflow in the study area. Beaver dams are found within the upper portions of the study area where there is a supply of wood, while major man-made impoundments are concentrated in areas where mining and agricultural land use are prominent.

Evergreen and aspen stands, sagebrush/grassland, and wetlands constitute the bulk of the vegetative communities in the subwatersheds (Maxim 2002e). Evergreen stands and forested riparian areas occur in the higher elevations, while aspen grow in the transition to the grasslands in the lower regions. Vegetation in the lower riparian areas is dominated by willows, sagebrush, and sedges (Maxim 2002e). Highly functional riparian areas could occur in the Lower Lanes Creek and Angus Creek subwatersheds (Maxim 2002e). Two riparian and wetland communities were found in the area near the proposed project, and will subsequently designated as Category III wetlands. Category III wetlands are common, small, and isolated and support low species diversity.

Topography, limited access, the availability of water, and diverse habitat types makes Rasmussen Ridge ideal for big game, of which elk, mule deer, and moose are the most common.



Source: USGS 100k Quadrangle; Soda Springs, ID

LEGEND

- *Hydrologic Unit Code Boundary*
- *Active/Historic Mine Area*
- *Boundary of the Watershed Analysis Unit*
- *Waterways*

NORTH

0 2 4

Scale in Miles

Source: Maxim 2002e

North Rasmussen Ridge Mine EIS Project

FIGURE 3.4-2
WATERSHED ANALYSIS UNITS

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 water.dwg
Scale: As Noted	Drawn By: MTM

The primary predators include mountain lion, black bear, coyote, badger, and bobcat, which feed mostly on small mammals and birds. Numerous species of bats and birds occur in the area, including nine special status raptors and two upland game birds. Non-game fish, including sculpin and minnow, and game fish (primarily trout), occur in the local streams. Overall, five federally listed or candidate species as well as 18 special status species have the potential to occur in the area.

Land use within the subwatersheds primarily includes timber harvesting, open pit mining, grazing, recreation, and associated roads. Public land administered by the USFS makes up almost two-thirds of the area and nearly the entire Sheep Creek subwatershed. Evidence of all uses has been seen on public land, while livestock operations dominate private land use in the lower elevations (Maxim 2002e).

Table 3.4-4 lists causes of change in the subwatersheds. Hillslope erosion, fluctuating annual precipitation, and wildland fire have historically been the dominant causes of change in the area (Maxim 2002e). Increased risk of catastrophic fire caused by fire suppression practices (road and fire breaks) has raised the potential for sedimentation and runoff, altering water quality in the region. Along with this change in water quality, angler harvest and fish eradication are the major concerns in the decline of the native cutthroat trout. Other human activity, primarily sheep and cattle grazing, mining operations, timber harvesting and road construction, has led to the loss of vegetation and increased erosion and sedimentation that has caused degradation of habitat.

Based on **Table 3.4-4**, Angus Creek is the most influenced subwatershed of the six subwatersheds, because of grazing, mining, road construction, and timber harvest. High instream levels of sediment, limited riparian vegetation, unstable banks, higher stream temperatures, and low macroinvertebrate populations and declining densities of cutthroat trout all indicate some changes are taking place (Maxim 2002e). The Lower Lanes Creek subwatershed exhibits the same characteristics, mostly as a result of grazing, although on a slightly smaller scale than in the Angus Creek subwatershed. Compared with the two subwatersheds discussed above, Chippy Creek, Upper Lanes Creek, and Middle Lanes Creek show moderate influences to subwatershed resources, related mostly to cattle grazing and road construction. Sheep Creek is the least affected of all six subwatersheds (Maxim 2002e). Road construction presents the most immediate threat to Sheep Creek. However, sedimentation and runoff would greatly increase in the event of a large wildfire as a result of fire suppression in the subwatershed.

3.5 VEGETATION, RIPARIAN AREAS AND WETLANDS

A vegetation study was performed in the study area in August 2001 (Maxim 2001d). The study included a survey of vegetation and mapping of dominant plant communities; a survey for threatened, endangered, and special status plants; field verification of previous wetland delineations; and collection and analysis of vegetation samples to document background concentrations of metals. The results of the vegetation study are presented in this section.

TABLE 3.4-4
DOMINANT CAUSES OF CHANGE AND INFLUENCE IN THE SUBWATERSHEDS

Causes of Change	Direct Impacts	Indirect Impacts	Period	Subwatersheds					
				Angus Creek	Sheep Creek	Lower Lanes Creek	Middle Lanes Creek	Upper Lanes Creek	Chippy Creek
Natural Causes									
Hillslope Erosion	Erosion Processes	Stream Channel Water Quality	On-going	M	L	H	M	M	M
Climate Fluctuation	Hydrology	Aquatic Habitat	On-going	H	M	L	M	H	H
Wildland Fire	Vegetation	Hydrology Erosion Processes	On-going	L	H	M	H	H	L
Human Causes									
Fish Eradication	Aquatic Species	-	1960s	U	U	U	U	U	U
Angler Harvest	Aquatic Species	-	Post-Settlement	U	U	U	U	U	U
Cattle Grazing	Vegetation Erosion Processes	Stream Channel Water Quality	Post-Settlement	H	L	H	M	M	H
Mining Operations	Vegetation Hydrology Erosion Processes Water Quality	Stream Channel Water Quality	1969-Present	H	L	M	N	N	N
Road Construction	Vegetation Erosion Processes	Stream Channel Water Quality	Associated Action	H	M	L	M	H	M
Timber Harvests	Vegetation Hydrology Erosion Processes	Stream Channel Water Quality	1974-1994	H	M	M	H	L	L
Sheep Grazing	Vegetation Erosion Processes	Stream Channel Water Quality	Post-Settlement	L	H	M	M	M	L
Fire Suppression	Vegetation	Hydrology Erosion Processes	Post-Settlement	L	H	M	H	H	L

H=High relative influence on trout-bearing streams; M=Moderate relative influence on trout-bearing streams; L=Low relative influence on trout-bearing streams; U=Undistinguishable influences on trout-bearing streams; N=No relative influences on trout-bearing streams

3.5.1 Forest, Upland, and Riparian Communities

Five plant community types were observed in the study area. Plant communities identified included mixed aspen/conifer forest, conifer, sagebrush/grassland, aspen forest, and riparian/wetlands (**Figure 3.5-1**). The mixed aspen/conifer forest was the most common community, making up 40 percent of the total cover in the study area. Conifer forest represented 30 percent of the total cover in the study area. The sagebrush/grassland community constituted approximately 28 percent of the study area. Aspen forest represented approximately 7 percent of the study area. Riparian/wetland communities represented less than 1 percent of the study area. Dominant species of each plant community are summarized in **Table 3.5-1**.

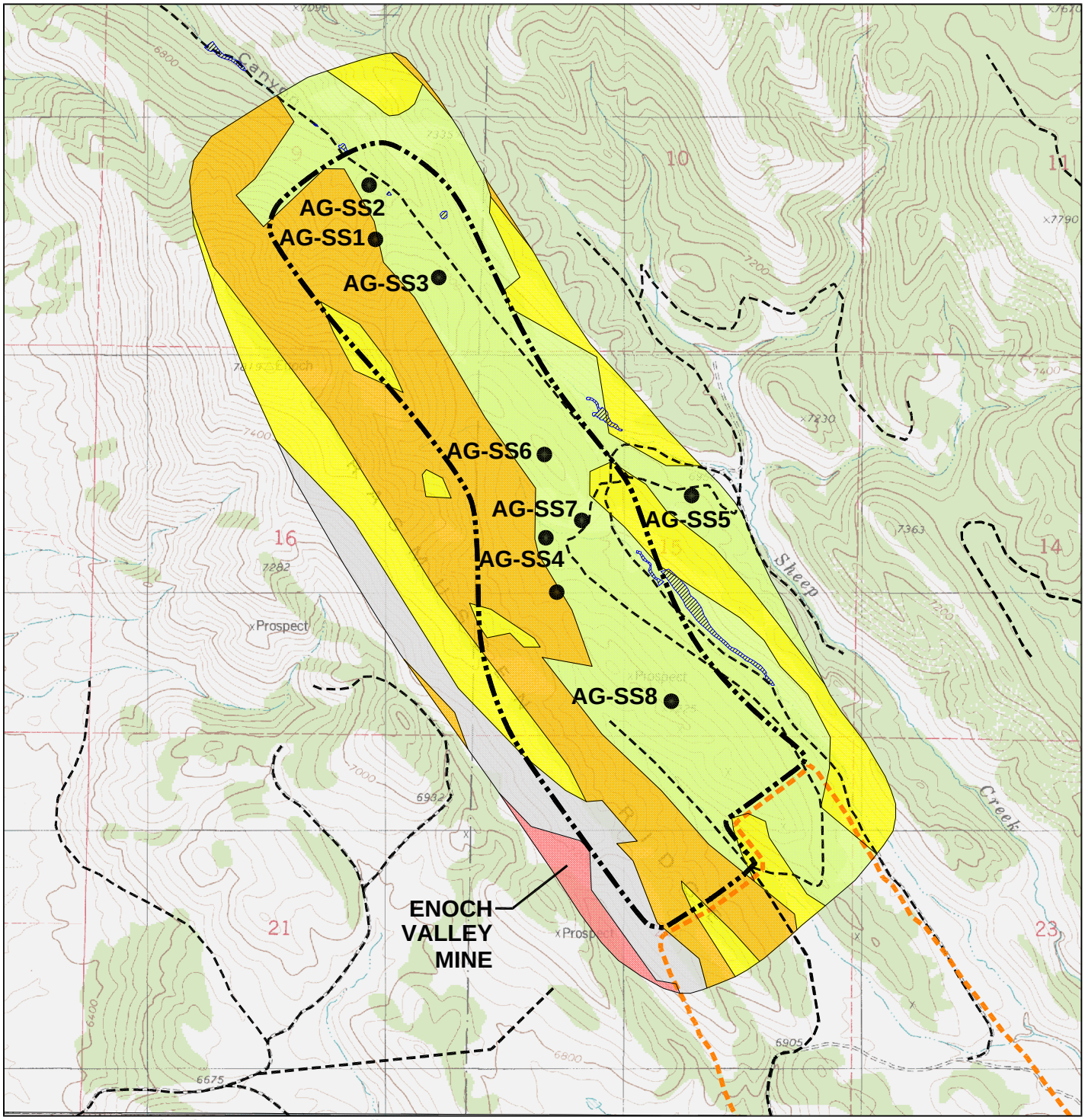
Mixed aspen and conifer forest predominates the study area, making up almost 564 acres of the 1,375 acres surveyed. This community can be found on all aspects and overlaps both conifer and sagebrush/grassland communities. The community is characterized by open stands of aspen and conifer, with occasional areas of dense aspen or snowberry. Conifers are of intermediate age, and most aspen are either saplings or young trees.

Conifer forest is the second most common plant community, totaling 420 acres of the study area. Conifer forest occurs at higher elevations along ridgetops and on west-facing slopes. Dominant species in conifer forest include lodgepole pine, Douglas fir, and subalpine fir. Understory in the conifer forest includes a variety of shrubs as well as pinegrass and elk sedge. Canopy cover in conifer forest is relatively open, with numerous downed trees. Most trees are young to intermediate in age. The abundance of downed trees, coupled with the relatively young age of standing trees, provides evidence of the previous logging of the USFS lands in the early 1980s.

Approximately 282 acres of sagebrush/grassland communities occur in the study area. Sagebrush/grassland occurs mainly on gently west- and south-facing slopes on dry soils or rocky outcrops. Common species include mountain big sagebrush, silver sagebrush, mountain snowberry, Oregon grape, and several forbs and grasses (**Table 3.5-1**).

Aspen forest occupies 100 acres of the study area. This forest type is found throughout the study area, primarily on mesic sites. Aspen forests are interspersed with sagebrush/grassland at lower elevations and with conifer forest at higher elevations. The majority of aspen are young, which is typical of forests in early successional stages. Aspen forests include a diverse understory of shrubs, forbs, and grasses (**Table 3.5-1**).

Riparian/wetland communities are found along No Name Creek, Sheep Creek, and Reese Canyon Creek. Riparian/wetland communities occupy approximately 9.14 acres of the study area. In general, riparian/wetland communities are small and are located near areas of human activity.



Source: USGS 7.5' Quadrangles, Lower Valley, Upper Valley, Wayan East, Wayan West, ID

LEGEND

- *Forest Road*
- *Study Area*
- *Approved Central Rasmussen Ridge Area*
- *Wetland*
- *Sampling Sites*

VEGETATION TYPES

- *Aspen*
- *Aspen/Conifer Mixed*
- *Conifer*
- *Disturbed*
- *Sagebrush*

NORTH

0 2000' 4000'

Scale (ft)

Source: Maxim 2001d

North Rasmussen Ridge Mine EIS Project

FIGURE 3.5-1
VEGETATION MAP WITH WETLAND LOCATIONS

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 Base.dwg
Scale: As Noted	Drawn By: ETC

TABLE 3.5-1
VEGETATION COVER TYPES AND ASSOCIATED SPECIES

Common Name	Scientific Name	Aspen	Conifer	Mixed Aspen/ Conifer	Sagebrush
Grasses/Sedges					
Elk sedge	*Carex geyeri*		X		
Kentucky bluegrass	*Poa pratensis*			X	
Pinegrass	*Calamagrostis rubescens*	X	X		
Prairie junegrass	*Koeleria cristata*				X
Timothy	*Phleum pratense*	X			
Forbs					
Bastard toadflax	*Comandra umbellate*				X
Black-headed coneflower	*Rudbeckia occidentalis*			X	
Capitate sandwort	*Arenaria congesta*				X
Meadow rue	*Thalictrum occidentalis*	X			
Mule's ear	*Wyethia amplexicaulis*				X
Nettle-leaf horsemint	*Agastache urticifolia*	X			
One-sided wintergreen	*Pyrola secunda*		X		
Silvery lupine	*Lupinus argenteus* Var. *parviflorus*			X	
Sticky geranium	*Geranium viscossimum*	X			
Wild strawberry	*Fragaria virginiana*			X	
Trees/Shrubs					
Aspen	*Populus tremuloides*	X		X	
Cascade mountainash	*Sorbus scopulina*		X		
Douglas fir	*Pseudotsuga menzeizii*		X	X	
Lodgepole pine	*Pinus contorta*		X	X	
Mountain big sagebrush	*Artemisia tridentata* ssp. *vaseyana*			X	
Mountain lover	*Pachistema myrsinites*		X		
Mountain snowberry	*Symphoricarpos oreophilus*	X		X	X
Oregon grape	*Mahonia repens*				X
Scouler's willow	*Salix scouleriana*			X	
Serviceberry	*Amelanchier alnifolia*		X		
Silver sagebrush	*Artemisia cana*				X
Sub-alpine fir	*Abies lasiocarpa*		X	X	

Source: Maxim 2001d.

3.5.2 Wetlands

Two wetland surveys have been completed for the study area. The first survey (TRC 2000) delineated jurisdictional wetlands located on the Rasmussen Mine property (see Figure 3.5.1). A follow-up survey (Maxim 2001e) verified the results of the previous effort and assessed the functions and values of wetlands located within the boundary of the study area. The assessment of functions and values was conducted in accordance with Montana Department of Transportation methodology (Berglund 1996).

3.5.2.1 Wetland Areas (Riparian and Springs/Seeps)

TRC Mariah Associates, Inc. (TRC) completed a wetland delineation for the study area in January 2000. The study identified four jurisdictional wetlands along No Name Creek, Sheep Creek and Reese Canyon Creek. Three wetlands are located in the eastern portion of the survey area along No Name Creek. The southern most wetland is 1.07 acres in size and is dominated by Booth's willow (*Salix boothii*), Colorado rush (*Juncus confusus*), and Kentucky bluegrass (*Poa pratensis*). The central wetland (3.03 acres) is described as a wet meadow that surrounds a man-made pond. Beaked water sedge (*Carex utriculata*) is dominant in the immediate vicinity of the pond. The northern most wetland in No Name Creek is 0.40 acres in size and is characterized by Kentucky bluegrass, tufted hairgrass (*Deschampsia caespitosa*), Colorado rush, and American false-helleborne (*Veratrum viride*).

Wetlands were also identified in Sheep Creek and Reese Canyon Creek. One wetland was identified in Sheep Creek that is 1.06 acres and is located near a small spring. Kentucky bluegrass, meadow barley (*Hordeum brachyantherum*), Colorado rush, and beaked sedge characterize the Sheep Creek wetland. The Reese Canyon wetlands cover 3.58 acres and include a small meadow located at the top of the drainage and five other wetland areas downstream. Dominant vegetation in the Reese Canyon wetlands include Colorado rush, Kentucky bluegrass, tufted hairgrass, and American false-helleborne.

3.5.2.2 Wetland Functions and Values Assessment

The results of the assessment of functions and values indicated that wetlands in the study area are classified as Category III (TRC 2000). Category III wetlands are relatively common, have lower species diversity, and are smaller and more isolated than are Category I or II wetlands. Wetlands located in the study area ranked high for sediment, nutrient, and toxicant removal. These wetlands were not considered potential habitat for threatened, endangered, or other special status species. This determination was based on the small size of wetlands in the study area and the high level of human activity near them. Most wetlands in the study area also received low rankings for flood attenuation and surface water storage. However, slope wetlands (for example in Sheep Creek and Upper Reese Canyon) ranked high for groundwater discharge and recharge. Slope wetlands received this ranking because their well-developed root systems help reduce erosion and trap sediment during periods of high flow. Most wetlands ranked low for recreation and education potential because of their small size and proximity to human activity.

3.5.3 Background Metal Concentrations in Vegetation and Soil

An Order II soil study was conducted during September 2000 and August 2001 to document background concentrations of metals in vegetation and soil (Maxim 2001c). Sites were sampled in upland plant communities within the study area (**Figure 3.5-1**). No riparian or wetland sites were sampled. Samples were analyzed for cadmium, copper, manganese, molybdenum, nickel, selenium, vanadium, and zinc. The results for nine representative soil samples are summarized in **Table 3.5-2,** and results for vegetation are summarized in **Table 3.5-3**.

TABLE 3.5-2
CONCENTRATIONS OF TRACE ELEMENTS IN REPRESENTATIVE SOIL SAMPLES NORTH RASMUSSEN RIDGE MINE

Site	Depth (inches)	Element (MG/KG)							
		Cd	Cu	Mn	Mo	Ni	Se	V	Zn
SS-1	0-6	23	11	365	<1	40	1	27	426
	6-16	10	20	102	2	28	2	48	114
	16-34	7	35	21	6	54	9	93	149
	39-60	61	139	36	2	38	2	332	230
SS-2	0-6	10	12	1850	<1	44	<1	20	255
	6-17	2	13	376	2	34	2	37	88
SS-3	0-12	12	17	1460	1	34	<1	23	317
	12-24	3	17	440	2	36	2	44	165
	24-40	1	30	237	3	42	1	43	108
SS-4	0-5	7	18	1280	1	32	<1	60	230
	5-24	6	16	1280	1	37	<1	58	215
SS-5	0-9	<1	12	2480	<1	16	<1	22	69
	9-18	<1	11	2390	16	<1	<1	22	68
	18-38	<1	19	1070	<1	18	<1	22	52
	38-60	<1	21	3440	<1	23	<1	23	58
SS-6	0-7	2	33	1240	3	64	2	45	175
SS-7	0-10	21	27	633	3	49	2	68	291
	10-24	20	30	365	3	55	2	83	275
	24-35	8	60	272	2	64	<10?	74	276
SS-8	0-17	16	22	1190	2	60	1	27	457
	17-39	2	31	181	3	103	2	32	300
	39-60	2	41	44	2	62	4	22	201
SS-9	0-6	6	18	744	2	35	2	54	160
	6-12	4	16	429	2	36	1	43	132
	12-25	3	22	280	3	44	3	75	127
	25-31	2	26	296	3	49	3	58	121
Background Levels in Western Soils (mg/kg) [1]		<3	21[2]	40 - 900	1 – 2 up to 40	4 – 80	<0.1 – 4.3	70[2]	<150
Mean		8.85	27.58	865.42	2.56	42.21	1.92	55.96	194.58
Standard Deviation		12.56	25.23	877.16	3.00	19.75	1.85	60.17	108.09

Notes: [1] Adapted from Shacklette and Borengen (1984).
[2] Value is mean concentration in western soils.
"<" indicates that element was not detected above the given quantity.
mg/kg = milligrams per kilogram
Source: Maxim 2001c.

TABLE 3.5-3
CONCENTRATIONS OF TRACE ELEMENTS IN REPRESENTATIVE VEGETATION SAMPLES NORTH RASMUSSEN RIDGE MINE

Site	Forb OR Grass (F OR G)	Element (MG/KG)							
		Cd	Cu	Mn	Mo	Ni	Se	V	Zn
SS-1	G	2	4	107	<1	2	<1	<1	61
	F	<1	2	71	1	3	<1	<1	58
SS-2	G	<1	4	123	<1	3	<1	<1	39
	F	3	8	259	<1	10	<1	<1	106
SS-3	G	<1	5	154	<1	2	<1	<1	48
	F	4	13	70	1	4	<1	<1	51
SS-4	G	<1	4	55	<1	2	<1	<1	19
	F	6	6	58	<1	5	<1	<1	60
SS-5	G	<1	4	326	<1	6	<1	<1	22
	F	<1	3	53	1	4	<1	<1	12
SS-6	G	2	8	124	6	8	<1	4	43
	F	<1	10	93	<1	4	<1	<1	43
SS-7	G	2	5	37	2	3	<1	2	26
	F	<1	4	24	<1	3	<1	<1	104
SS-8	G	<1	2	33	<1	2	<1	<1	26
	F	13	9	59	2	2	<1	<1	164
SS-9	G	<1	2	60	3	2	<1	<1	14
	F	<1	5	28	2	88	<1	<1	15
Mean		2.08	5.44	96.33	1.28	8.5	0.5	0.78	50.61
Standard Deviation		3.13	3.03	80.69	1.4	19.97	0	0.88	39.42

Notes: "<" indicates that element was not detected above the given quantity.
mg/kg = milligrams per kilogram
Source: Maxim 2001c.

The results of the analyses of soil indicated that concentrations of cadmium, copper, manganese, and zinc were frequently higher than typical concentrations found in soils of the western U.S. Concentrations of molybdenum, nickel, selenium, and vanadium also exceeded typical levels in western U.S. soils in several samples. Concentrations of cadmium exceeded typical background levels of 3 mg/kg at seven locations (in 14 samples). Concentrations of copper exceeded the mean level background of 21 mg/kg in sample collected at seven locations (in 13 samples). Concentrations of manganese exceeded typical background concentrations in western soils (40 to 900 mg/kg) in samples collected at six locations (in 10 samples). Concentrations of zinc exceeded typical background concentration at all nine sample locations (in 14 samples). Although selenium is known to occur at elevated concentration in this area the concentration of selenium in only one sample exceeded the range typically found in western U.S. soils.

Concentrations of trace metals in vegetation appeared to be loosely correlated to concentrations in companion soil samples. In general, concentrations of metals in vegetation were lower than concentrations of metals in companion soil samples, and metals do not appear to be concentrating in grass or forb samples.

3.5.4 Potential for Selenium Bioaccumulation

Selenium can be absorbed by plants to concentrations that are toxic to birds, fish, and mammals. Plants capable of accumulating selenium to high concentrations are known as seleniferous. Examples of seleniferous plants that occur in the western U.S. include fourwing saltbush (*Atriplex canescens*) and some species of milkvetch (*Astragalus* spp.).

Selenium toxicosis has been documented in horses in southeastern Idaho. In January 1997, the USFS received a report of six ill horses. The horses had been grazing a pasture located near a source of water located downgradient of a phosphate mine. The horses were later diagnosed with selenium toxicosis. A larger study was subsequently conducted to document concentrations of selenium in waterways on the Caribou National Forest. The study found concentrations of selenium at 17 locations in excess of Idaho's maximum contaminant level (MCL) for livestock drinking water consumption (USFS 1997). Idaho's MCL for selenium in drinking water is 0.05 mg/L.

Selenium was detected in soil samples collected from the study area; however, selenium was not detected in any vegetation samples. Concentrations of selenium in soil samples collected from the study site ranged from less than 1 ppm to 9 ppm.

A separate study conducted by Montgomery Watson concluded that regional background concentrations of selenium in southeast Idaho range from 0.61 ppm to 16.0 ppm. Typical concentrations of selenium in western U.S. soils range from less than 0.1 ppm to 4.3 ppm. Soils that contain concentrations of selenium above 2 ppm are considered seleniferous (CSU 2001).

A soil survey was also conducted for the Central Rasmussen Ridge area on August 25 and 26, 1999 (TRC 1999). Although the purpose of the study was to evaluate the suitability of topsoil for use in reclamation, it also documents baseline levels of selenium in the topsoil. Eight soil survey stations were sampled at 25 centimeter intervals to a total depth of 1.0 meter. Total concentrations of selenium in topsoil ranged from 0.5 mg/kg to 2.3 mg/kg dry weight, with a mean concentration of 1.0 mg/kg. Extractable concentrations of selenium were all below the detection limit of 0.02 mg/kg. Selenium was not detected in any vegetation samples collected near the of soil samples. As a result, there does not appear to be any evidence of natural bioaccumulation of selenium in vegetation samples collected from the baseline study area.

In one study in the Southeastern Idaho mining area (Mackowiak, Amacher and Herring 2002), wetland vegetation had mean tissue selenium above 10 mg/kg, whereas tissue selenium from a reference wetland outside of this area had a mean value of 1 mg/kg. Vegetation sampled near a seep contained 10 times more selenium than vegetation sampled 160 meters from the seep, suggesting some selenium immobilization may have occurred along the flow path. The mean selenium concentration in vegetation in Wooley Valley (unit 4) was approximately 30 mg/kg, while reference locations (excluding Maybe Canyon) were below 2 mg/kg. Legumes tended to contain the most selenium of all sampled lifeforms.

3.5.5 Timber Sales

In the early 1980s, commercial timber was removed from most of the Rasmussen Ridge leasehold. The North Rasmussen Ridge Mine site therefore would not require any Special Use Permits within timber sale areas.

The lease area falls partially or fully in one or two prescription units: a forest management unit and a phosphate lands unit that defaults to the forest-wide management prescription. Prescription 5.1 (b, c, d) - Timber Management, emphasizes scheduled wood-fiber production and use and other compatible commodity outputs, with consideration for long-term forest resilience. Alternative 7 of the Forest Plan DEIS is the preferred alternative and that states the timber resources in the lease area will be managed by one of two management prescriptions, depending on their exact location.

The forest restoration prescription emphasizes maintaining and restoring forest ecosystem processes and functions, and any volume that results from harvest is an outcome of restoration. Lands in this prescription are included in the suitable timber base and contribute to the allowable sale quantity. Firewood is available, as designated on fuelwood maps, from dead trees, designated aspen areas, and from slash and logs decked for that purpose. A timber management prescription also is in place for lands similar in structure to the lease area. The timber management prescription manages land to emphasize the cost-effective production of timber and is applied only to areas that have the highest potential to produce wood-fiber. The lease area does not fall into this category.

The elk and deer winter range prescription emphasizes vegetation management to maintain or improve cover or forage conditions needed for wintering deer and elk. These areas are not part of the suitable timber base and do not contribute to the allowable sale quantity.

3.5.6 Noxious Weeds

A review of Idaho Department of Agriculture records indicated that eight noxious weeds are well established or are becoming well established in Caribou County. Weeds with documented infestations that range from 50 acres to 1,000 acres in Caribou County include hoary cress (*Cardaria draba*), leafy spurge (*Euphorbia esula*), musk thistle (*Carduus nutans*), Russian knapweed (*Centaurea repens*), spotted knapweed (*C. maculosa*), Dyers woad (*Isatis tinctoria*), and yellow toadflax (*Linaria vulgaris*). Canada thistle (*Cirsium arvense*) affects the largest total surface area with a total infested area of between 1,000 and 10,000 acres.

Canada thistle, musk thistle, and yellow toadflax occur in some disturbed areas of the Rasmussen Mine. The mine has implemented a weed management program to control Canada thistle and yellow toadflax. Known occurrences of noxious weeds are monitored and chemically treated, as required, on an annual basis.

The USFS also has obtained data on management of noxious weeds in the Soda Springs Ranger District for the year 2000. Noxious weeds currently present in the Soda Springs Ranger District in Idaho and their areas of infestation include the following:

- Musk thistle – 100,000 acres
- Canada thistle – 20,000 acres
- Yellow toadflax – 3,900 acres
- Dyers woad (*Isatis tinctoria*) – 3,000 acres
- Mayweed – 300 acres
- Spotted knapweed (*Centaurea maculosa*) – 135 acres
- Black henbane (*Hyoscyamus niger*) – 100 acres
- Leafy spurge – 30 acres

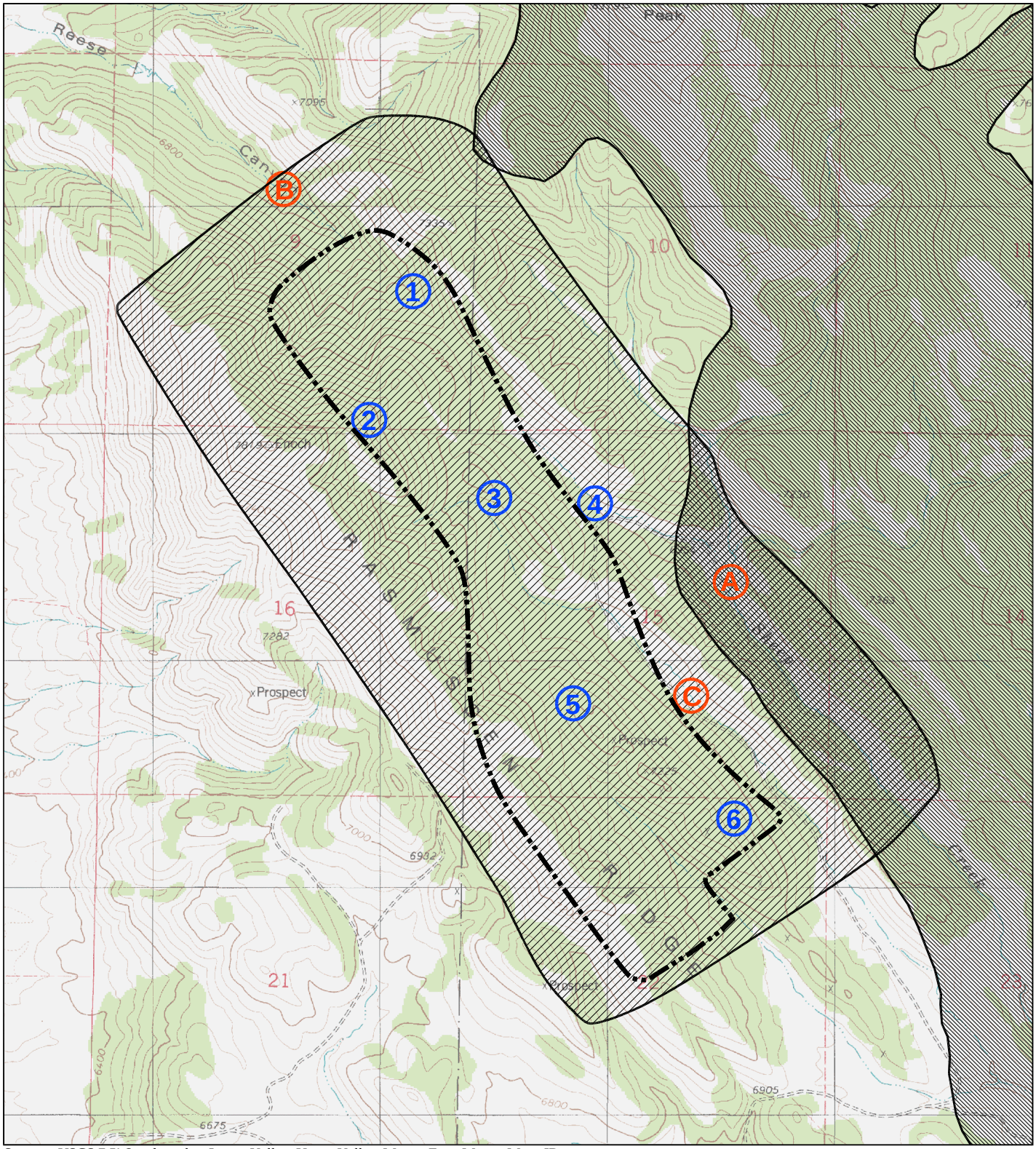
Other noxious weeds with total infested acreages in the Soda Springs District that are less than 10 acres include whitetop, poison hemlock, and Russian knapweed.

3.5.7 Fire Management

Fire management guidelines are described in each of the Caribou National Forest management prescriptions that apply to the lease area. The lands in the project area include both Phosphate Mine Areas (Prescription 8.2.2) and Elk and Deer Winter Range (Prescription 2.7.2), both of which follow the forest-wide guidance. For lands in a forest management prescription, wildfire will be suppressed using control strategies during the fire season. Pre- and post-fire season strategies may include containment, confinement, or control. Prescribed fire may be used to reduce fuel loading, obtain natural regeneration, improve livestock forage, improve wildlife habitat, and for other purposes that meet the needs of this prescription. Prescribed fire may be allowed to maintain or improve winter habitat and enhance ecological conditions for lands in an elk and deer winter range prescription.

3.6 TERRESTRIAL WILDLIFE

Wildlife habitat on Rasmussen Ridge includes aspen, aspen/conifer mixed, conifer, sagebrush, disturbed, wetland, and riparian areas (Maxim 2001d). The study area for wildlife is shown on **Figure 3.6-1**. Aspen stands occur in a small area on the southwest-facing slopes of the ridge in the southwest corner of the study area. Aspen/conifer mixed habitat (aspen, Douglas-fir, lodgepole pine, and occasionally sub-alpine fir) occurs along the east side below the conifer habitat and above the sagebrush habitat. This habitat is located on all aspects and has wide zones of overlap with sagebrush and conifer habitats. Conifer habitat (Douglas-fir, lodgepole pine, and occasionally sub-alpine fir) occurs along the west side, typically at higher elevations on Rasmussen Ridge. Sagebrush habitat occurs in several small, isolated patches on dry, rocky outcrops and slopes along the ridge, and at lower elevations adjacent to riparian zones. A small area of disturbance occurs within and adjacent to the area of the proposed mine expansion in the southwest corner. The disturbed area is mostly associated with old mining activity, existing roads, and drill pad access roads (Maxim 2001d). Past logging activity has also reduced old growth habitat, which is used by species such as the northern goshawk. As a result, the quantity of old growth habitat has been reduced by removal of large trees. Wetlands and riparian areas occur along Sheep Creek, No Name Creek, and Reese Canyon Creek. These habitats provide important nesting, resting, and feeding habitats for several wildlife species.



Source: USGS 7.5' Quadrangles, Lower Valley, Upper Valley, Wayan East, Wayan West, ID.

LEGEND

- *Study Area*
- *Expanded Study Area (Birds, Mammals, Bats, Reptiles, Amphibians)*
- *Elk and Deer Winter Range - Critical*
- 6 *Bird Calling Stations*
- A *Bat Survey Sites*

NORTH

0 2000' 4000'

Scale (ft)

North Rasmussen Ridge Mine EIS Project

FIGURE 3.6-1
WILDLIFE STUDY AREA AND SURVEY LOCATIONS

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 Base.dwg
Scale: As Noted	Drawn By: ETC

3.6.1 Mammals

Several mammalian species are known or expected to occur within the study area in the Caribou National Forest. These species include several members of the rodent family; various bats; intermediately sized species such as coyotes (*Canis latrans*); badgers (*Taxidea taxus*); bobcats (*Lynx rufus*); and mountain cottontails (*Sylvilagus nuttalli*); and large mammals including mule deer (*Odocoileus hemionus*), Rocky Mountain elk (*Cervus elaphus*), moose (*Alces alces*), black bear (*Ursus americanus*), and mountain lion (*Felis concolor*).

3.6.1.1 Big Game

Rasmussen Ridge is an important area for big game because of the diverse, interspersed habitat types, availability of water, gentle topography, and limited access. However, past and current mining have reduced the amount and quality of foraging habitat by reducing acres of habitat and increasing human disturbance. Elk and mule deer are the two most common large mammals that occur within the study area. Moose are known to use habitats in the study area, but to a lesser degree. All three species can be found within and around the immediate study area during spring, summer, and fall. During the winter, these species generally migrate to areas with less snow accumulation and greater availability of forage; however, some winter habitat is located in the vicinity of the study area.

The DEIS for the Caribou National Forest draft revised forest plan identifies critical elk and deer winter range located immediately east of the boundary of proposed disturbance within the Caribou National Forest (USFS 2001). No critical winter elk or deer habitat is located within the study area (**Figure 3.6-1**). No critical moose winter range occurs within the Caribou National Forest.

In the Rasmussen Ridge area, elk prefer sagebrush-grass and mountain brush habitats during winter, sagebrush-grass and aspen habitats in spring, aspen habitats in summer, and conifer habitats during fall. These habitats all occur within the study area. Accordingly, Rasmussen Ridge has been identified as an important elk summer range and calving area, and has also been used as winter range. There are no defined elk migration corridors in the Rasmussen Ridge area (Collins 1981). Regional studies conducted by the Idaho Department of Fish and Game (IDFG) (Kuck 1984) indicate that most elk in southeast Idaho tend to be nomadic but do not migrate long distances between summer and winter ranges. The mean year-round home range for elk was reported as 26 square miles, with a mean migration distance between summer and winter ranges of 4.1 miles.

Although the bottomlands of Angus Creek and Sheep Creek provide excellent forage for elk, portions of the unforested areas south of the proposed mine expansion are occupied by active mining-related facilities and are not optimal for foraging. In addition, the valley bottomland to the west has a relatively high density of roads and agricultural fields. Many studies (Thomas et al 1979; Lyon 1983) have shown that increased densities of open roads and levels of human activity reduce the effectiveness of elk habitat. Elk calving typically takes place between May 25 and June 5 in forested habitat, where levels of human activity and livestock grazing are low. Aspen stands in the southeastern portion of the study area may be used as calving areas, but they are small and

are not likely important. In terms of population numbers, IDFG periodically completes big game population surveys throughout the state. The proposed study area is located in IDFG Management Unit 76 that is bounded to the east by the Wyoming state line, to the south by the Utah state line, to the north by Highway 34, and approximately by the city of Soda Springs to the west. The most recent elk population surveys conducted in Management Unit 76 were completed in 1992, 1995 (IDFG 1999), and 1999 (IDFG 2000b). IDFG reported elk numbers equaling 2,654 in 1992, 3,213 in 1995, and 3,301 in 1999. The population of elk in the area appears to be increasing and is within the objectives defined by the IDFG (1999).

Mule deer prefer mountain brush and riparian vegetation during winter; mountain brush, riparian, aspen, and aspen/conifer habitats during spring and summer; and aspen and conifer during the fall. Mule deer use Rasmussen Ridge as summer range, but apparently do not use it as winter range. Mule deer exhibit a well-patterned migratory behavior, moving to areas of low elevation in the late fall and early winter and returning to the higher-elevation summer range in May (Collins 1981). Unlike elk, mule deer migrate longer distances from winter and summer ranges and do not show specificity to particular ranges. Deer migrate through the study area during the fall en route to winter range and during the spring en route to summer range. However, no specific migratory corridors have been identified within the area. The most recent population surveys for deer within Management Area 76 were conducted in 1991 and 1994. Surveys identified 4,405 mule deer during 1991 and 2,428 mule deer in 1994. This decline was attributed to the severe winter of 1991/1992. The population is currently considered stable (IDFG 1999).

Moose prefer aspen and conifer types during the winter, summer, and fall, and aspen in spring. Moose activity was also documented within riparian areas on the Rasmussen Ridge lease sites in November 1980 (Collins 1981).

Moose can also be found throughout the study area at any time of the year. Moose in the area do not concentrate in specific wintering areas, but are widely dispersed in aspen and conifer communities year-round (Kuck 1984). They tend to stay within a small home range and are well adapted for foraging in deep snow. The most recent survey for moose populations in the area was conducted by IDFG in 1999 for Management Unit 76. A total of 140 moose were observed; population estimates for the Management Unit are between 437 and 729 individuals (IDFG 2000b).

3.6.1.2 Carnivores

Carnivore track surveys were conducted during winter 2000 and 2001 within the study area (Maxim 2001d). In addition to these track surveys, carnivores were observed in the forest while other wildlife surveys were conducted during the spring and summer 2000. During these surveys, the following carnivores were observed: black bear, coyote, badger, and bobcat. The majority of the carnivores found in the area feed on small mammals and birds and use most of the habitat types in the area. Although mountain lions were not recorded, they are known to inhabit surrounding areas and typically occur in areas with high populations of elk and deer. Evidence of black bears in the area (claw markings on aspen trees) was also noted, primarily in the Reese Canyon drainage. No studies have been completed within the area that concern the uptake of selenium by carnivores as a result of feeding on prey species that were exposed to elevated levels

of selenium in vegetation. Evidence of badger was common in the No Name and Sheep Creek drainages.

A winter survey was also conducted in 2001 for forest carnivores (Maxim 2001d). No lynx or wolverine tracks were recorded. Bobcat tracks were observed that entered the No Name road from the west. Old tracks were also recorded just east of a cattle guard on Sheep Creek Road. Other carnivore tracks observed included weasel and coyote.

3.6.1.3 Bats

Two surveys for bats were conducted in the study area during July and August 2000 (Maxim 2001d). Riparian areas and ponds were surveyed using mist nets and a tunable broadband ultrasonic bat detector. Seven species of bats were either captured or detected during the surveys: big brown bat *(Eptesicus fuscus),* silver-haired bat *(Lasionycteris noctivagans),* western long-eared myotis *(Myotis evotis),* long-legged myotis *(Myotis volans),* Yuma myotis (*Myotis yumanensis*), California myotis (*Myotis californicus*), and little brown bat (*Myotis lucifugus*). An eighth species, hoary bat (*Lasiurus cinereus*), was detected but not confirmed. Of the bats that were captured, several individuals were lactating females and juveniles, suggesting the presence of active maternity roosts in the area (Maxim 2001d).

Two of the three survey sites (Sites B and C in Reese Canyon) were very active, and the third site (Site A near Sheep Creek) was moderately active, indicating that the study area is very good bat habitat (Maxim 2001d) (**Figure 3.6-1**). There are no known caves, abandoned mines, or fractured rock outcrops in the vicinity of the proposed North Rasmussen Mine, but there are numerous large-diameter snags and live trees that are likely suitable roosting habitat for bats.

3.6.1.4 Other Mammals

Several other small mammals were either directly observed or evidence of their presence (scat or tracks) was documented as part of baseline studies. Other mammals documented during the survey included beaver (*Castor Canadensis*), porcupine (*Erethizon dorsatum*), snowshoe hare (*Lepus americanus*), northern pocket gopher (*Thomomys armatus*), yellow pine chipmunk (*Eutamius amoenus*), and least chipmunk (*Eutamius minimus*).

3.6.2 Birds

A variety of vegetation types occur within the study area that provide a diversity of habitats for many bird species. Although each vegetation type offers important components of the habitat, the riparian areas that occur along the creeks are the most heavily used habitat by the birds in the area. The riparian areas are important during migration as these are often the only habitats within the arid west that are similar to the more mesic habitats found outside the intermountain region. The abundance of insects make riparian areas important foraging habitats for species that nest in the grass or shrublands adjacent to the riparian areas. Maxim (2001d) conducted two surveys for three-toed woodpeckers, two surveys for northern goshawk, two surveys for flammulated owl, and two surveys for boreal owl and great gray owl between May and July 2000. All incidental observations

of non-target bird species were recorded during these surveys for special status and migratory species.

3.6.2.1 Raptors

The forested and riparian areas provide numerous nesting opportunities for raptors. Foraging opportunities for raptors are also plentiful and occur throughout the various habitat types found within the area. Mature forest communities of both aspen and conifer, with large trees and snags, are especially important areas for raptor nesting.

Surveys for special status raptor species were performed in the spring of 2000 (Maxim 2001d) and included: northern goshawk (*Accipter gentiles*), boreal owl *(Aegolius funereus),* flammulated owl *(Otus flammeolus),* and great gray owl (*Strix nebulosa).* Raptors observed during the survey included American kestrel (*Falco sparverius*), flammulated owl, great-horned owl (*Bubo virgianus*), northern goshawk, and red-tailed hawk (*Buteo jamaicensis*). Other raptors, such as golden eagle (*Aquila chrysaetos*)*,* Cooper's hawk (*Accipiter cooperii*), and sharp-shinned hawk *(Accipiter striatus*) may nest in the aspen or conifer stands or forage within the various vegetation types throughout the study area but were not observed during the survey. Northern harriers (*Circus cyaneus)* typically nest in grassland habitat (to the west in Enoch Valley) and may also be found foraging in the study area but were not observed during the survey.

Winter surveys for owls were conducted in 2001 (Maxim 2001d). Calling stations were established at several locations, where the surveyor played pre-recorded calls of a boreal owl and a great gray owl. Flammulated owls were heard calling from two distinct locations on both nights before and after dusk.

3.6.2.2 Upland Game Birds

Blue grouse *(Dendragapus obscurus)* and ruffed grouse *(Bonasa umbellus)* are often present in forest communities on toeslopes and ridges and are commonly found in dense conifer and aspen stands in the area. Maxim (2001d) identified both species in the study area during surveys in 2000.

Sage grouse and Columbian sharp-tailed grouse were not observed during the survey. Sage grouse and Columbian sharp-tailed grouse habitat is very limited on Rasmussen Ridge and is marginal to non-existent in the study area (Maxim 2001d); however, Rasmussen Valley west of Rasmussen Ridge has historically supported strutting grounds for sage grouse (Collins 1981). Columbian sharp-tailed grouse are not expected to occur within the project area due to the lack of extensive grasslands and shrublands. Columbian sharp-tailed grouse have been observed 7 miles south of the project area. The study area may provide some winter foraging habitat for Columbian sharp-tailed grouse.

3.6.2.3 Waterfowl

Wet valleys in the Rasmussen Ridge area are known as areas for waterfowl nesting and brood rearing. Waterfowl nest on upland sites and rear broods on natural and man-made ponds in

Enoch Valley, Rasmussen Valley, Lanes Creek, and to a lesser extent in Sheep Creek and the Little Blackfoot River drainages (Collins 1981).

Canada geese (*Branta canadensis*), mallards (*Anas platyrhynchos*), teal (*Anas* spp.), greater sandhill cranes (*Grus canadensis*), curlews (*Numenius* spp.), and other waterfowl nest in areas surrounding but not within the study area. Sandhill cranes likely do not nest within the study area. Shorebirds such as sandpipers (*Calidris* spp.), avocets (*Recurvirostra* spp.), and willets (*Catoptrophorus semipalmatus*) may visit Lower Dry Valley and Rasmussen Valley during migration, but there is limited suitable foraging habitat (mud flats and shorelines) for these species, and they likely do not use the study area.

3.6.2.4 Migratory Birds

Of the 46 birds observed in the study area, 44 species are protected under the Migratory Bird Treaty Act (16 U.S.C. §§ 703-712, July 3, 1918, as amended in 1936, 1960, 1968, 1969, 1974, 1978, 1986, and 1989). A summary of migratory birds observed in the study area and their associated habitat types is provided in **Table 3.6-1**.

3.6.3 Amphibians and Reptiles

The study area supports three streams that provide suitable habitat for amphibians. These streams include the No Name Creek, Sheep Creek, and Reese Canyon Creek. Maxim (2001d) conducted call surveys for frogs and searched for amphibian egg masses, larvae, and adults within these drainages in May and June 2000. These areas provide habitat that could be used as breeding sites for adults and rearing areas for the young to develop. The surveys revealed boreal chorus frogs (*Pseudacris triseriata maculata*) in the West Fork of Sheep Creek. Tiger salamander larvae (*Ambystoma tigrinum*) were recorded in both small ponds in No Name Creek and the upper beaver ponds in Reese Canyon. Northern leopard frogs (*Rana pipiens*) were recorded in beaver ponds in Reese Canyon and in No Name Creek on several occasions (Maxim 2001d). The western toad (*Bufo boreas*) and tiger salamander (*Ambystoma tigrinum*) occur in southeastern Idaho (Digital Atlas of Idaho 2003); however, none were recorded during baseline studies.

Several common garter snakes (*Thamnophis sirtalis*) were recorded in the study area incidental to other surveys of wildlife, fisheries, and wetlands. Five young of the year were observed in Reese Canyon and an adult was seen in the middle reach of Sheep Creek (Maxim 2001d). The western terrestrial garter snake (*Thamnophis elegans*) and rubber boa (*Charina bottae*) occur in southeastern Idaho (Digital Atlas of Idaho 2003), but were not observed during surveys.

TABLE 3.6-1
MIGRATORY BIRDS OBSERVED IN STUDY AREA

Common Name/Species	Habitat	Common Name/Species	Habitat
American kestrel *Falco sparverius*	Sagebrush, riparian	Mallard *Anas platyhynchos*	Wetland
American robin *Turdus migratorius*	Riparian, conifer, mixed aspen/conifer	Mountain bluebird *Sialia currucoides*	Sagebrush, mixed aspen/conifer
Black-billed magpie *Pica pica*	Riparian, sagebrush, conifer	Mountain chickadee *Parus gambeli*	Mixed aspen/conifer, conifer, aspen
Brewer's blackbird *Euphagus cyanocephalus*	Sagebrush, riparian	Mourning dove *Zenaida macroura*	Sagebrush
Brown-headed cowbird *Molothrus ater*	Sagebrush, mixed aspen/conifer, wetland	Northern flicker *Colaptes auratus*	Mixed aspen/conifer, conifer, aspen, riparian
Cassin's finch *Carpodacus cassinii*	Mixed aspen/conifer, conifer	Northern goshawk *Accipiter gentilis*	Mixed aspen/conifer, aspen, riparian
Chipping sparrow *Spizella passerine*	Mixed aspen/conifer	Pine siskin *Carduelis pinus*	Mixed aspen/conifer, Conifer
Cinnamon teal *Anas cyanoptera*	Wetland	Red crossbill *Loxia curvirostra*	Mixed aspen/conifer, Conifer
Common nighthawk *Chordeiles minor*	Sagebrush	Red-breasted nuthatch *Sitta canadensis*	Sagebrush
Common raven *Corvus corax*	Mixed aspen/conifer, conifer	Red-naped sapsucker *Sphyrapicus nuchalis*	Aspen, mixed aspen/conifer, riparian
Common snipe *Gallinago gallinago*	Wetland	Red-tailed hawk *Buteo jamaicensis*	Riparian, sagebrush, mixed aspen/conifer, aspen
Dark-eyed junco *Junco hyemalis*	Mixed aspen/conifer	Sandhill crane *Grus canadensis*	Wetland, riparian
Downy woodpecker *Picoides pubescens*	Riparian, mixed aspen/conifer, aspen, conifer	Song sparrow *Melospiza melodia*	Riparian, wetland
Flammulated owl *Otus flammeolus*	Conifer, mixed aspen/conifer, aspen	Townsend's solitaire *Myadestes townsendi*	Mixed aspen/conifer
Franklin's gull *Larus pipixcan*	Wetland	Turkey vulture *Cathatres aura*	Sagebrush, mixed aspen/conifer
Gray jay *Perisoreus Canadensis*	Conifer, mixed aspen/conifer	Vesper sparrow *Pooecetes gramineus*	Sagebrush
Great-horned owl *Bubo virginianus*	Mixed aspen/conifer, conifer, aspen, riparian	Western tanager *Piranga ludoviciana*	Mixed aspen/conifer, conifer, aspen, riparian
Green-tailed towhee *Pipilo chlororus*	Mountain brush	Western wood-pewee *Contopus sordidulus*	Riparian, aspen, conifer, mixed aspen/conifer
Hairy woodpecker *Picoides villosus*	Mixed aspen/conifer, conifer, riparian	White-breasted nuthatch *Sitta carolinensis*	Mixed aspen/conifer, conifer, aspen
House wren *Troglodytes aedon*	Riparian, mixed aspen/conifer, aspen	Williamson's sapsucker *Sphyapicus thyroideus*	Mixed aspen/conifer, conifer, aspen
Lincoln's sparrow *Melospiza lincolnii*	Riparian	Yellow warbler *Dendroica petechia*	Riparian
MacGillivray's warbler *Oporornis tolmiei*	Riparian, mixed aspen/conifer	Yellow-rumped warbler *Dendroica coronata*	Mixed aspen/conifer, aspen, riparian

Source: Maxim 2001d

3.6.4 Selenium

A number of studies have been conducted to determine the effects of selenium on terrestrial wildlife such as birds and amphibians in southeastern Idaho. A recent study (Montgomery Watson 2000) demonstrated that seven of 20 species of small birds had egg concentrations of selenium greater than the recommended toxicity threshold concentration of ten milligrams selenium per kilogram of dry weight tissue. In 1999, Montgomery Watson (2000) collected 98 eggs in non-mining areas and 117 eggs from mining areas from several bird species. The study was designed to identify whether any regional trends exist between selenium concentrations in eggs and proximity to mining activity in southeastern Idaho. Their work revealed that levels of selenium in egg tissues on mining sites were significantly higher than on non-mining sites. Of the eggs from mining sites, 12.8 percent contained selenium concentrations that exceeded 10 ppm, a level considered potentially problematic for development of bird embryos. Species with concentrations of selenium in eggs greater than 10 ppm included yellow-headed blackbird, common snipe, European starling, mountain songbird, red-winged blackbird, American kestrel, and song sparrow.

A subsequent study was conducted in 2000 to evaluate the effects of selenium exposure on clutch size, hatchling success, fledgling success, and post-fledgling survival. Species studied included American coot, American robin, barn swallow, red-winged blackbird, and yellow-headed blackbird. These species were selected because they are common in the study area, their nests are easily found and observed, they rarely desert nests because of human disturbance, and they are rarely parasitized by brown cowbirds (Montgomery Watson 2000). The impact of selenium levels in eggs on the nesting success and fledgling success of individual blackbird and robin nests indicate that reproductive success consistently increased with increasing levels of selenium of 30 ppm selenium in eggs. A population-level assessment of the impact of selenium on blackbirds and robins also demonstrated no substantial negative impact of selenium contamination from phosphate mining (Garten, Vasterling, and Ratti 2002).

Selenium poisoning has been confirmed in many salamanders at the Gay Mine at the Ft. Hall Indian Reservation (Idaho) and the nearby Smoky Canyon Mine, with concentrations in some individuals that are 10 to 100 times the normal level in animal tissue (USGS 2001a, 2001b). Viral infections found in salamanders at both sites in Idaho may also be linked to high selenium body burdens (USGS 2001a, 2001b).

Laboratory studies have documented that selenium is potentially toxic to other terrestrial wildlife. Concentrations of 12 milligrams selenium per kilogram of food proved toxic to screech owls and caused near total reproductive failure (Wiemeyer and Hoffman 1996 in Sample et al. 1996). The maximum selenium tolerance level for large mammals such as cattle, sheep, horses, and pigs is estimated to be two milligrams selenium per kilogram of food (NRC 1980). Levels greater than the maximum tolerance level can cause chronic selenium toxicity. Concentrations of 0.5 milligrams selenium per liter of drinking water are considered toxic to large mammals such as cattle (Ganje 1966 in Gough et al. 1979). Severe reproductive effects were seen in a study of rats provided a concentration of 2.5 milligrams of selenium per liter of drinking water (Rosenfeld and Beath 1954).

3.6.5 Management Indicator Species

The Caribou National Forest has established three management indicator species (USFS 2001). Management indicator species include Columbian sharp-tailed grouse, sage grouse, and northern goshawk. These species were selected because of general public interest or because the habitat requirements for the species are similar to other species, enabling it to serve as a barometer for habitat health. The Caribou National Forest identified the Rocky Mountain elk and the mule deer as Management Indicator Species in the 1985 Forest Plan. However, they did not meet the criteria and are not considered a Management Indicator Species in the draft revised forest plan (USFS 2001). A summary of management indicator species considered in the study area and their habitats at risk are summarized in **Table 3.6-2**.

TABLE 3.6-2
MANAGEMENT INDICATOR SPECIES
CARIBOU-TARGHEE NATIONAL FOREST

Management Indicator Species	Habitat	Rationale
Columbian sharp-tailed grouse	Grassland and open canopy sagebrush	Only species at risk that is a year-round resident of this habitat.
Sage grouse	Sagebrush	Currently a management indicator species for the Caribou National Forest and USFS.
Northern goshawk	Mature and old forest structure, conifer	Sensitive species with a large range, uses a variety of forest types, and is feasible to monitor for structural changes within foraging areas.

Source: USFS 2001.

3.7 FISHERIES AND AQUATIC RESOURCES

The Blackfoot River drainage historically supported a high-quality Yellowstone cutthroat fishery. The Blackfoot River and tributaries were chemically treated in 1961 to eradicate non-game fish species.

As a result, spawning populations of native cutthroat trout were severely depleted. Introduction of non-native strains of cutthroat and rainbow trout began in 1962 and was widespread in the Blackfoot River drainage. Stocking of trout in the drainage has not returned the fishery to pre-1961 trout populations.

A baseline study of aquatic resources was conducted and included sampling of fish populations, descriptions of fish habitat, and sampling of benthic macroinvertebrates within Sheep Creek (Maxim 2001f).

3.7.1 Aquatic Habitat

Fish populations, fish habitat, fish genetics, substrate heavy metals, and macroinvertebrates were sampled in the study area in August 2000 (Maxim 2001f). These studies provided baseline data on biological and physical characteristics of the streams that might be influenced by the Proposed Action. The following subsections are a summary of results. **Figure 3.7-1** shows the study area and aquatic sampling locations.

3.7.1.1 Sheep Creek

Sheep Creek drains upland areas that are composed of a mixture of forest, shrub, and grass vegetation types. The streambanks primarily support willows (*Salix* spp.) and are bordered by grass and sedge (*Carex* spp.) meadows. Sheep Creek meanders through the length of the drainage and contains numerous beaver dams and short stretches of riffles, runs, and pools (Maxim 2001f).

3.7.1.2 Reese Canyon Creek

Reese Canyon Creek is a seep-fed stream with one seep that emerges in its upper portion, creating stream flow that is augmented by other small seeps throughout its length. During the August 2000 survey, the stream was dry in some reaches and had low flow in others. Beaver ponds are present in the middle reaches and contained water during August 2000. Riparian vegetation appears to be impaired by livestock grazing. A mix of willows, sedges, Douglas-fir, and subalpine fir predominate in the uplands (Maxim 2001f). Flow limits the availability of suitable spawning and rearing habitats for cutthroat trout. This stream was dry and was not sampled for fish or macroinvertebrates.

3.7.1.3 No Name Creek

No Name Creek is an intermittent stream that originates near the headwaters of Sheep Creek east of the existing mine. It flows south and eventually west through a narrow fault-block canyon and into the Angus Creek drainage. Willows, sedges, and shrubby species are the dominant vegetation along the stream. Gradient in the stream varies from 2 to 3 percent in the headwaters to more than 4 percent in the canyon. This stream is commonly dry during summer, fall, and winter (Maxim 2001f). This stream was dry and was not sampled for fish or macroinvertebrates.

Angus Creek provides spawning and rearing areas for cutthroat trout and has been known to support cutthroat trout. No Name Creek may provide suitable spawning habitat, but it seems to be limited by the lack of flow during many years (Collins 1981).

3.7.2 Fisheries and Macroinvertebrates

Streams in and adjacent to the study area have a low gradient, flow through lands grazed by livestock, and are often affected by beavers (Mariah 1992). These factors generally tend to increase the amount of fine materials in the substrate, therefore reducing the diversity of benthic

Source: USGS 100k Quadrangle; Soda Springs, ID

LEGEND

- Study Area
- Approved Central and South Rasmussen Ridge Area
- Macroinvertebrate Sample Location
- Top of Fish Shock Reach
- Bottom of Fish Shock Reach
- REACH 1 — Fish Habitat Reach

ATFS-AUFF = Fish Sampling in Reach 10
AUM = Macroinvertebrate Sampling in Reach 10
AMFT-AMFD = Fish Sampling in Reach 6
AMM1 = Macroinvertebrate Sampling in Reach 6

Source: Maxim 2001f

NORTH

0 4000' 8000'

Scale (ft)

North Rasmussen Ridge Mine EIS Project

FIGURE 3.7-1
AQUATIC RESOURCE DATA COLLECTION
SHEEP CREEK

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 Base.dwg
Scale: As Noted	Drawn By: ETC

macroinvertebrates. Long periods of below-normal surface water flows, such as the drought that occurred in 1991 and 1992, can also contribute to increased fine materials in substrate. These factors not only affect macroinvertebrate communities but also tend to reduce the quality of the streams for cutthroat trout (Mariah 1992).

Yellowstone cutthroat trout and introduced strains of cutthroat trout live as both migratory and resident populations in the Blackfoot River and tributary streams. Migratory fish move upstream from Blackfoot Reservoir starting in March and spawn in the tributary streams to the Blackfoot River. Resident populations of trout may also live and spawn in tributary streams year round. Spawning occurs from mid-May through early July (Collins 1981). Young cutthroat trout emerge from eggs from July through September (BLM et al 2000). Some young fish migrate downstream in the Blackfoot River to Blackfoot Reservoir, and others remain in tributary streams as resident, non-migratory fish. Brook trout *(Salvelinus fontinalis),* a non-native char, may also be found in the Blackfoot River drainage. Brook trout spawn in fall (October to December) and fry emerge from spawning gravel (known as redds) in April and May (BLM et al 2000). Rainbow trout *(Oncorhyncus mykiss)*, a non-native species, spawn in spring (March to June), usually in small tributaries with abundant gravel riffles. Eggs hatch within 4 to 7 weeks, and young fish move downstream into deeper pools (BLM et al 2000). Rainbow trout may also be present in the watershed but were not captured during surveys completed in August 2000. German brown trout *(Salmo trutta)*, also an introduced species, are also present in tributaries of the Blackfoot River but were not captured during surveys completed in August 2000. Numerous non-game fish may be found in the tributaries to the Blackfoot River, including sculpin *(Cottus* sp.*),* minnow (*Cyprinidae*), and dace. These non-native trout and other non-native fishes often contribute to the reduction or elimination of native trout populations such as Yellowstone cutthroat trout.

3.7.2.1 Sheep Creek

Sheep Creek was divided into 11 sub-reaches. Two reaches were sampled for fish populations in accordance with R1/R4 procedures, and one of these reaches was also sampled for presence and absence (spot shocked) (Figure 3.7-1). The USFS also conducted presence and absence sampling on a fourth reach (Lower Sheep Creek, not shown on Figure 3.7-1) in 2000. Four reaches were sampled along Sheep Creek for fish. These reaches include Upper Sheep Creek, Upper Sheep Creek Tributary, Middle Sheep Creek, and Lower Sheep Creek (reaches 1 through 11 are included within Upper Sheep Creek, Upper Sheep Creek Tributary, and Middle Sheep Creek).

A study conducted in 1997 concluded that Sheep Creek was in good condition when compared with other streams in the area (JBR 1997). The 1997 survey found a good complement of sensitive taxa in the orders of Ephemeroptera and Plecoptera. The 1997 survey also reported high index values for community tolerance and biotic condition for Sheep Creek. The authors concluded that these results indicate that Sheep Creek likely has good water quality, a diverse substrate, and good riffles.

Maxim (2001f) also conducted a survey of macroinvertebrates for Sheep Creek. Species recorded in the upper reaches of Sheep Creek included Ephemeroptera (62 percent), Coleoptera (10 percent), Diptera (7 percent), Plecoptera (5 percent), and Trichoptera (3 percent). The abundance of Ephemeroptera indicates that water quality is likely high since members of this order are generally intolerant of pollution. Middle Sheep Creek was also sampled as part of this survey. Ephemeroptera and Diptera were the most abundant orders recorded in the middle reaches of Sheep Creek. Plecoptera and Trichoptera represented a larger portion of the catch compared with the upper reaches of Sheep Creek. These orders are considered indicative of cold, fast-flowing streams with good oxygen content and water quality. Maxim did not sample the lower reaches of Sheep Creek, but previous surveys conducted by the USGS reported that the most abundant order was Trichoptera, with Plecoptera and Ephemeroptera also found. The lower reaches of Sheep Creek were also considered of good quality based on the results of the USGS study.

Yellowstone cutthroat trout was the most abundant fish species captured in Sheep Creek and was present at all sampling locations. Mottled sculpin (*Cottus bairdi*) and longnose dace (*Rhinichthys cataractae*) were less common. Longnose dace were captured in the Lower Sheep Creek reach only, and mottled sculpin were captured in all sampling locations except the Upper Sheep Creek sampling location.

Fish habitat within Sheep Creek is variable depending on location although overall structural diversity is sufficient throughout the creek to provide high quality year round habitat for both resident and migratory Yellowstone cutthroat trout. The presence and distribution of beaver dams within the stream currently limit the presence of migratory fish to the lower stream reaches. Maxim (2001f) concluded that fish captures indicated a healthy resident fish population dominated by Yellowstone cutthroat trout. No invasive or exotic species were captured, and the trout that were captured appeared healthy. Genetic results indicate that the cutthroat trout in the stream are pure strain Yellowstone, with no evidence of hybridization with rainbow trout. Results from the population sampling indicate that spawning and survival of young have been successful, at least in the recent past. Results for fish tissue indicate that concentrations of selenium are well below unhealthy levels. The high numbers of fish indicate that populations may be resident but the sizes recorded suggest that the fish are limited in growth by food and habitat restrictions.

Sheep Creek was identified as an important spawning and rearing area for wild Yellowstone cutthroat trout in the early 1980s. Sheep Creek and other valley tributaries produced the majority of wild cutthroat trout in the Blackfoot River system (Collins 1981). Livestock use has been heavy in the past, but cutthroat trout have persisted, and spawning and rearing habitats have not been excessively degraded.

3.7.2.2 No Name Creek

A survey conducted by JBR (1997) reported that the upper reaches of No Name Creek were of higher quality compared with lower reaches. However, although the upper station yielded more stoneflies than the lower reaches, only one mayfly and relatively few stonefly and caddisfly species were recorded. The lower reaches of No Name Creek were considered more lentic, or

slow moving, as evidenced by the presence of several aquatic beetle taxa. A higher number of caddisflies and mayflies were observed at the lower monitoring station (JBR 1997).

No Name Creek was surveyed in 1992 (Mariah 1992). The survey described the substrate of No Name Creek as primarily gravel immersed in sand and other fine sediments. Leeches, black fly larvae (Diptera), and the amphipod *Gammarus lacustris* primarily dominated benthic populations at No Name Creek. Diptera, mayflies, aquatic earthworms, and leaches dominated the middle reaches of No Name Creek. The lower reaches of No Name Creek were dominated by mayflies (Cinygmula) and stoneflies (*Zapata* spp.). Both Cinygmula and Zapata are considered indicative of good water quality (Mariah 1992). The lowest reaches of No Name Creek were dominated by true flies (Diptera).

3.7.3 Bioaccumulation of Selenium and Trace Metals

The bioaccumulation of selenium in fish and other aquatic organisms depends on the amount of selenium present in water and sediment and the chemical form in which selenium is present, as well as other factors. Selenium exists in five forms; the three most studied in terms of toxicological effects are the two inorganic forms (selenite and selenate) and the more toxic organic form, the amino acid called selenomethionine. Water temperature, age of the organism, mode of administration, and organ/tissue specificity also modify the rate of selenium accumulation (Eisler 1985). In aquatic habitats, higher animals show a generally marked increase in selenium residues as compared with waterborne concentrations which indicates that bioaccumulation of selenium occurs primarily through diet.

Field studies have demonstrated that selenium can enter the food chain through plants, become bioavailable, and subsequently bioaccumulate in animals. Although measured concentrations of selenium are often low in surface water, selenium can be present at elevated levels in sediment and thus become available for uptake by aquatic life through algal and planktonic food chains (Lemly 1996). A variety of toxic effects have been associated with exposure of fish to elevated levels of selenium in water and diet. The endpoints that can result from high exposure to selenium may be impairment of reproductive functioning and death.

Reproductive toxicity is reported to be one of the most sensitive endpoints for vertebrates exposed to selenium (Lemly 1997; Skorupa 1998). Teratogenic (malformations in embryo or fetus) deformities in fish or congenital malformations that occur as a result of excessive selenium in eggs are a permanent pathological marker of selenium poisoning (Lemly 1997). Selenium is efficiently transferred from parents to offspring through the eggs (Lemly 1993). Levels of selenium that cause teratogenic effects do not generally affect the health or survival of parent fish; the teratogenic process is an egg-larvae phenomenon. Data indicate that mortality of adult fish, even in sensitive species, occurs at exposure levels much higher than concentrations that may result in reproductive impairment (Skorupa 1998). Teratogenesis is a direct expression of selenium toxicity and is considered an important cause of reproductive failure in fish (Lemly 1997).

The EPA national water quality criterion for selenium for chronic aquatic habitat exposure is currently 0.005 mg/L. The EPA national water quality criterion for selenium for acute exposure is 0.020 mg/L. Lemly and Smith (1987), who reviewed much of the available literature on selenium

effects, reported that concentrations of selenium in water greater than 0.002 to 0.005 mg/L may bioaccumulate in food chains and result in adverse reproductive effects in fish. Baseline studies show that concentrations of selenium in Sheep Creek are much less than this level (Maxim 2001f). The concentrations measured in Sheep Creek are below the aquatic life standard (0.005 mg/L) for chronic exposure to selenium (Hardy and Moller 2002).

Montgomery Watson (2000) conducted three studies on the effects of selenium on the reproductive success of cutthroat trout. The study area for all three studies included the Blackfoot River and Henry's Lake. The three studies examined the following:

- Egg viability study to evaluate whether selenium is causing birth defects in cutthroat trout;
- Feeding study to assess the effects of selenium consumption on growth rates, survivorship, or breeding success of cutthroat trout;
- Genetic analysis to evaluate whether survivorship is present when comparing experimental results for two geographically isolated populations.

The preliminary results of the egg viability studies indicated that eggs collected from the Blackfoot River cutthroat trout contained two to three times more selenium than did control eggs collected from Henry's Lake (Montgomery Watson 2000). Although concentrations of selenium were higher in the Blackfoot River samples, they were still below the toxicity benchmark for selenium in fish eggs for increased birth defects of 10 mg/kg (dry weight). However, there was no discernable difference in the percent of deformed fry between the two populations. A feeding study was also conducted to evaluate the effects of selenium consumption on growth and reproductive performance of cutthroat trout. The results of the genetic study indicated that both populations were Yellowstone cutthroat trout, but were genetically distinct. The authors concluded, however, that bias in survivorship was not expected because both populations were the same subspecies.

A study on cutthroat trout given varying diets of seleno-methionine (SE-Met) found that average weight was unaffected by diet for the first year, but thereafter, fish fed the control diet weighed less than those fed diets containing SE-Met (Hardy and Moller 2002). Whole body selenium levels increased to 10 to 12 ug/g dry weight over the first 26 weeks of the feeding, but did not increase further with prolonged feeding. Mortality was 20 percent in fish fed the control diet and less than 10 percent in fish fed diets containing 4 ug/g dry weight selenium or higher. No clinical signs of selenium toxicity were observed nor were differences in reproductive performance (such as fecundity and egg hatchability) although in all dietary groups, egg fertility and hatchability were lower than that observed in eggs from wild cutthroat trout. Whole body and egg selenium levels reflected dietary intake in all treatment groups. Groups of fish fed the control diet for 32 weeks after having been fed diets containing various levels of Se-Met for 48 weeks returned to near baseline levels, indicating depuration of whole body levels of selenium over this time.

Lemly (1993) suggested a risk threshold of 12 micrograms per gram (µg/g) in concentrations of selenium in the liver of fish based on experimental results that linked exposure to selenite with perturbations of blood chemistry. However, the fish component for a hazard assessment protocol

for selenium presented by Lemly (1993; 1996) relies on data for fish eggs or whole-body residues (as a surrogate for eggs) but not on data for hepatic tissues. As Lemly recognized, only a weak basis exists for assessing ecological risk in nature based on hepatic concentrations of selenium and, therefore, they have little interpretive value.

Samples of trout tissue from Sheep Creek were obtained from fish collected during the sampling in September 2000. Ten whole body tissues were sampled and analyzed for concentration of selenium and cadmium. Whole-body values for selenium ranged from 1.2 to 5.6 µg/g dry weight. These values are below the risk threshold for bioaccumulation in fish as suggested by Lemly and others. Whole-body concentrations of cadmium ranged from 0.05 µg/g to 0.27 µg/g. These tissue concentrations are less than whole body tissue concentrations of 0.54 µg/g and 0.96 µg/g that produced no effect on growth and survival of young rainbow trout in the laboratory (BLM et al 2000).

Samples of fish tissue were also collected from Sheep Creek and analyzed as part of the North Rasmussen Ridge baseline aquatic study. Samples, which included both cutthroat trout and sculpin, were collected from upper and middle Sheep Creek. Concentrations of selenium in fish tissue ranged from 0.6 µg/g to 1.1 µg/g (wet weight). Concentrations of selenium in all fish tissue samples were below the 12 µg/g risk threshold. Concentrations of cadmium ranged from 0.07 µg/g to 0.26 µg/g (wet weight) (Maxim 2001f).

3.7.4 Stream Standards

In addition to human health standards, water quality standards for surface waters in Idaho include aquatic life standards that are based on the use classification of the stream.

Sheep Creek is identified as a “class 5 – highly critical” stream. A highly critical stream contains a fishery that is of value on a statewide basis. A continued high level of production is essential to sustain the current condition of the fisheries. The designation as a class 5 – highly critical stream includes Sheep Creek and all of its tributaries (USFS 1998).

No Name Creek is considered an Inland Native Fish Strategy (INFISH) category 4 stream – has perennial sections. INFISH is designed to protect riparian areas and fisheries from degradation caused by new or existing activities. To protect the riparian areas and fisheries, Riparian Habitat Conservation Areas have been established adjacent to designated fisheries or streams. The RHCA for No Name Creek is 50 feet wide on either side of the stream (USFS 1998).

3.8 THREATENED, ENDANGERED, AND SPECIAL STATUS SPECIES

The list of threatened, endangered, and special status species that could occur within the study area was developed from two sources. The USFWS (Mignogno 2003) and the USFS (Hamann 2001b) were contacted and each agency provided a list of species (**Table 3.8-1**). The USFWS identified three federally listed and one candidate species: bald eagle (*Haliaeetus leucocephalus*), gray wolf (*Canis lupus*), Canada lynx (*Lynx canadensis*), and yellow-billed cuckoo (*Coccyzus americanus*). The USFS identified 18 other sensitive species of interest because of concern about their population status or threats to their long-term viability. The USFWS and USFS identified

TABLE 3.8-1
USFWS AND USFS SPECIES OF INTEREST

Common Name	Scientific Name	USFS Status	USFWS Status	In Study Area
Bald eagle	*Haliaeetus leucocephalus*	NA	Threatened	No[1]
Canada lynx	*Lynx canadensis*	NA	Threatened	No
Gray wolf	*Canis lupus*	NA	Experimental Population, Non-Essential	Transients
Yellow-billed cuckoo	*Coccyzus americanus*	NA	Candidate	No
Cache's beardtongue	*Penstemon compactus*	Sensitive	Special Concern	No
Payson's bladderpod	*Lesquerella paysonii*	Sensitive	Candidate	No
Starveling milkvetch	*Astragalus jejunus* spp. *Jejunus*	Sensitive	NA	No
Spotted bat	*Euderma maculatum*	Sensitive	NA	No
Townsend's big-eared bat	*Plecotus townsendii*	Sensitive	NA	No
Wolverine	*Gulo gulo*	Sensitive	NA	No
Trumpeter swan	*Olor buccinator*	Sensitive	NA	No
Harlequin duck	*Histrionicus histrionicus*	Sensitive	NA	No
Boreal owl	*Aegolius funereus*	Sensitive	NA	No
Flammulated owl	*Otus flammeolus*	Sensitive	NA	Yes
Great gray owl	*Strix nebulosa*	Sensitive	NA	Likely
Three-toed woodpecker	*Picoides tridactylus*	Sensitive	NA	No
Spotted frog	*Rana pretiosa*	Sensitive	NA	No
Yellowstone cutthroat trout	*Oncorhynchus clarki bouvieri*	Sensitive	NA	No
Bonneville cutthroat trout	*Oncorhynchus clarki utah*	Sensitive	NA	No
Northern goshawk	*Accipiter gentilis*	MIS	NA	Yes
Columbian sharp-tailed grouse	*Tympanuchus phasianellus columbianus*	MIS	NA	No
Sage grouse	*Centrocercus urophasianus*	MIS	NA	No

Notes: [1]Bald eagles may use wintering area east of study area and the Blackfoot River watershed.
NA = Not Applicable
MIS = Management indicator species
Source: Mignogno 2003, Hamann 2001b.

species were considered in planning this project, and are addressed in a Biological Assessment (Greystone 2003a) and Biological Evaluation (Greystone 2003b).

The USFS identified three species of plants and 15 species of animals with special status. This analysis is summarized in **Table 3.8-1**. Detailed information on these species has been compiled in either a Biological Assessment for the USFWS available from BLM or a Biological Evaluation for the USFS that is available from USFS.

Two surveys were conducted for threatened, endangered, or special-status plants. Before field surveys began, the Idaho Conservation Data Center was contacted for a record search. The search did not identify any special status populations of plants within the study area. None of the plant species were observed within the study area during surveys, but potentially suitable habitat is present for all except slick-spot peppergrass.

The bald eagle is a periodic migrant in the area, but no known winter roost sites or breeding areas occur near the study area. Breeding wolves are not known to occur in or around the study area, but may travel through the area periodically. No evidence of Canada lynx was identified during surveys and it is unlikely to occur in the study area. However, the study area is located within a linkage corridor between lynx habitat in the Bridger-Teton National Forest (Greater Yellowstone Ecosystem) and the Ashley National Forest (Uintah Mountains) (Keyser 2002). The spotted bat was not observed during surveys, and suitable roosting habitat does not occur in the study area. Townsend's big-eared bat was not observed, and no known suitable day or night roosting areas occur in the study area.

The yellow-billed cuckoo (*Coccyzus americanus*) was listed as a candidate species by the USFWS on July 25, 2001 (66 FDR 38611 [USFWS 2001]). Habitat includes open and riparian woodlands and deciduous riparian habitat up to elevations of 6,600 feet. In southwestern Idaho, the yellow-billed cuckoo is considered a rare and erratic summer resident and breeder in mainly the Snake River valley (USFWS 2001). Yellow-billed cuckoos have not been detected during breeding surveys conducted in Idaho between 1966 and 2000 (Sauer, et al. 2000). According to USFWS data, the only documented occurrence of yellow-billed cuckoo and only known suitable habitat within the Caribou-Targhee National Forest is located on the Palisades Ranger District.

No evidence of wolverine was observed during surveys. However, the study area provides foraging habitat for wolverine. Wolverine may travel through the study area periodically, and are known to occur near Caribou Mountain in the Caribou-Targhee National Forest. No suitable habitat for the Trumpeter swan is present in the study area, as is also the case for the Harlequin duck. Neither the swan nor the duck was observed during surveys. Several Northern goshawks were observed in the study area during surveys, although suitable habitat does not occur in the area and no nests were located. Prior to past logging activities, the study area may have provided nesting habitat for northern goshawks. However, the study area is likely only used now as foraging habitat because most large trees have been removed by past logging. Surveys have not documented the presence of Columbian sharp-tailed grouse in the study area (Section 3.6.2.2). The study area may provide limited winter foraging habitat for Columbian sharp-tailed grouse due to the presence of aspen and serviceberry.

No boreal owls were heard or observed during surveys, but may occur because potentially suitable habitat is available in the area. The flammulated owl is expected to occur in the study area based on audible detections of the owls during surveys. The great gray owl was not seen or heard during surveys, but is considered likely to occur in the study area because suitable habitat is available. Although potential habitat exists in the study area, no evidence of three-toed woodpecker was observed during surveys. The spotted frog was not observed during surveys. Yellowstone cutthroat trout have not been observed in the study area, but suitable habitat is present and populations exist in lower Sheep Creek. Bonneville cutthroat trout do not exist in the study area because the study area is outside the Bonneville Basin.

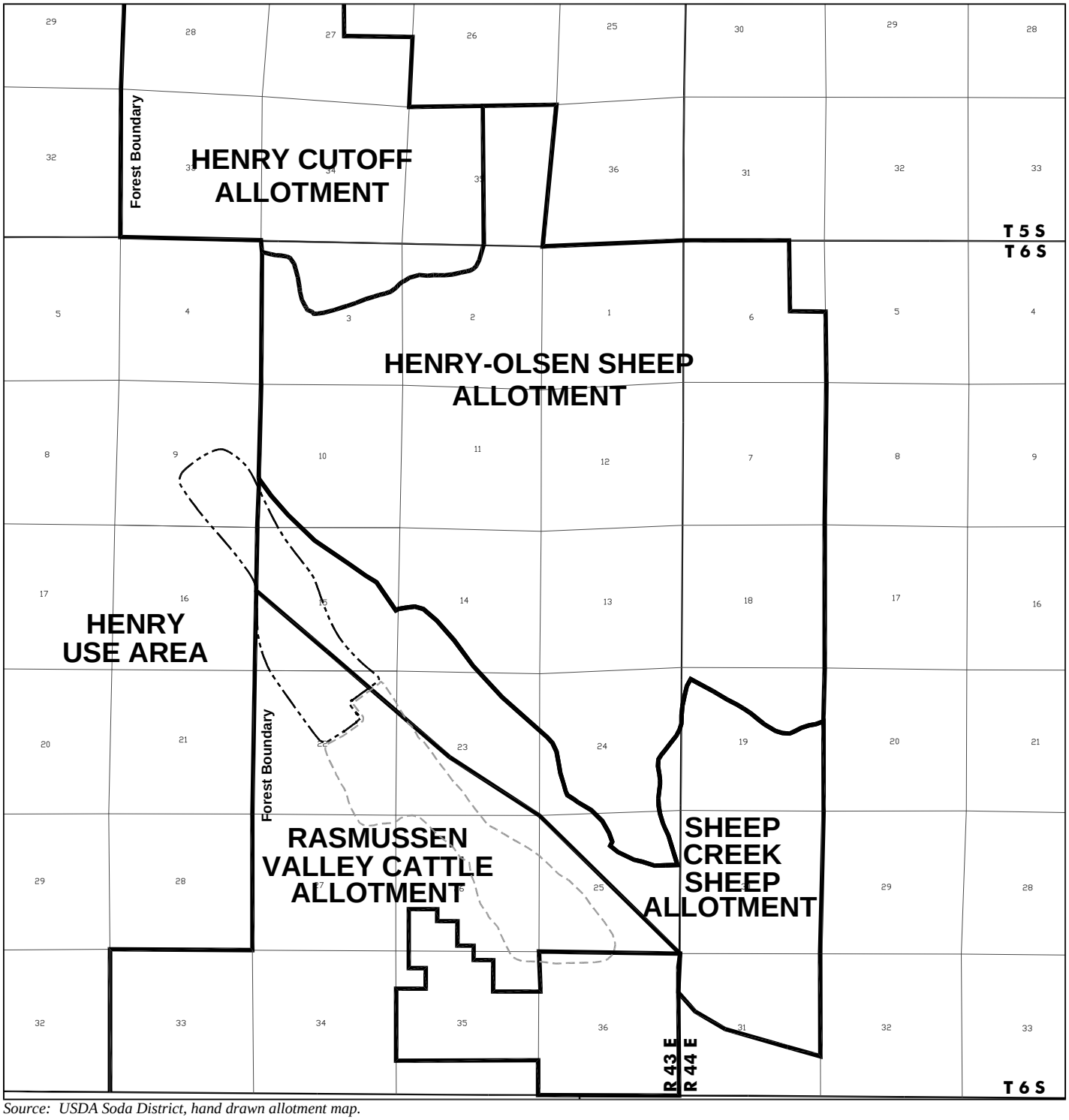
3.9 GRAZING MANAGEMENT

The study area is currently used to graze livestock during the summer, however, the Rasmussen Ridge Mine site has been excluded from grazing. Three USFS grazing allotments are located within the study area: Rasmussen Valley Cattle Allotment, Sheep Creek Sheep Allotment, and the Henry-Olsen Sheep Allotment (**Figure 3.9-1**). State and private lands located west of the project site are also leased for grazing. Forage production on these lands ranges from 400 pounds to 800 pounds air dry weight per acre (BLM and USFS 1997b). The vegetation communities in the grazing allotments include grassland/sagebrush, aspen forest, and mixed aspen/conifer forest. The species composition of these communities is presented in Section 3.5.1.

Cattle graze the Rasmussen Valley Cattle Allotment between June 11 and September 30. The allotment is leased by two permittees and is permitted for 378 cow/calf pairs, for a total of 1,399 head months. Of the 6,495 acres located within the Rasmussen Valley Cattle Allotment, 4,200 acres are considered suitable for grazing. Unit 1A of the Rasmussen Valley Cattle Allotment is currently closed to grazing due to mining activity. This unit did support 205 cattle for 48 days before mining began in the area. This unit contains about 2000 acres and supported 23 percent of the grazing use on this allotment.

The Sheep Creek and Henry-Olsen Sheep Allotments are held by a single permittee. Sheep graze these allotments between July 1 and September 5. The combined allotments are permitted for 1,000 ewe/lamb pairs, for a total of 2,203 head months.

According to the Caribou National Forest Plan, all lands except for talus slopes, water and rocks are considered suitable for grazing. Approximately 20,304 cattle (71,707 HMs) and 79,235 sheep (187,206 HMs) currently graze the Caribou National Forest. Within the Caribou National Forest, approximately 65 percent of grazing lands are currently meeting the Forest Plan objectives and another 27 percent of grazing lands are moving towards those objectives. In those areas where grazing is currently not meeting Forest Plan objectives, conditions are expected to improve under planned objectives. The Forest Plan includes a prescribed burning plan that involves treatment of sagebrush and mountain shrub vegetation annually. Treated areas are not available for livestock grazing for one year prior to treatment and for two-years following treatment. Prescribed burning effectively reduces the number of acres available for grazing because treatment areas are not available to livestock. Under Alternative 2 – Proposed Action of the Forest Plan DEIS, approximately 7,750 acres of sagebrush or mountain shrub would be treated using prescribed burning. Using a three year rotation, about 23,250 acres, producing 4,650 HMs of forage, would



Source: USDA Soda District, hand drawn allotment map.

LEGEND

- *Study Area*
- *Approved Central and South Rasmussen Ridge Area*

NORTH

0 1 2

Scale (miles)

North Rasmussen Ridge Mine EIS Project

FIGURE 3.9-1
GRAZING ALLOTMENTS

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 Base.dwg
Scale: As Noted	Drawn By: ETC

be unavailable for grazing on an annual basis. Under Alternative 2, restriction of cattle grazing in riparian areas would also result in the loss of 2,203 cattle HMs.

State and private lands located on the western portion of the study area are leased by the Idaho Citizen's Grazing Association. This association is almost 100 years old and includes a number of operators. The allotment located immediately to the west of the study area is the Henry Use Area. Sheep are grazed every other year on this allotment from May 15 until the end of June. At the end of June, the sheep are moved to adjacent Forest Service leases. In some years, the sheep may return to graze the Henry Use Area after September 15.

3.10 RECREATION

Outdoor recreation is one of the primary uses of federal lands in Caribou County, the Soda Springs Ranger District of the Caribou National Forest, and to a limited extent in the analysis area by providing scenic or historic attractions and a wild lands environment. Tourism is an important factor in the increasing diversity of the Caribou County economy because of these and other recreational opportunities provided by numerous private operators in the area. Destinations for recreation in the county include the Blackfoot Reservoir, Gray's Lake Wildlife Refuge, and the Soda Springs Geyser. Demand for recreation originates from resident and non-resident populations.

The analysis includes all areas where access to National Forest system lands is affected by the Proposed Action at the North Rasmussen Ridge Mine. Forest system roads that access the mine site or are directly connected to roads that access the mine site define the analysis area, which is bounded on the north by Sheep Creek, on the east and west by the National Forest Boundary, and on the south by Blackfoot River Road. The cumulative analysis area extends farther to the south to the Soda Springs/Montpelier Ranger District boundary to include other past and current phosphate mining operations on the Caribou National Forest in the Soda Springs District.

3.10.1 Recreation Use and Management

The Caribou National Forest in the Soda Springs Ranger District provides a wide variety of year-round dispersed recreational opportunities. Dispersed activities account for the largest amount of recreation use on the forest. Currently, more dispersed recreation facilities are needed to meet demand and reduce the impacts of recreation to forest resources.

There is little developed recreation in the analysis area, which is located on Rasmussen Ridge. The developed site nearest to the mine is the Mill Canyon campground, located about 5 miles south of the mine near the Blackfoot River. There are no other developed recreation sites on the forest within the analysis area. The Gravel Creek campground is north of Grays Range outside of the analysis area. Other developed recreation in the general vicinity of the analysis area includes state-managed facilities at the Blackfoot River State Recreation Management Area.

A broad spectrum of dispersed recreation occurs year-round on the forest. The Blackfoot River Management Area, which encompasses the analysis area, receives moderate to heavy use for activities such as hunting big game, waterfowl, and upland birds, hiking, fishing, snowmobiling, Nordic skiing, pleasure driving, and gathering forest products. Numerous 4-wheel drive roads traverse the area and provide opportunities for dispersed activities. Recreation uses in Rasmussen Valley on the south side of Rasmussen Ridge consist of sightseeing, dispersed camping, and hunting. Livestock permittees and private property owners also use this area and appreciate the visual and remote qualities of this valley. Recreation use is light until the hunting season.

Hunting is a major recreation use of the area. The general big game hunting seasons occur between late August through mid-December, depending on the method. Elk, deer, moose, and game birds occur in suitable habitat throughout the analysis area. The IDGF manages big game populations in hunt units. The analysis area is within hunt unit 76. Hunters generally enter the area near the existing mine from FDR 195, although some hunters hike from Lane's Creek County Road into the more inaccessible and remote portions of the area. **Table 3.10-1** summarizes the number of participating hunters and recreation days for each hunt unit.

There are a great variety of year-round fishing opportunities in southeast Idaho. Currently, the supply meets the demand. Most fishing within or near to the analysis area occurs on the nearby Blackfoot River and the Blackfoot Reservoir. Some limited fishing may occur in the lower segments of Sheep Creek east of the mine site.

TABLE 3.10-1
BIG GAME HUNTING DATA IN UNIT 76 IN 1999

	Total Hunters	Total Harvest	Percent Success	Total Recreation Days
Deer 1999	3,426	786	23.0	24,307
Deer 2000	NA	1,236	NA	NA
Deer 2001	3,057	1,493	49.0	14,205
Elk 1999	1,340	285	21.3	13,492
Elk 2000	NA	298	NA	NA
Elk 2001[1]	843	220	26.0	8,003

Source: Idaho Department of Fish and Game 2001.
NA = Not available
[1] = Archery only reported. Archery usually comprises 17 percent of the total elk harvest.

State Highway 34 north of Soda Springs is part of the Bear Lake-Caribou Scenic Byway. This route is shared by the Pioneer Historic Byway. Both were designated as Idaho State Scenic Byways by the Idaho Department of Transportation.

3.10.2 Caribou National Forest Recreation Management

Forest-wide general direction for developed recreation is to construct, reconstruct, and maintain developed sites in accordance with existing Recreation Opportunity Spectrum (ROS) class for the management area. The general direction for dispersed recreation is to provide a broad spectrum of dispersed recreation opportunities based on the existing ROS class for the management area.

The analysis area is located in the Blackfoot River Management Area. Management prescriptions for the management area are defined under Preferred Alternative 7 of the Draft EIS for Caribou National Forest Draft Revised Forest Plan. The management prescriptions identify the specific activities that are to be emphasized or permitted in each management area.

There are seven management prescriptions for the portion of the Blackfoot River Management Area that is within the analysis area. These are 8.2.2 – Concentrated Development – Mines, which includes the mine site; 2.7.2 – Elk and Deer Winter Range; 3.2 – Semi-Primitive Motorized; 3.3 – Semi-Primitive Motorized – restoration; 5.1 Timber Management; 5.3 – Forest Management – restoration; and 6.3 Range Management. Small areas of land managed with a semi-primitive motorized prescription are located adjacent to the west side of the mine site and throughout the analysis area. The largest area managed with a semi-primitive motorized prescription is more than 8 miles south of the mine site and the south end of the analysis area in the vicinity of Dry Ridge.

The goal for Semi-Primitive Recreation is to emphasize the prescription's uses while optimizing wildlife and fish habitat, water yield, and livestock grazing. Timber harvest prescriptions are limited to three stage shelterwood or partial cut methods. Recreation facilities will be to enhance the visitor's experience or protect the environment, but not to increase visitor comfort. Structural and nonstructural improvements associated with range, wildlife and fish, and water yield are permitted. Existing visual quality objectives must be maintained or improved. The standards and guidelines for dispersed and developed recreation are to manage to enhance the goal statement objectives.

Standards and guidelines for recreation resources in management prescriptions 6.3 and 5.1 emphasize Roaded Natural and Semi-Primitive Motorized within the Blackfoot River Management Area. Recreation management is not compatible with management prescription 8.2.2 – Concentrated Development – Mines.

3.10.3 Recreation Opportunity Spectrum Management

USFS lands are inventoried by ROS class to define the types of outdoor recreation opportunities the public desires and to identify the opportunities the forest can provide. The ROS system categorizes forest lands in six classes, each defined by its setting and by the possible recreation experiences and activities it affords. The analysis area has been inventoried with two ROS classes: Semi-Primitive Motorized and Roaded Natural.

The Semi-Primitive Motorized classification is characterized by moderately dominant alterations by people. It also is characterized a moderate probability of isolation from the sights and sounds of people, except for evidence of primitive roads and trails. Small areas of USFS land managed with Semi-Primitive Motorized prescriptions are located adjacent to the west side of the mine site and scattered throughout the analysis area. The analysis area includes primitive roads and trails.

The Roaded Natural class characterizes a predominantly natural environment with evidence of moderate permanent alternative resources and resource utilization. Evidence of the sights and sounds of man is moderate but in harmony with the natural environment. Opportunities exist for both social interaction and moderate isolation from the sights and sounds of man.

3.10.4 Roadless Areas

There are 34 inventoried roadless areas in Caribou National Forest. The nearest roadless area is 5 miles east of the mine site and is separated from the analysis area by private lands in the Upper Valley.

3.11 VISUAL RESOURCES

Scenic resources vary by location and existing natural features, including vegetation, water features, landforms and geology, and human-made elements. Scenic forest settings contribute to all recreation experiences.

3.11.1 Forest Service Scenery Management

The Caribou-Targhee National Forest has been directed to use the revised system, called the Scenery Management System (SMS), for project planning (USFS 2001). The USFS uses the SMS to establish the relative value and importance of scenery on USFS lands. The system is used in the context of ecosystem management to inventory and analyze scenery, assist in developing natural resource goals and objectives, monitor scenic resource, and ensure attractive landscapes are sustained in the future. The five components of Scenery Management System implementation are:

- Landscape character description
- Existing scenic integrity
- Scenic attractiveness
- Constituent analysis and visibility analysis
- Scenic classes

For the purposes of this analysis, the section on General Visual Characteristics will describe these components, and the section on key observation points will analyze these components for the existing condition. Visual resources analyses will incorporate the SMS, using the former Visual Management System (VMS) inventory data. Additionally, the scenery inventory, landscape character goals, and Scenic Integrity Objective (SIO) for the forest landscapes will be

identified by the project or area-level analysis (USFS 2001). Scenery will be managed using the Forest Plan Visual Quality Objectives (VQOs), or translated SIOs.

The VMS was developed to inventory and manage the visual resources of National Forest lands. The visual management inventory consists of three steps:

- Landscape character type
- Variety class
- Sensitivity levels

These steps are combined and interpreted to develop VQOs. The VQOs guide the amount of visual impact that management activities may have on the appearance of the landscape. The SMS evolved from and replaces the VMS. The system is used in the context of ecosystem management to inventory and analyze scenery in a national forest, to assist in the establishment of overall resource goals and objectives, and to monitor the scenic resource.

3.11.2 Landscape Character Description

Landscape character creates a "sense of place" and describes the image of an area. Rasmussen Ridge is located on the east side of the Rasmussen Valley Basin, which is enclosed on the east by Grays Range and on the west by the Wooley Range. The study area is along the eastern portion of the Rasmussen Ridge, an area of hilly terrain that ranges from 6,400 feet amsl at the valley floor to more than 8,300 feet amsl on nearby peaks. Reese Canyon is adjacent to the northwest portion of the study area. There are no naturally occurring distinguishable exposed soils and rock outcrops within the study area.

The area is characterized by rolling ridges, with a mixture of vegetation. The northern aspects, along higher ridges, are vegetated with conifer-aspen, and the foothills are vegetated with sagebrush interspersed with aspen. The valley bottoms are a mix of sagebrush and grass. The Sheep Creek drainage, east of the study area, has dense vegetation that consists of riparian in the drainage bottom to coniferous vegetation on the top of Rasmussen Ridge.

Views of the study area are limited. Henry Cutoff Road, Olsen Creek Road, Little Long Valley Road, and Sheep Creek Road are travel routes in the vicinity. The existing mine is visible from Upper Sheep Creek Road. Henry Cutoff Road, an improved road, is 1 mile north of the study area and is 800 feet lower in elevation. Olsen Creek Road, an unimproved road, is 1½ mile southeast of and is at a similar elevation as the study area. Little Long Valley Road, an unimproved road, is 2 miles south of the study area and is 600 feet lower in elevation.

The surrounding area is primarily used for summer grazing, logging, and mining. Some man-made features, such as corrals, fences, roads, and stock watering ponds, have been added to the area.

3.11.3 Existing Scenic Integrity

The landscape character description is used as a reference for the Existing Scenic Integrity (ESI) of all lands. ESI indicates the degree of "intactness" and "wholeness" of landscape character and helps locate and rank areas that need scenic rehabilitation. Conversely, ESI is a measure of the degree of visible disruption of landscape character. Six terms are used to describe the levels of existing and proposed scenic integrity as well as Scenic Integrity Objectives.

New System SIO	Old System VQO
Very High	Preservation
High	Retention
Moderate	Partial Retention
Low	Modification
Very Low	Maximum Modification
Unacceptably Low	Maximum Modification

Several man-made surface disturbances already exist within and around the study area. The Enoch Valley Mine is located in the north end of the Rasmussen Valley, about 1/3 mile west of the existing Central and South Rasmussen Ridge mines. The South and Central Rasmussen Ridge mines constitute an area with a VQO of Modification or a Low SIO. More than 488 acres have been disturbed by activities at Agrium's South and Central Rasmussen Ridge mines and more than 450 acres at Enoch Valley Mine. As of the end of 2000, more than 125 acres have been reclaimed at the Rasmussen Ridge mines. More than 310 acres have been reclaimed in the Enoch Valley Mine (USFS 1998). In 2001, additional disturbance associated with construction of a haulroad and stripping of topsoil occurred at Monsanto's South Rasmussen Ridge Mine. Ore and overburden removal was scheduled to begin in 2002.

VQOs of Modification (M) and Maximum Modification (MM) occur in generally "unseen areas" of potential phosphate mining areas (USFS 2001). Under the visual quality objective of M, management activities may dominate the original characteristic landscape. Class MM allows the greatest modification of the landscape. These VQOs translate into SIOs of Low and Very Low.

3.11.4 Scenic Attractiveness

Scenic attractiveness is the primary indicator of the scenic beauty of a landscape and of the positive responses it generates for people. It helps identify the landscapes that are valued for scenic beauty based on commonly held perceptions of the beauty of landform vegetation patterns and composition, water characteristics, land-use patterns, and cultural features. Scenic attractiveness indicates varying levels of long-term beauty of the landscape character. Two scenic attractiveness classifications are:

> Class A – Distinctive, which consists of landforms, vegetation patterns, water characteristics, and cultural features that combine to provide unusual, unique, or outstanding scenic quality. These areas have strong positive attributes of variety, unity, vividness, intactness, harmony, uniqueness, pattern, and balance.

Class B – Typical, which consists of landforms, vegetation patterns, water characteristics, and cultural features that combine to provide ordinary or common scenic quality.

The existing surface disturbance associated with the mine is located within an area considered Class B - Typical. The landforms in the study area, which consist of foothill lands, are not unique to the region. The vegetation patterns, which consist of conifer-aspen, sage, and grasses, are common to the region. There are no outstanding water characteristics or cultural features within the study area. As a result, these characteristics combine to provide common scenic quality.

3.11.5 Constituent Analysis/ Visibility Analysis

Landscape visibility consists of human values as they relate to their relative importance to the public and the relative sensitivity of scene base on distance from the observer. Human values that affect perception of landscapes are derived from constituent analysis. Constituent analysis serves as a guide to perceptions of attractiveness, helps identify special places, and helps to define the meaning people give to the landscape.

The public importance and the scenic attributes of the landscape are expressed as a concern level. Areas are assigned a concern level of 1, 2, or 3 to reflect the relative high, medium, and low visual importance of the area. Seen areas and distance zones are considered from these concern level areas to establish the sensitivity of scenes based on their distance from an observer.

In light of its location, the study area is generally not visible to the average observer. The study area is in the background from Little Long Valley Road and would, generally, be considered concern level 3, or of low visual importance. The proposed disturbance area is not visible from the other roads in the area.

3.11.6 Scenic Classes

A numerical class value is assigned to forest lands using the data gathered for scenic attractiveness and landscape visibility. The ratings 1 through 5 indicate the scenic importance of the landscape areas. Generally, scenic classes 1 and 2 have high public value, classes 3 through 5 have moderate value, and classes 6 and 7 have low value.

The scenic attractiveness of the study area, which consists of the existing mine disturbance, is considered typical. Coupled with the visual analysis or concern level of 3, the scenic class of the study area ranges from 5 to 6.

3.12 LAND USE AND ACCESS

3.12.1 Ownership

The Rasmussen Ridge leased area (North, Central, and South areas) encompasses 1,357 acres of land, as shown on **Figure 2.1-1**. Approximately 1,120 acres of the leased area is federally administered and is within the Caribou-Targhee National Forest. The remaining 237 acres of the

leased area are state-administered lands. Of the 269 acres proposed for disturbance at North Rasmussen Ridge, approximately 249 acres would be on Federal leases and 20 acres on State leases.

The mineral estate (mineral ownership) for the phosphate resources within the study area is primarily federally administered. The BLM Pocatello Field Office administers the federal mineral leases within the Caribou-Targhee National Forest. A total of 237 acres of the mineral ownership within the study area consists of state-administered lands with mineral leases managed by the Idaho Department of Land (**Figure 2.1-1**).

3.12.2 Existing Land Uses

The existing land uses within the study area include commercial mining, timber, domestic livestock grazing, and dispersed recreation. The current and historical land use for both the federal and state lands within the proposed mine area is primarily rangeland used for livestock grazing.

Previous disturbances in the project area include extensive exploration and logging (BLM and USFS 1990). A total of 220 exploratory holes were drilled in the North Rasmussen area (Agrium 2001). Mining began in the Central Rasmussen Ridge Mine in 1997. The South Rasmussen Ridge Mine was in operation from 1990 to 1997 (USFS 1998) and disturbed 257 acres. The Central Rasmussen Ridge Mine is estimated to disturbed 231 acres (USFS 1998). Within the Rasmussen Ridge area and Enoch Valley, 1,000 acres have previously been disturbed by mining, and about 440 acres have been reclaimed (USFS 1998).

The commercial timber resources were previously logged in the early 1980s for most of the Rasmussen Ridge area.

The federal lands within the study area are currently used for livestock grazing under the grazing allotments. Approximately 97 percent of the Caribou-Targhee National Forest is designated into grazing allotments and is open to grazing by either cattle or sheep (USFS 2001). The state and private lands within the study area are also leased for grazing.

3.12.3 Land Use Planning and Controls

The USFS Soda Springs Ranger District administers surface activities on federal lands within the Caribou-Targhee National Forest. The management standards and guidelines for development within the national forest are provided in the Caribou-Targhee National Forest Land and Resource Management Plan (Revised Forest Plan, USFS 2001). The management plans for the national forest support mining of phosphate resources under the Multiple-Use Sustained-Yield Act of 1960. The forest plan classifies the land within the national forest into various prescription categories, each with management practices selected to accomplish specific land and resource management objectives. The study area is categorized as both an existing and proposed concentrated mine development prescription area (USFS 2001).

The BLM Pocatello Resource Area Office administers the federal phosphate leases within the Caribou-Targhee National Forest. The USFS provides BLM with recommendations for lease issuance and development proposals, but the BLM has final authority for the leases on National Forest System lands. Conditions for approval and mitigation measures may be applied to federal phosphate leases.

State-owned lands in the study area are available for mineral and agricultural leasing, timber leasing and sales, and public recreation. Land use goals for most of the state lands within this area includes mine development. Under the State of Idaho Surface Mining Act, a reclamation plan with bonding must be approved before mining begins.

3.12.4 Access and Transportation

The study area is served by a well-developed regional road system that provides ready access from Soda Springs, which is located about 30 road-miles southwest of the existing mine site. The primary route to access the study area is State Highway 34, which connects to Soda Springs and U.S. Highway 30 to the south. The highway north of Soda Springs is a two-lane paved road that connects to Blackfoot River Road. Blackfoot River Road connects to forest system roads that access the study area. The study area can be also be accessed from the west from Enoch Valley Road and FDR 121. State Highway 34 also provides access to the Blackfoot Reservoir west of the study area and to Gray's Lake National Wildlife Refuge, north of the study area. Blackfoot River Road provides access to the forest south of the study area, in the Dry Ridge area. There are about 100 employees at the Central Rasmussen Ridge Mine, who currently use the local roads to commute. Employees commute from Soda Springs, Montpelier, and other communities via U.S. Highway 30 and State Highway 34.

Internal access to the mine site from Blackfoot River Road is on Forest Development Roads (FDR) 346, 872, 121, 195, and 243 (**Figure 3.1-2**). These forest system roads connect with several smaller roads to form a network that provides access to most of the study area. FDR 243 provides direct access to the mine site as well as forest lands on the north side of Sheep Creek. There are no traffic data for USFS roads in the study area. A few roads are gravel-surfaced and will accommodate passenger cars during snow-free months. Some roads within the study area are completely or partially closed during the winter because the Forest Service does not plow them.

Phosphate ore is hauled via 85-ton truck down the haulroad (FDR 999) to the tipple and railroad loadout area. From here, the ore is transported by rail to Agrium's processing plant located 5 miles north of Soda Springs.

3.13 CULTURAL RESOURCES AND NATIVE AMERICAN RELIGIOUS CONCERNS

Cultural resources include archaeological and historical manifestations of past human activity and traditional cultural concerns. These resources may be significant for their associations with events or persons important in cultural tradition or history, may be important manifestations of art, architecture, or typical traditional patterns, or may be likely to yield important information regarding past technologies, settlement patterns, subsistence strategies, or other research

questions important in history or prehistory. Primarily under the mandates of the National Environmental Policy Act (NEPA, P.L. 91-190; 40 U.S.C. 1500-17.7; 42 U.S.C. 4321-61) and the National Historic Preservation Act (NHPA, P.L. 95-515; P.L. 102-575; 16 U.S.C. 470-470t), as amended, and their principal implementing regulations (40 CFR §1 and 36 CFR §800), federal agencies are required to consider the effects of actions that they undertake, fund, or sanction on significant cultural resources. Significant cultural resources are defined as sites, objects, or districts that are eligible for or listed on the National Register of Historic Places under the Criteria for Eligibility (36 CFR §60.4). Additional laws and regulations including, but not limited to the Archaeological and Historic Preservation Act (P.L. 93-291; 16 U.S.C. 469-469c), the Federal Land Policy and Management Act (PL 94-579), the American Indian Religious Freedom Act (P.L. 95-341; 42 USC 1996 and 1996a; 43 CFR §7), the Archaeological Resources Protection Act (P.L. 96-95; 16 U.S.C 470aa-470mm; P.L. 100-555; P.L. 100-588), and the Native American Graves Protection and Repatriation Act (P.L. 101-601; 104 Stat. 3048; 25 U.S.C. 3001; 43 CFR §10) may apply to the consideration of certain resources. In general the preferred alternative for treatment of significant cultural resources is avoidance and protection.

3.13.1 Prehistoric Context

Southeastern Idaho is in the northeastern Great Basin culture area. The prehistory of the region is typically divided into three broad periods: (1) Paleoindian; (2) Archaic; and (3) Protohistoric. Each of these periods is characterized by distinct artifact types and by different settlement and subsistence patterns. The distinguishing characteristics of each of these periods are discussed below.

Paleoindian Period (ca. 12,000 to 7,800 years ago). The Paleoindian Period is divided into two subperiods based on hafted biface technologies and evidence of subsistence patterns. These periods are the Llano or Fluted Point (ca. 12,000 to 10,500 years ago) and the Plano (ca. 10,500 to 7,800 years ago). The best-known hafted bifaces or point types of the Llano subperiod are the Clovis and Folsom fluted points. Clovis and Clovis-like points have been found at a number of sites in southeastern Idaho but not in securely radiocarbon dated contexts. Clovis points predate Folsom and in other areas, including the Big Horn Basin of Wyoming, have been found in association with late Pleistocene mammoth remains. Folsom points are often associated with late Pleistocene forms of bison, somewhat later than the mammoth remains. They have been found in well-dated deposits at Owl Cave in southeastern Idaho, as well as a number of surface sites. The Plano Period, which spanned nearly three millennia, is comparatively well represented in southeastern Idaho. This period is represented by a wide range of large point styles that are distinct from the earlier fluted points. The fauna associated with these sites are more diverse than is typical of Llano sites, but includes modern and early Holocene forms of bison.

Archaic Period (ca. 7,800 to 300 years ago). The Archaic Period is distinguished from the Paleoindian Period by distinctive stemmed (Pinto series) and notched (Bitterroot Side-notched and Elko series) point types and evidence of a broader resource base. The shift from the larger lanceolate-shaped points of the Paleoindian to smaller stemmed and notched points is believed to be related to a change in hafting technology. Ground stone artifacts and small animal remains are also found at many sites, suggesting use of a wider range of resources. The Archaic Period is subdivided into three subperiods: (1) Early Archaic (7,800 to 4,500 years ago); (2) Middle

Archaic (ca. 4,500 to 1,300 years ago); and (3) Late Archaic (ca. 1,300 to 300 years ago). These cultural periods are characterized by biface technologies and shifts in patterns of settlement and subsistence. The Early Archaic is marked by the appearance of distinctive large side-notched and bifurcate stemmed points. The typical point types include Bitterroot Side-notched, Pinto series, and Elko series. There is no evidence of a substantial shift in subsistence practices. Groups remain highly mobile and retain a focus on hunting large game, similar to the earlier Paleoindian Period. The Middle Archaic is marked by an increase in the frequency of bifurcate-stemmed (Pinto and Gatecliff series), large corner-notched (Elko series), and lanceolate (Humboldt series) points, and a decrease in the frequency of Bitterroot Side-notched. Earth oven features are also commonly associated with sites of this period. Later in the Middle Archaic large corner-notched points and small point types become more abundant. The Late Archaic Period is marked by ceramics and small triangular and side-notched points. At least two cultural groups, the Fremont and the Shoshonean, are represented by these remains. Many contemporary Fremont groups in Utah are horticulturalists, and ceramics are often thought of as a marker of sedentary horticulturalists. However, current evidence indicates that the northern Fremont were hunter-gatherers. Shoshonean occupation is marked by brown-ware ceramics, Desert Side-notched points, and Cottonwood triangular points. These Numic cultural groups were also mobile hunter-gatherers with ceramics.

Protohistoric Period (ca. 300 years ago to historic). The Protohistoric Period is marked by the influence of the European market system and the appearance of European artifacts. One of the most conspicuous influences on cultural change was the horse. The horse made new hunting techniques possible and increased the potential range of hunting forays. At the same time, the demands of horse herds for water and forage limited potential settlement locations. The Shoshonean horse cultures of the Protohistoric Period in this region were the predecessors of the historic Shoshone and Bannock. As in other regions, conflicts between encroaching Euroamericans and indigenous cultures led to displacement of the indigenous cultures and establishment of the reservation system. The Fort Hall and Wind River reservations were established in 1867 and 1868. Even though the native groups relinquished their claim to the lands outside the reservations, they retain traditions about the lands and connections with sacred sites. These sacred sites include burials, rock art, monumental rock features, natural features, rock structures or rings, sweat lodges, timber and brush structures, eagle traps, and prayer and offering localities. Much of the landscape itself figures prominently in the identity and traditions of the native groups, and sacred places are not necessarily defined by archaeological remains.

3.13.2 Historic Context

The earliest documented accounts of Euroamericans in southeastern Idaho are of fur trappers and explorers in the early 1800s. By the 1840s, emigrants to the West Coast were following the trails identified by the earlier explorers and fur trappers. The Hudspeth Cutoff of the Oregon and California Trail passed through Soda Springs. In the 1860s, Mormon pioneers established settlements in southeastern Idaho. The discovery of gold in the Idaho panhandle in 1861 brought an influx of miners, and a regional mining boom continued into the 1890s. From 1870 to 1920, Soda Springs was a major supply point for mining camps in the Caribou Mountains. With the building of the transcontinental railroad in the 1860s, railroad workers entered the region. Tie hack camps supplied ties for the transcontinental railroad, and the timber industry supplied the

mines and the growing towns. Even though the timber resources of southeastern Idaho are not as abundant as in other parts of the state, they have played a key role in the development of the region. Cattlemen entered the region in the 1860s to supply the mines and eastern markets. Although sheep had been brought into the region along the emigrant trails, large herds were not established in Caribou County until the 1890s. The mining opportunities and railroad construction also attracted Chinese emigrants and later Japanese. Some homesteading took place in southeastern Idaho in the 1890s and early 1900s, but many of those homesteads failed in the 1920s and 1930s and reverted to federal control.

3.13.3 Previous Studies and Known Resources

A baseline cultural resource report was prepared for the North Rasmussen Ridge Mine Project (Maxim 2000). The study included a review of available information and a report of pedestrian surveys of the proposed area of impact. Pedestrian surveys located and recorded a single isolated historic artifact. Pre-field review identified four previous cultural resource investigations in the general area. No record was found of any known sites in the vicinity of the project. The baseline report states that the high elevation, rugged terrain, and distance from reliable sources of water made this area unattractive for sustained prehistoric or historic occupation. Early mining in the region was oriented to precious metals, and there are no precious metal deposits in the study area. There are also no indications that the area was used for ranching. No prehistoric or historic sites were anticipated in the study area.

Investigations of 150 acres in the previously unsurveyed portions of the study area were conducted by parallel pedestrian transects at 20-meter intervals (Maxim 2000). Two small areas of steep slopes were excluded from the investigation. A single historic isolated find was located and recorded. This isolated find, discovered at the edge of the study area, was described as a segment of riveted "smokestack." Given the relatively rugged terrain and the absence of mining or industrial buildings or equipment in the vicinity, it is likely that this smokestack is a stovepipe dropped by a passing shepherd's wagon. No areas were identified within the study area that exhibited the potential to contain undiscovered cultural resources.

3.13.4 Native American Traditional Concerns

The study area is within the traditional homeland of ancestors of the Northern Shoshone and Bannock Tribes. The study area is within the Shoshone Reservation broadly defined by the Fort Bridger Treaty as it was signed in 1863 and ratified in 1864. However, the Northern Shoshone and Bannock who now occupy the Fort Hall Reservation were not represented at those negotiations, and the western boundary of the reservation was not clearly defined. The subsequent Fort Bridger Treaty of 1868 refers to a reservation "which shall embrace reasonable portions of the 'Port neuf' and 'Kansas Prairie' [*sic* – Camas Prairie] countries." This treaty confirmed the vague definition of the Fort Hall Reservation in a Presidential Executive Order in 1867. As with the earlier Eastern Shoshone or Wind River Reservation, safe passage of white men, emigrants, travelers, and overland stage lines along established routes through the reservation territories was guaranteed.

The first firmly defined boundaries of the Fort Hall Reservation were surveyed in 1872 and encompassed 1.2 million acres, and does not include the study area. The study area is not within the current boundaries of the Fort Hall Reservation. These tribes retain certain rights and privileges on public land administered by the BLM and USFS. Off-reservation treaty rights include hunting, fishing, plant gathering, and grazing livestock. Federal agencies have implicit trust responsibilities to maintain the habitat of traditional natural resources in a viable and sustainable condition.

3.14 SOCIAL AND ECONOMIC CONDITIONS

This section describes the existing socioeconomic structure of Caribou County and the Town of Soda Springs, including population, economy, housing, and community services. Available socioeconomic data were collected from local and state government sources. The primary sources of information were various Idaho Department of Commerce data.

Part of the neighboring Bear Lake County, including the City of Montpelier, provides approximately half of the current workforce at the Rasmussen Ridge Mine. Bear Lake County and Montpelier are included in the population analysis because the County is impacted by the addition of personal income to the County economy through the wages paid to County residents.

Caribou County, Bear Lake County, and the communities near the mine site that provide housing for mine employees comprise the analysis area for socioeconomic resources. Caribou and Bear Lake Counties are located in southeast Idaho. The City of Soda Springs is the Caribou County seat. The Town of Grace is located 8 miles southeast of Soda Springs. Phosphorus mining and related industries provide employment for workers residing in both communities. The two communities are the largest in Caribou County, and together account for nearly 60 percent of the population in the county. The City of Montpelier in Bear Lake County is nearly 30 miles southeast of Soda Springs on U.S. Highway 30.

3.14.1 Population

Historically and currently, population trends in Caribou and Bear Lake Counties have been tied to resource development, particularly mining and agriculture. The phosphate industry provides employment for a significant portion of the population.

Caribou County has lost and gained population in the last 20 years, reflecting the fluctuations of mining and agriculture in the local economy. In the years between 1980 and 1990, the population of the county decreased by 19.9 percent. The population grew to 7,304 people in 2000, an increase of 4.9 percent over the 1990 population (Idaho Department of Commerce 2001a). The total population in 2000 is still 16 percent less than the 1980 population, due to downturns in agriculture and mining industries since the 1980s. Population changes over time are shown in **Table 3.14-1**. Population fluctuations in Bear Lake County have followed a similar pattern.

Soda Springs is the largest community in the county, accounting for 46.3 percent of the county population in 2000 (Idaho Department of Commerce 2001a). The urban population in the county is 46.3 percent of the total population. Population density in the county is sparse at 4.1 persons

per square mile. Caribou County had one of the lowest growth rates in Idaho between 1990 and 2000, ranking 41st out of Idaho's 44 counties (Idaho Department of Labor 2001a). The City of Montpelier accounted for 43.4 percent (2,785) of the Bear Lake County population in 2000.

TABLE 3.14-1
POPULATION GROWTH IN CARIBOU COUNTY AND SODA SPRINGS

	1980		1990		2000	
	Population	Growth (%)	Population	Growth (%)	Population	Growth (%)
State of Idaho	944,127	-	1,006,734	6.6	1,293,953	28.5
Caribou County	8,695	-	6,963	-19.9	7,304	4.9
Soda Springs	4,051	-	3,111	-23.2	3,381	8.7
Grace	1,216	-	973	-20.0	990	1.7
Bear Lake County	6,931	-	6,084	-12.2	6,411	5.4
Montpelier	3,107	-	2,656	-14.5	2,785	4.9

Source: Idaho Department of Commerce 2001c and 2001d; U.S. Census Bureau 2001a.

Caribou County's 2000 demographic estimate (U.S. Census Bureau 2001a) indicates that the majority of the residents are between the ages of 20 and 44 years. The median age is 53. In addition, residents of Caribou County comprise a fairly homogenous population, with a very low percentage of minorities. **Table 3.14-2** illustrates Caribou County's age distribution.

Table 3.14-3 illustrates the ethnic distribution in Caribou County. The population of Caribou County is predominantly white (96.1%), as shown in **Table 3.14-3** (U.S. Census Bureau 2001a). Other minority groups in the area constitute a small percentage of the total population. There were no areas identified in the analysis area that consisted of predominantly minority populations.

The U.S. Census Bureau (2001a) has estimated the number of people of all ages in poverty for Caribou County in 1997. Approximately 714 people, or 9.6 percent of the total population, had incomes below the poverty level in the county in 1997. There were no concentrations of residents below poverty level identified in the county, however, rural populations in southeast Idaho generally experience higher rates of poverty than urban areas.

TABLE 3.14-2
CARIBOU COUNTY AGE DISTRIBUTION (2000)

Age	Number	Percentage of Total
0-4	547	7.5
5-19	1,962	26.9
20-44	2,192	30.0
45-64	1,609	22.0
65+	994	13.6

Source: U.S. Census Bureau 2001a.

TABLE 3.14-3
CARIBOU COUNTY ETHNIC COMPOSITION (2000)

Race	Population	Percent
White	7,022	96.1
Black or African American	4	0.1
American Indian or Alaskan Native	15	0.2
Asian	6	0.1
Native Hawaiian or Other Pacific Islander	9	0.1
Other Race	161	2.3
Two or More Races	87	1.1
Totals	7,304	100.0
Hispanic Heritage*	289	4.0

Note: * Persons of Hispanic Heritage may be of any race.
Source: U.S. Census Bureau 2001a.

3.14.2 Economy and Employment

Historically and currently, the economies of Caribou and Bear Lake Counties have been dependent on the agricultural and mining sectors. The mining sector has been characterized by boom-bust cycles, which reflected the downturns and upswings of the mining industry. However, in recent years, there have been efforts to diversify the economy of the area. The area has seen growth in tourism and recreation, which in turn has stimulated the services and trade sectors. The largest employment sectors in 2000 were manufacturing, agriculture, services, government, and retail trade. The largest gains in employment between 1990 and 1999 were in the services, construction, and manufacturing sectors. The mining sector lost jobs during the same time period. In 1999, mining accounted for 9.2 percent of employment, which is a decline from 13.1 percent of employment in 1990. Manufacturing includes phosphate products manufactured within the county that are produced from phosphate ore mined in the county. The mining industry in Caribou County includes workers from the Bear Lake County labor force. However, employment and labor force characteristics do not reflect the number of workers from neighboring counties. **Table 3.14-4** summarizes employment by economic sector in Caribou and Bear Lake Counties.

Employment opportunities in the tourism and recreation industries are seasonal, consisting of employment related to hunting in late summer/early fall months and employment in other seasonal recreation industries. Employment in the agriculture industry, which has declined in the last decade, is also seasonal. In 1999, unemployment rates ranged from a low of 5.3 percent in October to a high of 7.7 percent in December. The unemployment rate has declined from a high of 7.5 percent in 1994 to the 1999 unemployment rate of 6.0 percent, a result of the increasing diversity of economic sectors providing employment in the county that offsets the fluctuations resulting from fluctuations in mining and agriculture industries. The 1999 employment is higher than the unemployment rate of 5.2 percent for the State of Idaho. **Table 3.14-5** summarizes labor force characteristics between 1990 and 1999.

The employment rates do not reflect economic conditions that have resulted in the loss of relatively high paying jobs in the mining industry. A general shift towards jobs that pay lower wages have led to an increasing number of workers holding more than one job to maintain an acceptable living standard (Idaho Housing and Financing Association 2001).

TABLE 3.14-4
EMPLOYMENT BY ECONOMIC SECTOR IN CARIBOU COUNTY

Economic Sector	1990		1999	
	Number of Employees	Percent	Number of Employees	Percent
Farm	636	15.8	705	15.4
Ag. Serv, Forest, Fish & Other	65	1.6	87	1.9
Manufacturing	681	16.9	808	17.7
Mining	526	13.1	422	9.2
Construction	161	4.0	306	6.7
Transport., Comm., & Pub. Utilities	136	3.4	174	3.8
Wholesale Trade	128	3.2	134	2.9
Retail Trade	459	11.4	535	11.7
Finance, Insur., & Real Estate	150	3.7	144	3.2
Services	446	11.1	597	13.1
Federal Civilian	54	1.3	46	1.0
Federal Military	45	1.1	31	0.7
State & Local Government	543	13.5	575	12.6
Total Employment	4,030		4,564	

Source: Idaho Department of Labor 2001.

TABLE 3.14-5
LABOR FORCE CHARACTERISTICS IN CARIBOU COUNTY

	1990		1994		1999	
	Caribou	Bear Lake	Caribou	Bear Lake	Caribou	Bear Lake
Total Labor Force	2,953	2,362	3,227	2,906	3,134	3,038
Employed	2,802	2,233	2,986	2,731	2,946	2,901
Unemployed	151	129	241	175	189	137
Unemployment Rate	5.1	5.6	7.5	6.0	6.0	4.5

Source: U.S. Census Bureau 2001b.

3.14.3 Housing

The 2000 U.S. Census of Population and Housing estimates a total of 3,188 housing units in Caribou County, of which 2,034 units, or 63.8 percent, are owner occupied. Of the total units, 1,505 housing units are in Soda Springs and 389 units are in Grace. The total vacancy rate for homeowners and rental in the county was 19.7 percent. The available housing stock was slightly greater in Bear Lake County, however, a greater percentage of available homes were seasonal homes, with a correspondingly higher rental vacancy rate. **Table 3.14-6** summarizes the housing characteristics in Caribou and Bear Lake Counties in the Census year 2000.

TABLE 3.14-6 HOUSING CHARACTERISTICS IN CARIBOU AND BEAR LAKE COUNTIES, 2000		
	Caribou	**Bear Lake**
Total Housing Units	3,188	3,268
Occupied Housing Units	2,560	2,259
Owner Occupied Units	2,034	1,878
Renter Occupied Units	526	381
Vacant Housing Units	628	1,009
Seasonal, Recreational, or Occasional Use	257	729
Homeowner Vacancy Rate (percent)	2.2	2.8
Rental Vacancy Rate (percent)	28.9	12.8

Source: U.S. Census Bureau 2001c

The median home value in Soda Springs and Grace in 2000 was $97,300. The available housing data suggest that building activity is not keeping pace with current population growth. The units currently being built do not meet the housing demands at the low end of the price spectrum (Idaho Housing and Financing Association 2001).

3.14.4 Community Services

There are three school districts in Caribou County. Communities in the project area are served by two school districts: the Soda Springs District #150 and the Grace District #148. There are five schools in the Soda Springs District #150 with a 1999 fall enrollment of 1,120 students. In the Grace District #148, there are three schools with a 1999 fall enrollment of 569 students (Idaho Department of Education 2001). The nearest adult education is provided through the College of Southern Idaho, a community college in Twin Falls, or Idaho State University in Pocatello.

The Caribou County Sheriff's Department in Soda Springs, and the Idaho State Highway Patrol provide law enforcement for Caribou County. The Sheriff's Department also provides a volunteer group for search and rescue. Law enforcement in Soda Springs is provided by the Soda Springs Police Department, which employs a staff of seven full-time officers (Idaho Department of Commerce 2001b).

Fire protection services in Soda Springs are provided by the Soda Springs Fire Department, which is manned by a combination of paid and volunteer personnel (Idaho Department of Commerce 2001d). Fire protection in Grace is provided by a volunteer fire department (Grace Chamber of Commerce 2001b). Caribou County also has a volunteer fire department that services the areas outside of Soda Springs and Grace and will also assist either of the city fire departments.

The Caribou County Hospital and Nursing Home in Soda Springs provides comprehensive health care facilities, including a full-service hospital with 27 beds, emergency care, industrial testing, and 24-hour ambulance service. The hospital also provides a 43-bed skilled nursing home. There are also a variety of health practitioners and specialists in the area.

The Utah Power and Light Company provides residential electricity in Caribou County. Each community has a water transmission and distribution system. Water system service in rural Caribou County is supplied primarily by wells or other authorized suppliers.

A treatment plant is responsible for solid waste management in unincorporated Caribou County. Soda Springs is served by its own waste water treatment facility. The Town of Grace has a sewage disposal facility that is capable of providing treatment for a population of 2000, more than double the current population. The landfill nearest to the communities is the Caribou County Landfill located near Grace.

3.14.5 Fiscal

Public finance activities, lease fees, taxes, and other fees paid to the federal, state, and local entities, impact Caribou County, the State of Idaho, and the federal government. None of the proposed facilities are located within Bear Lake County.

The taxes and royalties assessed on mineral development and production are a significant source of revenue for the State of Idaho and local governments, including Caribou County. The mining industry pays rent, royalties, and bonuses on federal leases, mine license taxes to the State of Idaho, and local property taxes on production equipment.

A mine license tax of 2 percent is collected by the state for the value of ores mined or extracted. In fiscal year 2000, the state collected revenues of $1,038,288 from the mine license tax, a decrease of 53.67 percent from the 1999 revenues of $2,240,990.

Property taxes are levied by Caribou County on facilities and/or improvements constructed by companies. The average 2000 tax rate for rural areas in Caribou County was 1.3025 percent.

3.15 ENVIRONMENTAL JUSTICE

U.S. Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations) directs federal agencies to assess whether the Proposed Action or alternatives would have disproportionately high and adverse human health or environmental impacts on minority and low-income populations. Environmental issues can be identified through public involvement and the scoping process. After conducting a public scoping process and public involvement program (as described in Chapter 1) no responses were received that raised any concerns about environmental justice in minority or low-income populations.

The North Rasmussen Ridge Mine site is located in a sparsely populated rural area of Caribou County. No distinct population groups have been identified in proximity to the proposed mine expansion site. The Fort Hall Indian Reservation is more than 25 air miles west of the mine site. The nearest community is Soda Springs, 19 air miles southwest of the site.

CHAPTER 4- ENVIRONMENTAL CONSEQUENCES

CHAPTER 4 ENVIRONMENTAL CONSEQUENCES

This chapter discusses anticipated direct and indirect impacts of the Proposed Action, one alternative, and the No Action Alternative for the North Rasmussen Ridge Mine. The following table presents a brief comparison of the disturbance and reclamation areas of the different alternatives. Continued operation, closure, and reclamation of the North Rasmussen Ridge Mine would result in an irreversible or irretrievable commitment of various resources. These resources would be consumed, committed, or lost during and after the life of the project. Nonrenewable resources, such as minerals in the ore, would be irreversibly committed during ore-processing operations. Irreversible and irretrievable commitment of resources and residual effects that would likely occur as a result of the Proposed Action or alternatives are discussed for each resource. Potential mitigation measures developed in response to anticipated impacts are also discussed for each resource. The Proposed Action is described in Chapter 2 and it basically involves developing expanded mining facilities to continue mining on existing leases. A comparison of impacts between the Proposed Action and alternatives is summarized in **Table 2.6-1** in Chapter 2. Cumulative effects (discussed in Chapter 5) result from incremental effects of the action when added to other past, present, and reasonably foreseeable future actions.

Disturbance and Reclamation Comparison of Alternatives (acres)

Description	Existing Disturbance	New Disturbance	Reclaimed Area	Percent Reclaimed
South Rasmussen	257	0	257	100
Central Rasmussen	231	0	196	84.8
Proposed North Rasmussen Ridge Mine				
Proposed Action	0	269	197+35	86.2
Alternative 1 – Proposed Action with Impermeable cap	0	320	248+35	88.4
Alternative 2 – No Action	0	0	-35	

+35 and -35 refers to Central Rasmussen Ridge Mine final pit area

4.1 MINERALS, TOPOGRAPHY, GEOLOGY, AND PALEONTOLOGY

4.1.1 Direct and Indirect Impacts

4.1.1.1 Proposed Action

Mineral Resources

Mineral resources would be directly affected by removal of phosphate ore and overburden. The phosphate resources produced under the Proposed Action would be available to meet regional or national demands for this commodity.

Under the Proposed Action, the deeper phosphate resources that would remain after mining in the North Rasmussen reserve would be uneconomic to remove at currently anticipated prices. Prices for phosphate would need to increase for mining of the remaining resources to become economic. The potential for future recovery of the remaining phosphate resources would be reduced by backfilling of the pits. The backfill material in the pits would have to be removed, and the pits would have to be enlarged substantially for the remaining phosphate resource to be mined. A substantial increase in the value of the phosphate would be necessary to offset the costs associated with removal of the backfill in the pits and the stripping of additional overburden required to enlarge and deepen the pits.

Topography/Disturbance

The pattern of naturally occurring rock outcrops would be altered wherever rock exposures would be excavated. Existing topographic features and landforms would be altered by removal and relocation of the waste rock (overburden) during mining operations under the Proposed Action. Waste rock would be hauled to the Central Rasmussen Mine pit and used as backfill material or as backfill material within the North Rasmussen Ridge Mine pits. An estimated 269 acres of land surface in the project area would be disturbed under the Proposed Action.

The North Rasmussen Ridge Mine pits, which encompass 199 acres, would be excavated as two pits under the Proposed Action. The combined pits would be 11,435 feet in length starting on the south end, at section 12500N, and ending on the north end, at section 23935N. These pits would be separated by 70 feet of original ground allowing No Name Creek to pass through the mine area. Approximately 49 percent of the waste rock generated under the Proposed Action would be placed in North Rasmussen Ridge backfill areas A, B, and C. Under the Proposed Action, backfill area C would be only partially backfilled. The backfill would cover the exposed ore and waste shales and the final pit bottom. Backfilling of the North Rasmussen Mine pits would reclaim 127 acres to original contour and 72 acres of partial backfill that would reduce the height of the residual highwalls.

The remainder of the waste rock available for use in backfilling mine excavations would be used in the Central Rasmussen Mine pit. Approximately 46 percent of the waste rock generated under the Proposed Action would be placed in Central Rasmussen backfill area F. The remaining 5 percent of waste rock generated under the Proposed Action would be placed in the Central Coyote Corner backfill area. The waste rock would be run of mine and would be placed in the deepest area and covered with 8 to 10 feet of chert and limestone and 2 to 3 feet of growth media. Under the Proposed Action, all of the 231 acres disturbed by the Central Rasmussen Mine pit would be reclaimed. This amount represents an increase in the acreage that would be reclaimed in the Central Rasmussen Mine pit area, from 196 acres under the approved Central Rasmussen Ridge Mine plan, to 231 acres under the Proposed Action, an increase of 35 acres.

Geology/Geologic Hazards

The geology of the project area would not be changed by phosphate mining; however, surficial deposits and bedrock would be removed by excavation and waste rock would be redeposited. Phosphate mining under the Proposed Action would disrupt the naturally occurring stratigraphic

sequence within the mine pit. This disruption would facilitate continued study of the phosphate-bearing strata where the stratigraphic section is exposed by excavation but making study difficult or impossible where large volumes of rock are removed or covered by waste rock. New human-engineered surficial deposits (pit backfill areas, and growth media storage areas) would be created during mining. At the conclusion of mining, reclaimed surface areas would also represent new human-engineered surficial deposits.

Depending on intensity, distance from the epicenter, and condition of structures, an earthquake may cause damage to mine facilities, surface rupture, displacement landslides, change in water flow from springs and wells, and failure of earthen dams. North Rasmussen is in seismic Zone III. Highwalls and backfill slopes are expected to be stable for facilities designed and operated in accordance with the practices currently in use at the Central Rasmussen Ridge Mine and in consideration of the potential seismic risks. The placement of backfill would provide additional support for highwalls that would further reduce the potential for instability. Because the areas for disposal of backfill are designed to incorporate convex faces at 3.0h:1.0v, no geotechnical stability hazards likely would be associated with the backfill areas.

Non-earthquake related potential impacts associated with geotechnical instability can be controlled using current sound operational practices. Operational practices have been developed to address each of the factors related to geotechnical stability. Where underlying slopes are too steep, material would be placed at the toe of the backfill to buttress the slopes. Trucks would be stopped on stable ground and unloaded to minimize shock loading on potentially unstable slopes. Rock would then be placed by dozer. Overloading would be reduced by limiting the height of backfill lifts. Reclamation recontouring would be performed concurrently or shortly after slope construction.

Geochemistry

The mining of ore and overburden under the Proposed Action would produce highly fractured rock from bedrock that is currently undisturbed and buried, with limited exposure to atmospheric oxygen or water. These rock fragments or particles of varying sizes would be exposed to surface conditions during mining and backfilling, introducing atmospheric oxygen and water that initiate weathering. The reactive surface area of the mined material used as backfill material would be far greater than that of the in-situ rocks. Weathering processes would include oxidation and the addition of moisture from precipitation. The increased surface area that is subject to weathering and leaching would most likely result in leaching harmful products into groundwater, surface waters and soils. Once the overburden is in its final backfilled site and is reclaimed, exposure to surface conditions and weathering processes would be reduced. However, it would take several hundred years or more for leaching products in the backfill to return to pre-disturbance levels.

Acid Rock Drainage (ARD)

Exposure of overburden rocks to the atmosphere could result in the oxidation of sulfide minerals and produce sulfuric acid and other chemical products. Because the solubility of most metals increases under acidic conditions, the weathering of waste rock could cause dissolution of metals and increased concentrations in surface or groundwaters.

ABA testing of 152 samples of overburden from Rasmussen Ridge indicates that the neutralizing potential for run of mine overburden is 17 time greater than the acid producing potential. This result indicates that the waste rock that would be held in disposal facilities and used as backfill under the Proposed Action is unlikely to generate ARD. Summary data for acid-base accounting tests on material proposed as backfill was presented in **Table 3.1-3**.

Results of ABA testing are also in agreement with the observed weathering behavior of historic waste rock at the Rasmussen Ridge Mine and other phosphate mines in the region. ARD has not been observed at existing waste rock dumps at Rasmussen Ridge or the neighboring Dry Valley and Smokey Canyon Mines (BLM et al 2000; BLM and USFS 2002). Dry Valley and Smokey Canyon mines recover phosphate from the same stratigraphic sequence that would be mined in the North Rasmussen Ridge pits.

Selenium and Other Elements

Weathering of shales within the Meade Peak Member of the Phosphoria Formation could also cause the oxidation of minerals and organic materials in waste rock that contain selenium and other metals. Selenium and other constituents released from the overburden during weathering could infiltrate into underlying earth materials or could be flushed from the overburden by surface runoff. Surface runoff that carries selenium, dissolved metals, or other constituents of potential concern (COPCs) could be discharged to surface waters unless it is controlled by storm water management systems or backfilled into the mine panels. Infiltrating water could be discharged from the backfill as seeps or springs or could continue to percolate downward through soils and bedrock, where it could recharge shallow or deep aquifers (BLM and USFS 2002).

The potential for oxidation of selenium-bearing minerals and organic matter and subsequent release of metals and other elements has been identified at other mines in southeast Idaho that produce phosphate from the Meade Peak Member. These metals include selenium, arsenic, antimony, cadmium, chromium, copper, lead, manganese, nickel, iron, aluminum, and zinc. The release of these constituents has been inferred to result from oxidation of overburden and rinsing of secondary mineral salts (BLM and USFS 2002).

Elemental Geochemistry

Assays for 50 elements in 119 samples of overburden indicate that cadmium, nickel, antimony, selenium, and zinc occur in the proposed mine waste rock at concentrations above normal crustal abundances (Rose et al. 1979). Average concentrations of cadmium in the proposed overburden are highest in Footwall Mud (92.17 ppm) followed by limestone (43.24 ppm), Center Waste Shale (29.77 ppm), Hanging Wall Mud (22.89 ppm), alluvium (4.88 ppm), and Rex Chert (3.13 ppm). Average concentrations of nickel are highest in the Footwall Mud (557.7 ppm) and lowest in alluvium (75.4 ppm). The Footwall Mud also has the highest concentration of antimony and zinc (7.49 and 3,489 ppm, respectively). Concentrations of selenium are greatest in the Hanging Wall Mud (76.0 ppm) followed by the Center Waste Shale (51.6 ppm), Footwall Mud (26.4 ppm), Rex Chert (16.6 ppm), alluvium (6.5 ppm) and limestone (4.1 ppm) (Maxim 2002a). Concentrations for selected constituents in proposed overburden were presented in **Table 3.1-4**.

Although the elemental assays indicate which metals are present in the overburden and to what extent they are enriched relative to other lithologies, they do not provide information about the potential solubility or mobility of the metal in the environment.

Column Leaching Tests

Column leaching tests were performed to evaluate the potential for release of metals from overburden materials and to identify COPCs. Eleven columns were constructed using cuttings from exploration drilling in the area of the proposed pit. Columns were prepared for each significant overburden rock type, including one column for alluvium, one for Rex Chert, one for Hanging Wall Mud, one for Footwall Mud, two for unweathered Center Waste Shale, two for weathered Center Waste Shale, and three for limestone.

Concentrations in column leachates were generally highest in the initial pore volume and decreased in subsequent pore volumes before becoming stable at lower levels. Arithmetic mean concentrations in column test leachate for combined pore volumes 1 through 10 are summarized in **Table 4.1-1** (also see **Table 3.1-6**). Plots showing TDS and selenium concentrations as a function of pore volume are shown on **Figure 4.1-1**.

Results of the column leaching tests indicate that seven parameters are COPCs in groundwater and four parameters are identified as COPCs in surface water. COPCs for the proposed North Rasmussen Ridge Mine are summarized in **Table 4.1-2**.

With the exception of fluoride and pH in leachates for unweathered Center Waste Shale, all other parameters evaluated in column test leachates beside those identified as COPCs were present at levels below applicable standards for groundwater and surface water or below the method detection limit and are not considered constituents of potential concern. Fluoride and pH are not considered to be COPCs because their concentrations are below applicable standards when calculated on a run of mine basis.

Column leachates were analyzed for total selenium, selenite (selenium^{4+}) and selenate (selenium^{6+}). Selenate (selenium^{6+}) was the predominant species observed in column leachates and typically accounted for between 65 and 95 percent of the total concentration of selenium. Selenite (selenium^{4+}) concentrations were typically 10 to 20 times less than selenate (selenium^{6+}) concentrations. These comparisons are approximate however, because the methods used to analyze for total selenium and individual species typically yield slightly different results. Oxidation of selenite (selenium^{4+}) to selenate (selenium^{6+}) also may have occurred during or after sample collection.

The COPCs identified in **Table 4.1-2** have the potential to contaminate groundwater and surface water that may receive seepage from the backfilled pit or exposed pit walls. Potential environmental impacts from COPCs are further discussed in the water resources section of this chapter.

TABLE 4.1-1
ARITHMETIC MEAN CONCENTRATIONS FOR COLUMN TEST LEACHATES, ALL PORE VOLUMES

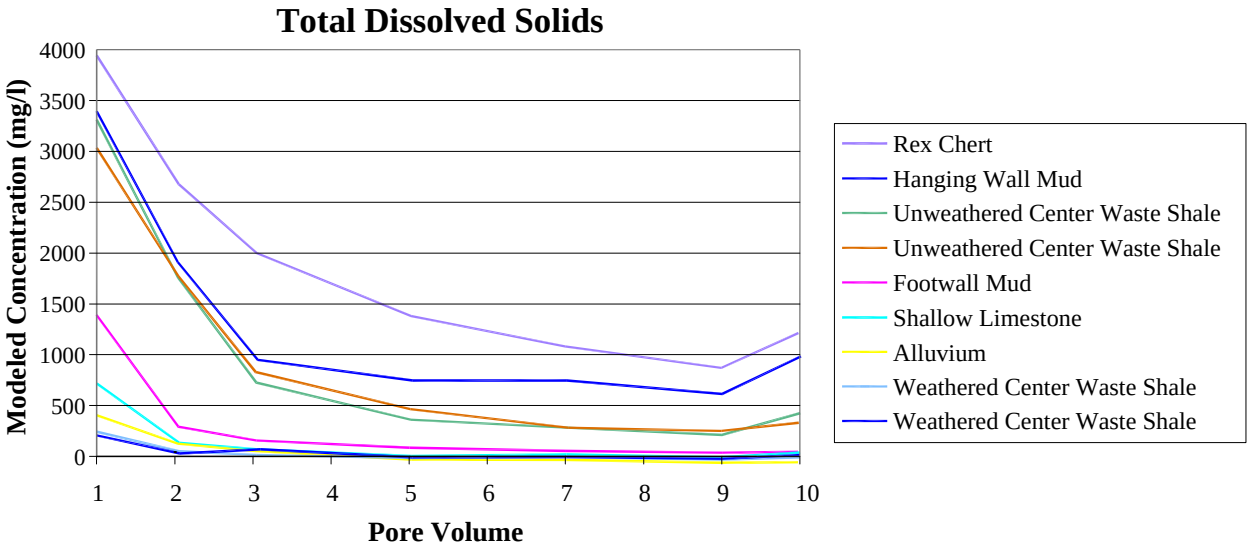
	Unit	Idaho Groundwater Standard	Idaho Aquatic Standard (CMC/CCC)	Method Detection Limit	Hanging Wall Mud	Footwall Mud	Alluvium	Shallow Limestone	Rex Chert	Unweathered Center Waste Shale	Unweathered Center Waste Shale	Weathered Center Waste Shale	Weathered Center Waste Shale	Deep Limestone	Deep Limestone	Run of Mine Weighted Average
Column ID		--		--	ARC 1	ARC 3	ARC 4	ARC 5	ARC 6	ARC 7	ARC 8	ARC 9	ARC 10	ARC 11	ARC 12	--
Calcium	mg/L	--	-- / --	1	293	70	42	45	376	204	214	22	24	NA	NA	178
Magnesium	mg/L	--	-- / --	1	62	26	4	21	85	52	47	2	3	NA	NA	42
Potassium	mg/L	--	-- / --	1	9	6	3	4	9	7	5	2	2	NA	NA	6
Sodium	mg/L	--	-- / --	1	9	9	8	10	14	9	6	6	6	NA	NA	10
Chloride	mg/L	250 (s)	-- / --	1	3	5	3	9	6	7	6	4	3	NA	NA	6
Sulfate	mg/L	250 (s)	-- / --	1	**889**	204	23	84	**1305**	**715**	**709**	28	28	5.6	7.6	**554**
Acidity as CaCO3	mg/L	--	-- / --	1	20	9	12	8	27	21	14	12	12	NA	NA	17
Alkalinity as CaCO3	mg/L	--	-- / --	1	83	75	111	111	37	4	22	36	38	68.2	81.2	60
Bicarbonate	mg/L	--	-- / --	1	101	91	136	136	45	5	27	44	46	NA	NA	81
Carbonate	mg/L	--	-- / --	1	1	1	1	1	1	1	1	1	1	NA	NA	1
Total Dissolved Solids	mg/L	500 (s)	-- / --	10	**1417**	402	184	253	**1950**	**1101**	**1098**	154	154	NA	NA	**925**
pH	s.u.	6.5-8.5 (s)	-- / --	0.1	7.6	7.8	7.9	8.0	7.1	**5.9**	6.8	7.4	7.5	7.89	8.09	7
Ammonia and N	mg/L	--	-- / --	0.05	0.10	0.04	0.04	0.04	0.04	0.04	0.06	0.05	0.04	NA	NA	0.05
Nitrate + Nitrite as N	mg/L	10	-- / --	0.01	0.06	0.12	0.09	0.26	0.49	0.17	0.21	0.46	0.16	NA	NA	0.29
Phosphorous, Total	mg/L	--	-- / --	0.005	0.409	0.215	0.269	0.046	0.106	1.288	0.499	2.334	3.148	NA	NA	0.52
Fluoride	mg/L	4.0	-- / --	0.1	0.80	2.66	0.73	1.51	0.92	**5.11**	**6.14**	0.87	0.83	NA	NA	1.57
Eh	mV	--	-- /--	1	221	210	198	215	251	275	306	232	227	200.6	189.0	234
Aluminum, Dissolved	mg/L	0.2 (s)	-- / --	0.1	0.1	0.1	0.1	0.1	**0.2**	**0.8**	**0.3**	**0.2**	**0.2**	NA	NA	**0.2**
Antimony, Dissolved	mg/L	0.006	-- / --	0.001	**0.007**	**0.011**	0.005	**0.008**	0.004	**0.011**	**0.012**	**0.006**	**0.009**	**0.008**	**0.006**	**0.006**
Arsenic, Dissolved	mg/L	0.050	0.05 / 0.05	0.001	0.010	0.008	0.002	0.001	0.003	0.011	0.005	0.004	0.011	0.0074	0.0026	0.005
Barium, Dissolved	mg/L	2	-- / --	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	NA	NA	0.2
Beryllium, Dissolved	mg/L	0.004	-- / --	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	NA	NA	0.002
Cadmium, Dissolved	mg/L	0.005	0.004 / 0.001	**0.0010**	**0.0085**	**0.0010**	0.0002	0.0001	**0.0175**	**0.0361**	**0.0256**	0.0005	0.0002	0.0003	0.0003	**0.0096**

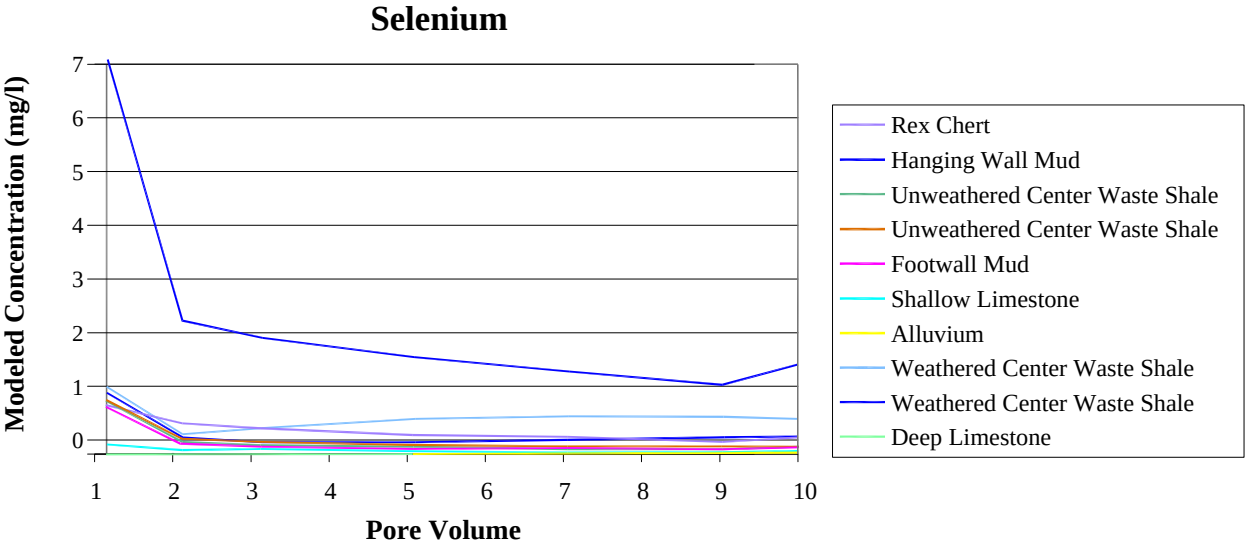
TABLE 4.1-1 (CONT.)
ARITHMETIC MEAN CONCENTRATIONS FOR COLUMN TEST LEACHATES, ALL PORE VOLUMES

	Unit	Idaho Groundwater Standard	Idaho Aquatic Standard (CMC/CCC)	Method Detection Limit	Hanging Wall Mud	Footwall Mud	Alluvium	Shallow Limestone	Rex Chert	Unweathered Center Waste Shale	Unweathered Center Waste Shale	Weathered Center Waste Shale	Weathered Center Waste Shale	Deep Limestone	Deep Limestone	Run of Mine Weighted Average
Chromium, Dissolved	mg/L	0.100	0.549 / 0.178	0.005	0.005	0.013	0.006	0.005	0.005	0.005	0.005	0.012	0.014	NA	NA	0.006
Copper, Dissolved	mg/L	1.30	0.017 / 0.011	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	NA	NA	0.01
Iron, Dissolved	mg/L	0.3 (s)	-- / --	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.086	0.086	0.108
Lead, Dissolved	mg/L	0.015	0.065 / 0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	NA	NA	0.001
Manganese, Dissolved	mg/L	0.05 (s)	-- / --	0.015	**1.2**	**0.4**	**0.3**	**0.2**	**5.6**	**1.6**	**1.7**	**0.1**	**0.1**	**0.07**	**0.07**	**2.1**
Mercury, Dissolved	mg/L	0.0020	0.0021 / 0.000012	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	NA	NA	0.0000
Nickel, Dissolved	mg/L	--	1.415 / 0.157	0.05	**0.79**	0.07	0.05	0.05	**4.02**	**0.60**	**0.47**	0.05	0.05	NA	NA	**1.39**
Selenium, Dissolved	mg/L	0.050	0.02 / 0.005	0.001	**2.517**	**0.212**	**0.003**	**0.075**	**0.433**	**0.280**	**0.256**	**0.375**	**0.661**	0.0012	0.001	**0.372**
Selenium IV, Dissolved	mg/L	--	-- / --	0.001	0.017	0.013	0.001	0.033	0.008	0.049	0.049	0.058	0.231	0.0009	0.0008	0.033
Selenium VI, Dissolved	mg/L	--	-- / --	0.001	4.03	0.310	0.004	0.061	0.551	0.371	0.355	0.453	0.462	0.0015	0.001	0.508
Silver	mg/L	0.1 (s)	3.4 / --	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	NA	NA	0.003
Strontium, Dissolved	mg/L	--		0.1	0.4	0.2	0.2	0.2	0.8	0.3	0.3	0.1	0.1	NA	NA	0.4
Thallium, Dissolved	mg/L	0.002		0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	NA	NA	0.002
Zinc, Dissolved	mg/L	5.00	0.114 / 0.105	0.05	0.08	**0.13**	0.07	0.05	**5.86**	**1.57**	1.01	0.05	0.05	0.05	0.05	**2**

Notes:

Column ARC 2 was a control column and is not included in this summary table
NA denotes that samples were not analyzed for the constituent
NC denotes that the run of mine concentration was not calculated because all concentrations in column leachates were below the method detection limit
-- Denotes no established standard
(s) Denotes a secondary groundwater standard
Values that exceed applicable standards are in **bold** type





Source: Whetstone 2002

North Rasmussen Ridge Mine EIS Project	
FIGURE 4.1-1 CONCENTRATIONS OF COLUMN TEST LEACHATES	
ANALYSIS AREA: Caribou County, Idaho	
Date: 02.27.03	Drawing File: 1164 CON CON.dwg
Scale: NTS	Drawn By: ETC

TABLE 4.1-2
CONSTITUENTS OF POTENTIAL CONCERN

Constituent	Potential Concern in	
	Groundwater	Surface Water
Total Dissolved Solids	√	
Sulfate	√	
Aluminum	√	
Antimony	√	
Cadmium	√	√
Manganese	√	
Nickel		√
Selenium	√	√
Zinc		√

Existing Overburden Seeps

Data on water quality from existing overburden seeps at Rasmussen Ridge indicate that selenium, cadmium, manganese, nickel, and zinc, are mobile in seepage at concentrations that exceed applicable standards for groundwater and surface water. Observed concentrations in samples from the South Rasmussen Ridge mine range from 0.038 to 0.17 mg/L for selenium, less than 0.003 to 0.007 mg/L for cadmium, 0.044 to 1.64 mg/L for manganese, 0.03 to 0.17 mg/L for nickel, and 0.024 to 0.52 mg/L for zinc. Data are not available for other constituents in external waste rock dump seepage from South Rasmussen Ridge. Available field data generally agree with results for column tests regarding COPCs that were identified as mobile in seepage from overburden rocks.

Paleontology

Impacts to paleontological resources could occur from the disturbance of the phosphate ore from the Phosphoria Formation (Meade Peak Member) or waste rock from the Phosphoria Formation (Meade Peak and Rex Chert members) and the Wells Formation when Panels A and B would be mined. Invertebrate fossils in these geologic units are not known to be significant or restricted to the Rasmussen Ridge area and are likely to be found throughout the outcrop areas of these formations in southeastern Idaho and adjacent areas.

Paleontological resources are fragile and, once disturbed, lose much of their preserved information. Avoidance of significant sites is the preferred mitigation measure for adverse effects on paleontological resources. However, it is anticipated that those resources found in the ore or waste rock, would be mined, and the ore sent to the mill for processing. Little or no protection or avoidance would be possible if mining occurs. Appropriate agency mitigation would be implemented if resources are discovered.

Paleontological resources are non-renewable and can become exhausted. Although fossils are rarely one of a kind, a limited number of specimens may be preserved in any geologic formation

and use for scientific study can be greatly reduced or foregone if they are damaged, destroyed, or removed without proper scientific documentation. Mining activities would result in a loss of resources and/or scientific values. The loss of resources at North Rasmussen Ridge is not quantifiable.

4.1.1.2 Alternative 1 - Proposed Action with Impermeable Capping of Backfilled Area

Under Alternative 1, it is assumed that the potential for release of constituents from overburden would be the same as for the Proposed Action. The direct and indirect effects under Alternative 1 would be similar to the Proposed Action, with the following exceptions.

An additional 26 acres of land surface in the project area would be disturbed under Alternative 1 for a new external waste rock dump that would contain an estimated 2.7 million lcy of waste rock. This dump would be needed to accommodate excess waste rock that could not be used as backfill. There would be excess waste rock because construction of an impermeable cap requires flatter slopes to maintain stability. Flatter slopes do not have as much capacity for backfill as do steeper slopes.

New disturbance would also be required under Alternative 1 for a surface mining operation and mine roads needed to supply clay material for the impermeable cap in backfill areas at Rasmussen Ridge. The acreage affected by this new disturbance has not been quantified, but likely would be about 25 acres. If clay cannot be located in the nearby area, the costs of the clay cap would increase substantially. Use of a synthetic material for the impermeable cap would eliminate the disturbance for a clay source but would substantially increase the cost of implementing Alternative 1.

4.1.1.3 Alternative 2 – No Action

As a result of the direct and indirect effects associated with Alternative 2 - No Action, the phosphate resources in the North Rasmussen Ridge area would not be mined. Remaining phosphate resources would remain in place and would be available to be mined at some future date. However, it is likely that the quantity of remaining phosphate resources would be insufficient to justify the expense of mine startup in the Rasmussen Ridge area after a period of inactivity and after mine access roads in the Central and South Rasmussen areas have been reclaimed.

No new disturbance of the land surface in the project area would occur under Alternative 2. Existing disturbances from roads and facilities as part of ongoing mining at Rasmussen Ridge would be reclaimed when operations at the Central Rasmussen pit conclude.

Under Alternative 2, the reclamation plans for the Central Rasmussen Mine area would not be changed. An estimated 35 acres of the Central Rasmussen Mine pit would not be backfilled and would remain in an unreclaimed state, as specified in the approved mine plan. Highwalls in the unreclaimed portion of the pit would not be eliminated through backfilling of waste rock from North Rasmussen. Pit materials that contain selenium and other elements would be exposed to weathering processes if the 35 acre portion of the Central Rasmussen pit were not backfilled.

Earth materials containing selenium or other elements that are exposed in the Central Rasmussen pit would likely release these constituents into groundwater, surface waters or soils. The release of concentrations of selenium or other elements into the environment and subsequent uptake could have adverse effects on plant or animal life.

4.1.2 Irreversible and Irretrievable Commitment of Resources

Each level of agency decision-making ensures the orderly development of federally owned phosphate resources. Agency actions are incrementally more irreversible as more site-specific analysis occurs. Leasing of the mineral and surface occupancy rights has already occurred within the project area and has conveyed to the lessees the right to explore for, develop, and produce phosphate resources that are contained in the lease holdings. Thus, development or production that requires surface disturbance is reasonably foreseeable within the lease holdings and can be authorized by the agencies. The Proposed Action would authorize site-specific phosphate mining, including production, within the project area.

4.1.2.1 Proposed Action

Mineral resources are non-renewable. Phosphate production under the Proposed Action would represent an irreversible and irretrievable commitment of resources, as the phosphate produced would no longer be available for future use. Economically mineable reserves of phosphate ore in the Rasmussen Ridge area would be depleted when mining ends under the Proposed Action. This loss would be small when compared with the total phosphate reserves available for future use in this region. Supplies of phosphate within southeastern Idaho, western Wyoming, and southwestern Montana are vast. Therefore, economically mineable reserves of this commodity are not likely to be exhausted at any reasonably foreseeable future date.

Impacts to topographic features and rock exposures that would result from excavation under the Proposed Action would be irreversible and irretrievable. New human-engineered features, such as the North Rasmussen Mine pits, or surficial deposits (pit backfill areas and growth media storage areas) created during mining and modified during reclamation would be irreversible and irretrievable engineered features when mining ends.

Any loss of paleontological resources associated with activities under the Proposed Action would represent an irreversible and irretrievable commitment of resources. However, similar fossils found in the project area could possibly be found in southeastern Idaho in similar formations. These losses would probably not represent a significant impact.

4.1.2.2 Alternative – 1 Proposed Action with Impermeable Capping of Backfilled Area

The irreversible and irretrievable commitments of resources under Alternative 1 would be similar to the Proposed Action, with the following exceptions. Mineral materials are non-renewable resources. Production of material for the impermeable cap under Alternative 1 would represent an irretrievable commitment of resources, as the materials produced would no longer be

available for future use. This loss would be insignificant when compared with the total volume of mineral materials that are available for future use in this region.

4.1.2.3 Alternative 2 – No Action

Under Alternative 2, there would be no irreversible or irretrievable commitment to development of the phosphate resources in the North Rasmussen Ridge area. Economically mineable phosphate reserves would not be depleted within the North Rasmussen Ridge area.

Under Alternative 2, the final 35 acre Central Rasmussen Mine pit would not be backfilled. Mining would continue in the Central Rasmussen Mine pit, in accordance with approved mine plans. An estimated 231 acres would be disturbed during mining, and an estimated 196 acres (or 85 percent of the disturbed area) would be reclaimed at the conclusion of mining. The unreclaimed portion of the pit would be an irretrievable engineered feature when mining ends.

4.1.3 Residual Impacts

4.1.3.1 Proposed Action

Metals and other elements, including selenium, introduced into the near-surface environment by weathering processes that would occur during activities under the Proposed Action would not disappear when mining ends. Metals and other elements, including selenium, would continue to be present in residual pit highwalls and in-pit backfill areas, and would continue to be dissolved and mobilized in seepage for hundreds of years after the facilities have been reclaimed (BLM and USFS 2002). Control factors included in project design, mitigating measures, and use of BMPs would greatly limit the severity of residual impacts.

Collectively, the following procedures would reduce the exposure of ore and waste shale zones that contain potentially seleniferous materials, limiting residual impacts under the Proposed Action. Backfill material would be placed selectively so that center waste shale and other potentially seleniferous material would be located in the middle to deep areas of the backfill. Eight to 10 feet of non-seleniferous limestone and chert would be used to cover any potentially seleniferous materials, providing a barrier to their exposure. Enough non-seleniferous backfill material would be rehandled, about 1.2 million lcy, to ensure that ore and shale exposures in the pit would be covered. Rehandled materials would be covered with up to 2 to 3 feet of growth media and revegetated as directed by BMPs for backfill reclamation.

The probability that a post-mining pit lake would form in backfill area C as a residual impact would be greatly reduced by the project design. The rehandled backfilled material would be sloped so that water would flow toward the limestone footwall over a distance and area that are adequate to allow the water to drain into the footwall or backfill. Analysis of infiltration through the rehandled backfill indicated that water from a 10-year, 24-hour storm would infiltrate into the footwall limestone in 23 days. The 10-year, 24-hour storm involved rain on top of snow and comprised the worst case storm for runoff.

The potential for geotechnical instability of remaining highwalls in the North Rasmussen Mine pit would represent a residual impact. The probability of pit wall failures that would occur as a

residual impact would be reduced because the rehandled materials would be placed along the pit wall toes to provide a buttress for the lower portions of the pit walls.

4.1.3.2 Alternative 1 - Proposed Action with Impermeable Capping of Backfilled Area

The residual impacts under Alternative 1 would be similar to the Proposed Action, with the following exceptions. Placement of an impermeable cap would greatly reduce exposure of meteoric water to the ore, waste shale zones, and backfill that could contain potentially seleniferous materials. This procedure would further limit the residual impacts associated with the exposure of seleniferous materials under Alternative 1 to less than the impacts that are anticipated under the Proposed Action.

4.1.3.3 Alternative 2 – No Action

Metals and other elements, including selenium, introduced into the near-surface environment by weathering processes that act on the unreclaimed portion of the Central Rasmussen pit would continue long after mining operations end. Metals and other elements, including selenium, would continue to be dissolved and mobilized in seepage for hundreds of years after the facilities have been reclaimed (BLM and USFS 2002). Water runoff control factors included in the Central Rasmussen Mine design and mitigating measures (backfilling pits, capping and revegetation) would limit the severity of residual impacts.

The potential for geotechnical instability of highwalls in the unreclaimed portion of the Central Rasmussen Ridge mine pit also would represent a residual impact. The potential for a pit lake to form in the Central Rasmussen Ridge Mine and allow exposure to seleniferous outcrops would also represent a residual impact.

4.1.4 Mitigation Summary

Project design features, BMPs, and the proposed Reclamation Plan (see Chapter 2) are the elements of the Proposed Action designed to reduce environmental impacts to minerals, topography, and geology.

Conditions of approval for the mine plan require protection and prompt reporting of vertebrate paleontological resources discovered during the project. Operations must be suspended until the discovery and mitigation are evaluated. In addition to potential adverse impacts during construction or mine excavation, significant fossils may become exposed during subsequent erosion of freshly excavated rocks at the mine site. The mitigating measures applicable to the Proposed Action would also apply to Alternative 1.

4.2 AIR RESOURCES

4.2.1 Direct and Indirect Impacts

This section discusses the potential direct and indirect impacts to air quality related to the Proposed Action and alternatives. In general, none of the alternatives would result in a significant increase in air quality impacts beyond the current level.

4.2.1.1 Proposed Action

The Proposed Action would continue the levels of air pollutant emissions that currently result from mining at the Central and South Rasmussen mines.

Table 4.2-1 presents estimates of emissions for current operations at the Central Rasmussen Ridge Mine and the overall emissions as mining moves into the North Rasmussen Ridge Mine. These emissions are based on the current level of mining. All emissions are and would be within NAAQS and would not be considered an impact to human health, as the nearest residence is over two miles north of the proposed project area. These emissions would be a continuation of similar emissions that are currently approved and no downwind effects to persons or sensitive sites would occur.

The stationary sources include three diesel generators and one propane boiler. The internal combustion engines include the mobile gasoline and diesel equipment that is involved in mining, hauling, and personnel transport. Fugitive dust is related to vehicle activity on unpaved roads, and to windblown soil, overburden, and ore handling.

TABLE 4.2-1
TOTAL ANNUAL EMISSIONS (TON/YR)

Source	NO_x	CO	VOC	SO_2	PM_{10}
Stationary Sources	66.18	14.19	5.23	4.32	4.66
Equipment Engines	1,207.53	669.35	85.29	125.76	79.54
Mining Fugitive Emissions	-	-	-	-	515.88

4.2.1.2 Alternative 1 – Proposed Action with Impermeable Capping of Backfilled Area

Alternative 1, Proposed Action with impermeable capping of backfill, would result in a temporary increase in impacts to air quality for all criteria pollutants. This increase would be related to increased vehicle and material handling activity related to capping. Proposed emissions would not be substantially greater than for the Proposed Action and would be within NAAQS.

4.2.1.3 Alternative 2 – No Action

Alternative 2, No Action, would result in declining impacts to air quality over time as mining declines along with diminishing reserves at the existing Central Rasmussen Mine.

4.2.2 Irreversible and Irretrievable Commitment of Resources

Impacts to air quality from the Proposed Action or from either alternative would not involve any irreversible commitment of resources. Continuing mining for eight years would constitute an irretrievable degradation of air quality from dust and emissions.

4.2.3 Residual Impacts

Impacts to air quality from the Proposed Action or from either alternative would not involve any residual impacts.

4.2.4 Mitigation Summary

Current measures to control or mitigate emissions of air pollutants at the existing mine would also be employed in the Proposed Action or Alternative 1. Project design features and BMPs (see Chapter 2) are the elements of the Proposed Action designed to reduce environmental impacts from air emissions. No mitigation measures are deemed necessary.

4.3 WATER RESOURCES

4.3.1 Direct and Indirect Impacts

4.3.1.1 Proposed Action

Under the Proposed Action, the panels would be mined in sequence (Panel A and Panel B) and all of the waste rock would be placed in either the Central or North Rasmussen pits. North Rasmussen backfill areas A and B would be completely backfilled, capped with non-seleniferous limestone or chert, covered with growth media, and revegetated. Backfill area C would be partially backfilled and revegetated as described in Section 2.2.3. The open panel would have the potential to affect flow of surface water and groundwater during mining. The fully and partially backfilled panels would have the potential to affect the flow and quality of surface water and groundwater after mining. Potential impacts to water resources were assessed using (1) infiltration modeling to estimate the rate of precipitation infiltration through the backfill, (2) spreadsheet modeling to evaluate potential changes in flow of surface water, alluvium, and Rex Chert, (3) geochemical modeling to calculate chemical reactions as seepage moves through the unsaturated zone, and (4) a numerical groundwater model to evaluate impacts to flow and water quality in the Wells Formation regional aquifer.

It should be noted that model results have a large degree of uncertainty associated with them, and that they are useful for screening potential impacts. However, model results should not be

interpreted as firm, fixed numbers. A more detailed discussion of the degree of uncertainty in the model results is presented in the Water Resources Technical Report (Whetstone 2002).

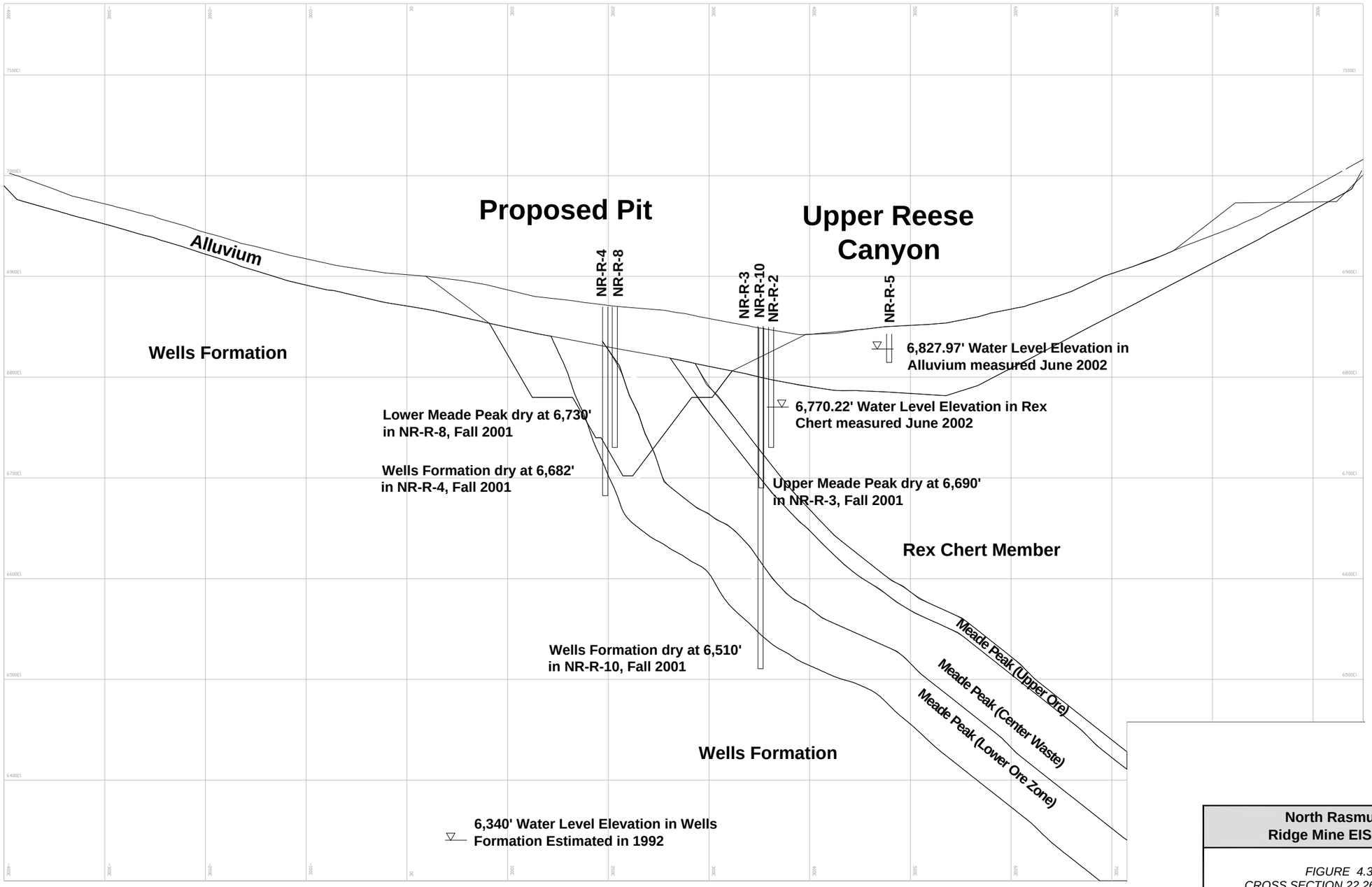
Conceptual Model / Overview

The hydrostratigraphy of the proposed pit is shown in **Figure 4.3-1**. Conceptual diagrams of the flow system before, during, and after mining are shown in **Figure 4.3-2**. Before mining, precipitation that falls within the project area runs off into the creeks, evaporates or is transpired by plants back into the atmosphere, or infiltrates into aquifers in the alluvium, Rex Chert, or Wells Formation (**Figure 4.3-2(a)**). During mining, the open pit would intercept surface water runoff and shallow flow in the alluvium (**Figure 4.3-2(b)**). After mining, the pits would be backfilled and surface water runoff would be restored to pre-mining conditions (**Figure 4.3-2(c)**), except in the area of the partially backfilled pit. Flow paths in the alluvium would be intercepted by the backfilled pit, except where surface drainage control structures would be built to re-direct flow of surface water. Recharge rates to the alluvium and Rex Chert beneath the backfilled panels would be lower than before mining because of the effectiveness of the engineered cover in limiting infiltration and the preferred flow path of water through the coarser backfill material. Recharge rates to the Wells Formation regional aquifer would be decreased beneath the fully backfilled panels and increased beneath the partially backfilled panels.

These changes to the flow system would also affect water quality because meteoric water that infiltrates through pit backfill or runs off of exposed pit walls would leach selenium and other COPCs from the rock. The chemistry of seepage from backfill and runoff from pit walls would be affected by a number of factors including the volume of infiltration or runoff, the chemical composition of the rocks, the reactive surface area of the rocks, pH conditions, oxygen availability, adsorption of ions to clay and mineral surfaces, and precipitation and dissolution reactions. Bacterially mediated reactions could also occur; however, chemically active oxidizing bacteria have not been observed historically at the site.

Overburden rocks would be exposed to surface weathering when they are mined and transported to backfill other areas in the pit. Mining also increases the reactive surface area of the rocks by breaking them into smaller pieces. Exposure to meteoric water and oxygen may leach metals or other constituents that are soluble or adsorbed to mineral surfaces in the overburden and can initiate oxidation of sulfide minerals, resulting in the release of sulfate, selenium, and other metals. Constituents of potential concern that may be released from overburden and pit walls includes sulfate, aluminum, antimony, cadmium, manganese, nickel, selenium, and zinc (Maxim 2002b).

Seepage through backfill and runoff from pit walls would infiltrate through rocks in the pit floor and walls and move through bedrock and alluvium before it enters groundwater or surface water. As water moves through the bedrock and alluvium, reactions may occur that would decrease concentrations of COPCs in seepage. Attenuation reactions include precipitation, adsorption, and changes in pH.



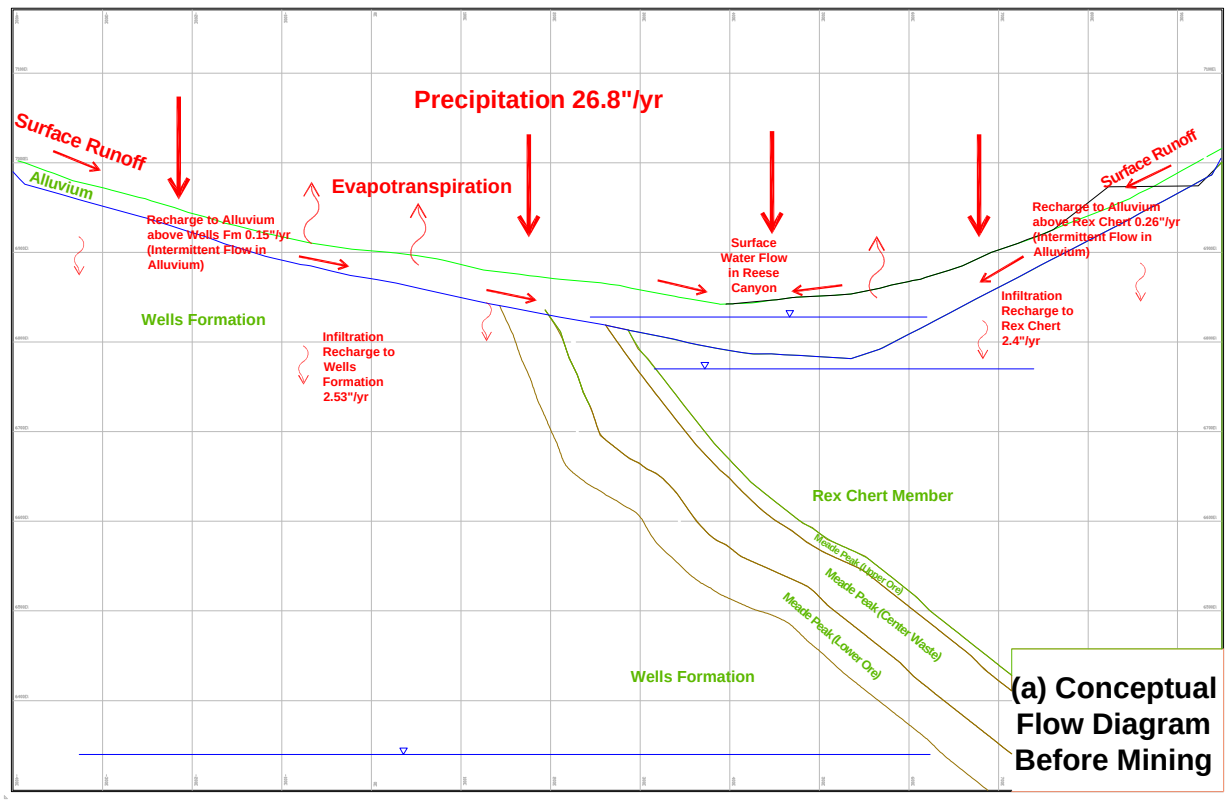
Source: Agrium 2002

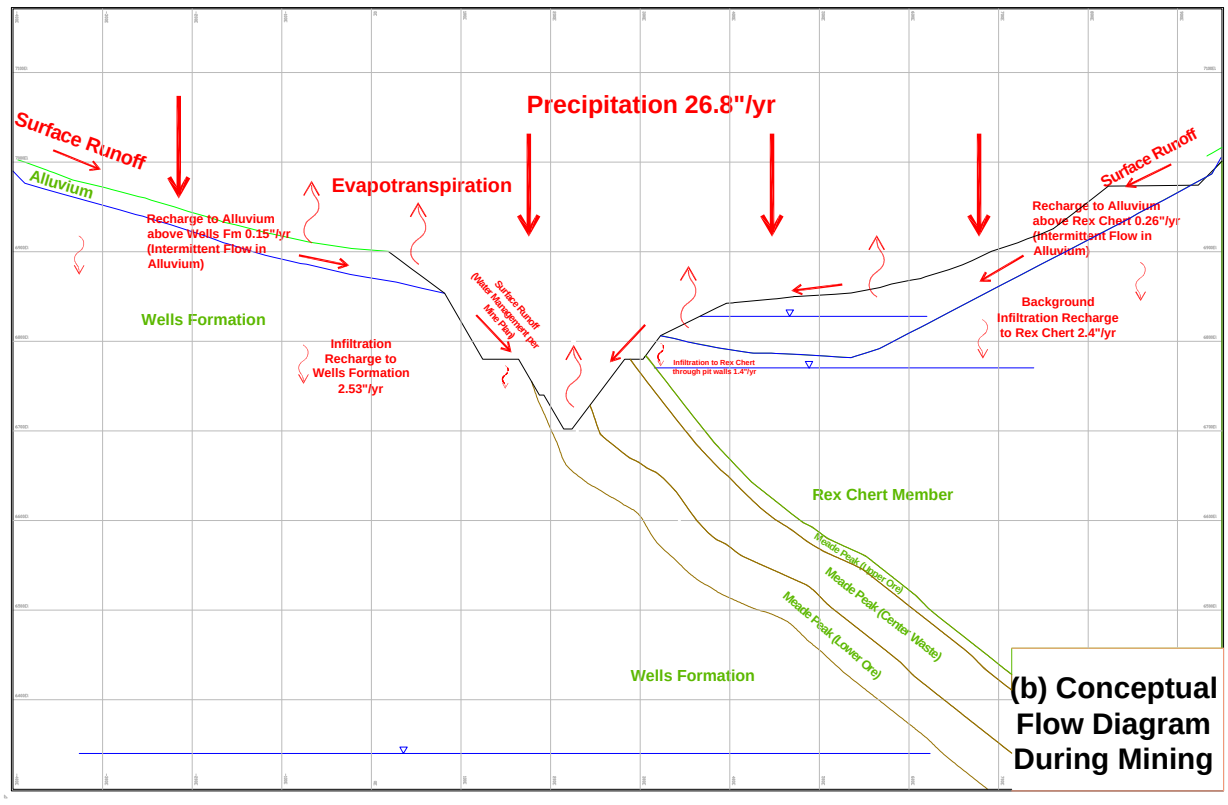
North Rasmussen Ridge Mine EIS Project

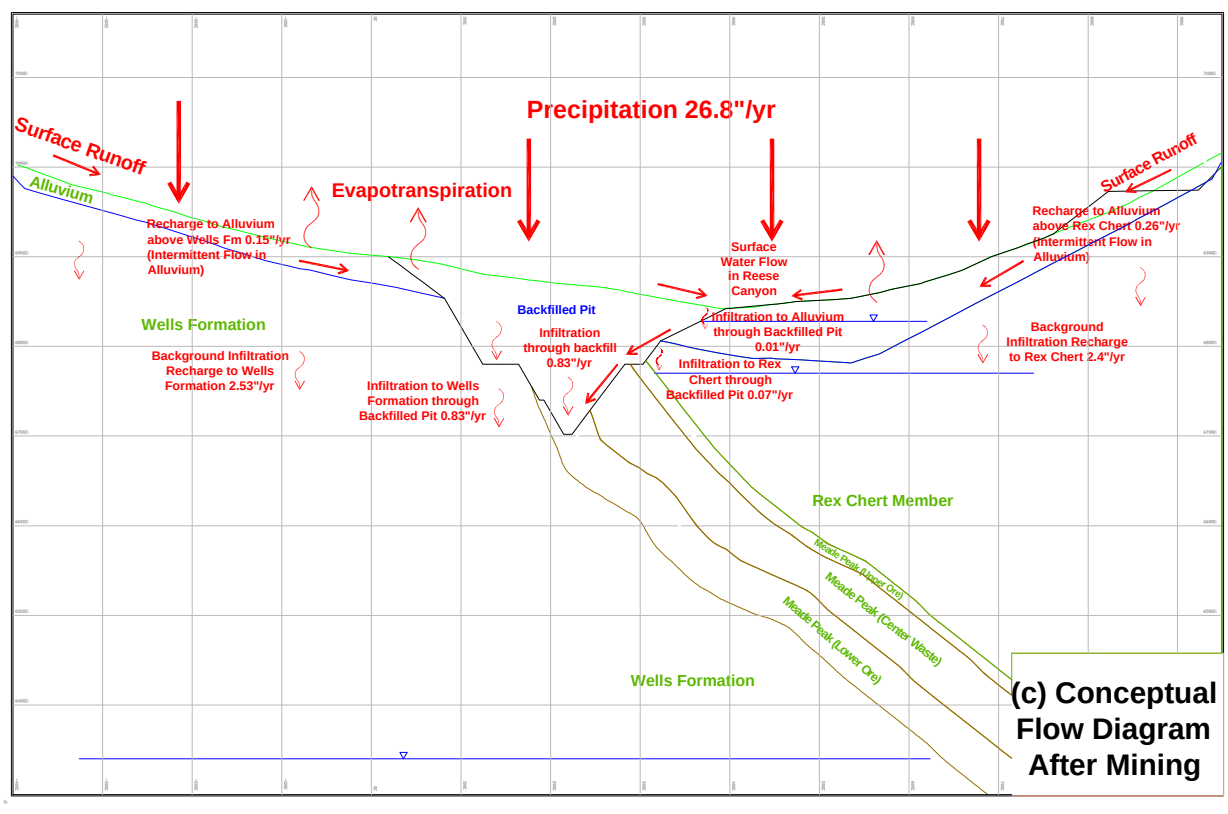
FIGURE 4.3-1
CROSS SECTION 22,260 SHOWING HYDROSTRATIGRAPHY OF THE PROPOSED PIT

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 CRS SEC HYDRO.dwg
Scale: 1" = 40 FEET	Drawn By: MTM







North Rasmussen Ridge Mine EIS Project

FIGURE 4.3-2
CONCEPTUAL DIAGRAMS OF HYDROLOGIC SYSTEM FLOW

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 CON FLO.dwg
Scale: NTS	Drawn By: MTM

Source: Whetstone 2002

Numerical Models

Numerical models were developed, based on the conceptual models described above, to quantify the infiltration through the backfill, interception of surface runoff, recharge to the upper aquifers, geochemical reactions in seepage from pit backfills, and flow and transport in the regional aquifer.

Infiltration through the Backfilled Panels

Seepage through the proposed backfilled pit panels was modeled using the U.S. Environmental Protection Agency HELP3 model a quasi-two-dimensional hydrologic model of water movement across, into, through, and out of landfills (Hydrologic Evaluation of Landfill Performance, version 3.06, Schroeder et al 1994a). This model was developed by the Corps of Engineers Waterway Experiment Station under contract to EPA to compare alternate landfill cover designs. The model utilizes input data on weather, soil and waste rock conditions, and cover design. The model uses numerical solution techniques that account for the effects of surface storage, ground frost, snowmelt, runoff, infiltration, evapotranspiration, vegetative growth, soil moisture storage, lateral subsurface drainage, and leakage through various types of liners (Schroeder et al 1994a). Run-on from upgradient slopes was calculated externally and input to the HELP model as additional precipitation (Whetstone 2002). The backfilled panels were divided into seven zones according to geometry and potential to receive run-on from upslope. These zones are illustrated in **Figure 4.3-3**.

The steps and assumptions involved in the HELP modeling are summarized in **Table 4.3-1**. More detailed descriptions of HELP model input parameters, assumptions, and results are provided in the Water Resources Technical Report (Whetstone Associates 2002).

The results of infiltration modeling are shown in **Table 4.3-2**. Zones A1, C1, and C2 received no run-on from upgradient sources; average infiltration was 0.78 inches/year (in/yr), with minor variations caused by percent and length of slope. Higher infiltration was predicted for zone A2 (0.93 in/yr), zone B1 (0.80 in/yr), and zone B2 (0.87 in/yr) as a result of runon from upgradient sources. Infiltration rates in zone C3 would be very high (88.5 in/yr) because the area receives run-on from zones C1, C2, the pit walls, and upgradient undisturbed ground, while no runoff would occur. The area-weighted average infiltration for the six fully backfilled zones with engineering controls was 0.83 in/yr. If surface water engineering controls were not employed to reduce or eliminate run-on to the reclaimed pits, area-weighted average infiltration rate through the fully backfilled pits would be 1.22 in/yr. This seepage would infiltrate through the floor of the pit and through 400 feet of unsaturated rock to the underlying regional aquifer.

Geochemical Modeling

Modeling of chemical reactions in seepage from pit backfills was performed using the program PHREEQC v.2.6 (Parkhurst and Appelo 2000) to develop input concentrations for transport modeling of COPCs in the regional aquifer (Maxim 2002a). PHREEQC has been widely used to model the chemistry of waters impacted by mining and was developed by scientists at the United States Geological Survey.

Geochemical modeling runs were made for sequential pore volumes of seepage from the partially and fully backfilled panels (a pore volume is the volume of seepage equal to the pore space of the backfill material). Chemical reactions in seepage from the fully backfilled panels were modeled in three steps:

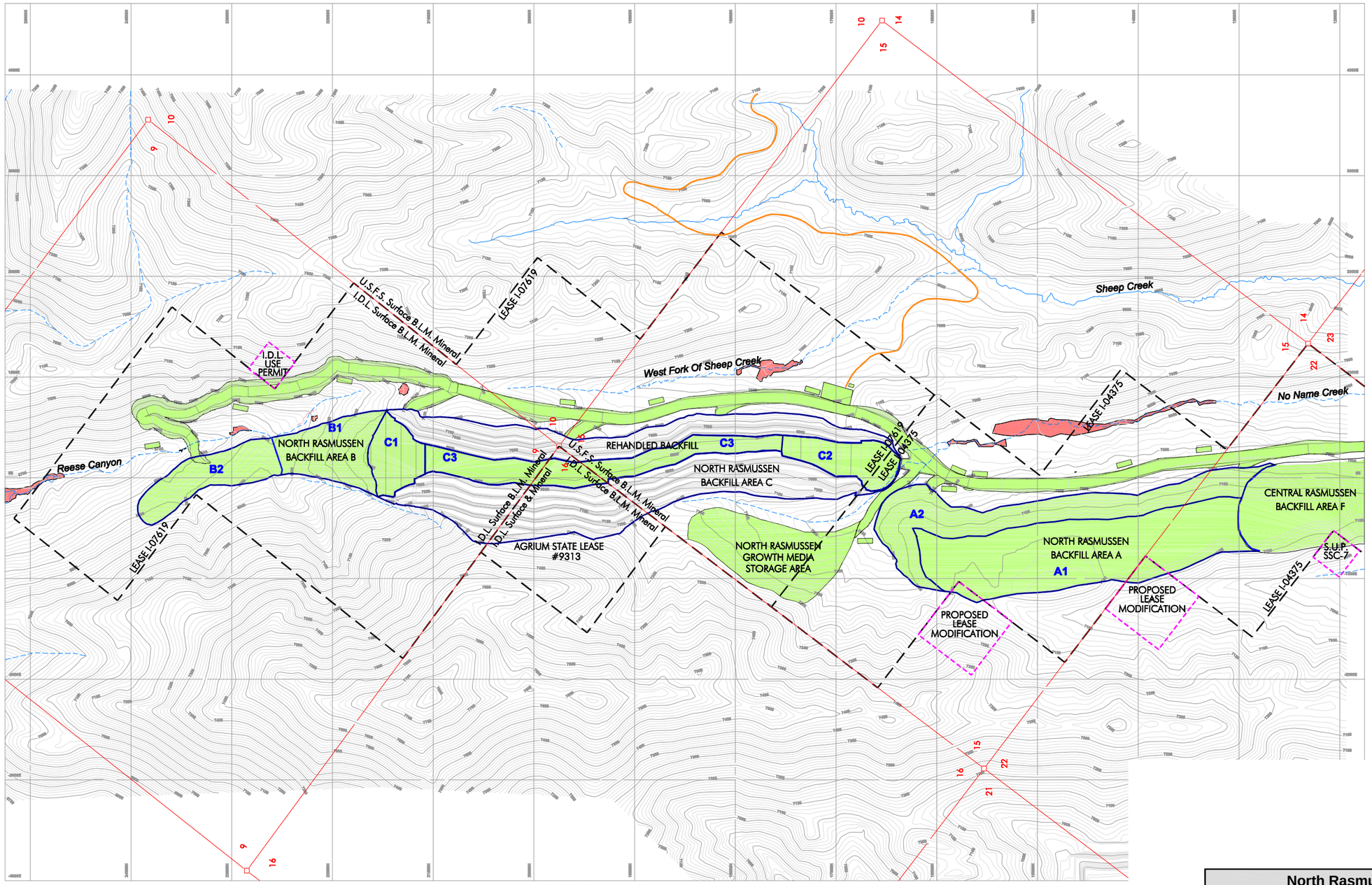
- Step 1 evaluated the composition of seepage before leaving the pit. Volume-weighted concentrations from column tests were mixed to simulate the expected composition of seepage from run of mine (ROM) backfill and oversaturated minerals were allowed to precipitate. Sorption of metals to precipitating minerals (calcite ferrihydrite, and manganite) was modeled.
- Step 2 evaluated chemical reactions that would occur as seepage moves through the unsaturated limestone below the bottom of the pit before reaching the water table. Oversaturated minerals in seepage in contact with limestone were allowed to precipitate and sorption to iron oxides and calcite were modeled.
- Step 3 modeled chemical reactions that would occur at the water table. Oversaturated minerals were allowed to precipitate.

The approach for modeling of seepage chemistry from the partially backfilled panel was identical to that used for the fully backfilled panel with the addition of an initial step which considered the reactions that would occur in runoff from the pit walls before entering the backfill material. A summary of assumptions and reactions used for the geochemical models is presented in **Table 4.3-3**.

Model results for the proposed action indicate that selenium and aluminum concentrations would be below their respective groundwater standards of 0.05 mg/L and 0.2 mg/L in seepage reaching the water table. Cadmium, antimony, sulfate and TDS concentrations would exceed their respective groundwater standards of 0.005 mg/L, 0.006 mg/L, 250 mg/L, and 500 mg/L in seepage for some pore volumes, and manganese would exceed its groundwater standard of 0.05 mg/L in all seepage pore volumes reaching the water table. Groundwater standards for cadmium and antimony are primary standards based on human health considerations. Groundwater standards for sulfate, TDS, and manganese are secondary standards based on aesthetic qualities (IDAPA 58.01.11). Geochemical modeling results were used as input for the source term in the contaminant transport model and are summarized in **Table 4.3-3**.

4.3.1.2 Flow and Transport in the Regional Aquifer

A three-dimensional groundwater flow and contaminant transport model of the regional groundwater system was prepared to evaluate migration of COPCs from the backfilled mine pit. The groundwater flow model simulates flow and transport in the Grandeur Tongue, Wells Formation, and Thaynes Formation, and was prepared using the computer codes MODFLOW and MT3DMS. MODFLOW was developed by the USGS (McDonald and Harbaugh 1988) to simulate groundwater flow and was used to develop the flow field for contaminant transport modeling. MT3DMS was used to model the transport of COPCs in the regional aquifer and is an updated version of the program MT3D that was developed by S. S. Papadopulos & Associates in conjunction with the EPA (Zheng 1990; Zheng and Wang 1999). Both programs are widely accepted by regulatory agencies for modeling groundwater flow and contaminant fate and transport.



Source: Agrium 2001

North Rasmussen Ridge Mine EIS Project

FIGURE 4.3-3
INFILTRATION ZONES
FOR HELP MODEL

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 HELP MOD.dwg
Scale: 1" = 1000 FEET	Drawn By:MTM

TABLE 4.3-1
INFILTRATION MODELING SUMMARY

	Modeling Step	Assumptions
1	Determine long-term monthly average temperature and precipitation values.	Somsen Ranch is a valid representative station for site, based on elevation (6,800 feet), close proximity to the mine (4.1 miles), and long period of record (20 years)
2	Generate daily values for temperature, precipitation, solar radiation.	Daily weather data is stochastically described by mean and extremes from Somesen Ranch station with stochastic coefficients from Pocatello Idaho; solar radiation is a function of latitude and precipitation (cloud cover).
3	Identify applicable wind speed, relative humidity, growing season, evaporative zone depth, leaf area index.	Average annual wind speed is 10.2 mph; quarterly relative humidity is 70%, 52%, 43%, 65%; LAI is 2.0; growing season for grasses starts on Day 132 and ends on Day 259; EZD is 24 inches (See Water Resources Technical Report for extensive detail on parameter selection).
4	Identify backfill infiltration zones based on slope length, slope angle, and potential for run-on.	Backfill area is divided into 7 infiltration zones.
5	Set up model layers based on proposed capping design and alternatives. Assign layer material properties based on in-situ and laboratory testing of site-specific materials.	Material soil properties are described by Brook-Corey parameters determined from laboratory soil moisture retention curves, including wilting point, field capacity, porosity, and saturated hydraulic conductivity for ROM, limestone/chert, and growth media (See Water Resources Technical Report for extensive detail on model layer geometry and material properties).
6	Calculate run-on from upgradient sources.	Run-off from bare pit walls and upgradient undisturbed ground estimated using initial abstraction and runoff coefficient; runoff from upgradient capped slopes onto downgradient capped slopes is calculated by HELP model.
7	Increase the precipitation data set (100 years of daily precipitation) to account for run-on.	Run-on to downgradient slopes is evenly distributed over the entire receiving slope; Time delay between precipitation and run-on is less than 24 hours; run-on has no effect on daily temperature or solar radiation.
8	Run HELP model and use final moisture contents as starting moisture content for 100 year simulation.	No water is taken into or released from storage in the backfill (quasi-steady-state conditions); Incident daily precipitation is routed to runoff, evapotranspiration, lateral drainage, or percolation using equations and methodology described in HELP3 model documentation.
9	Run sensitivity analyses for increased precipitation, lower evaporative zone depth, a range of leaf area indices, and alternative cover designs including a non-engineered cover, clay cap, and synthetic liner cap.	Reasonable range of parameter variation for sensitivity analysis includes: decreasing growth media thicknesses to 24 inches and 18 inches; changing leaf area indices to 0.5, 1.0, 1.5, and 2.5; increasing evaporative zone depth to 36 inches; increasing average annual precipitation to 28.6 inches.

TABLE 4.3-2
WATER BALANCE RESULTS OF HELP INFILTRATION MODELING FOR NORTH RASMUSSEN RIDGE MINE BACKFILL (IN INCHES/YEAR)

Zone[1]	Precipitation + Run-on	Runoff	Evapo-transpiration	Infiltration
NR Backfill Area A1	26.84	10.57	15.47	0.79
NR Backfill Area A2[2]	29.45	12.38	16.13	0.93
NR Backfill Area B1[2]	27.45	11.07	15.57	0.80
NR Backfill Area B2[2]	28.15	11.58	15.71	0.87
NR Backfill Area C1	26.84	10.64	15.45	0.75
NR Backfill Area C2	26.84	10.59	15.46	0.78
NR Backfill Area C3	109.32	0.00	20.86	88.45

[1]See Figure 4.3-3
[2]Includes engineered controls for run-on.

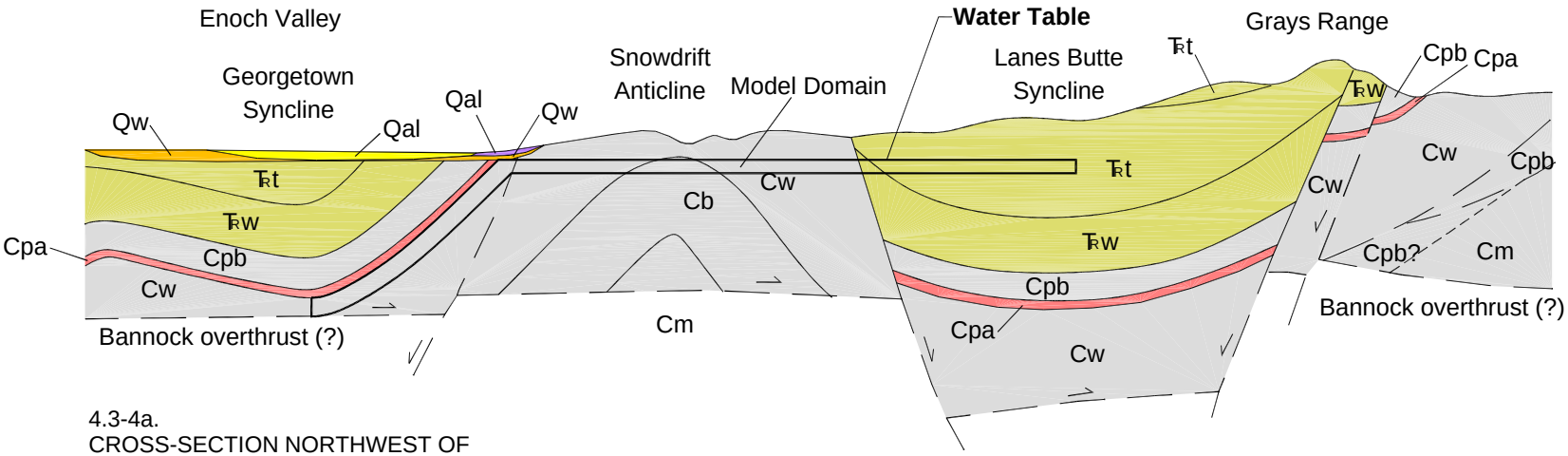
The model area is shown in cross-section on **Figure 4.3-4**, in plan view in **Figure 4.3-5**, and is 5 miles wide by 10 miles long. The locations of the cross sections are shown on **Figure 3.1-1**. Six layers were used to model a 500-foot thick section of bedrock starting at the water table or top of the Wells Formation where confined conditions exist. The layers have variable elevations and simulate the structure of the Snowdrift Anticline. Groundwater flow was modeled as moving north 40° west at a gradient of 0.0057, consistent with the regional groundwater flow system (Maxim 2002d). Constant head cells were used at the northwest and southeast boundaries of the model to establish the flow field.
Assumptions used for the groundwater flow and contaminant transport model include:

- The hydraulic conductivity of the aquifer is isotropic parallel to bedding and is equal to the average value of 1.82 ft/day calculated from the available pumping test data (Whetstone 2003). Hydraulic conductivity across bedding is assumed to be 5 times less than hydraulic conductivity parallel to bedding (estimated) and is 0.364 ft/day.
- Faults have high permeability along strike and low permeability across the fault plane compared with the surrounding aquifer. Hydraulic conductivity along faults was assumed to be 10 times greater than in the surrounding bedrock (estimated). Hydraulic conductivity across faults is 10 times less than surrounding bedrock (estimated). The Limerock, Enoch Valley, Henry, and Offset faults were included in the model, along with one other unnamed fault.
- Storage is equal to an average value of 0.0047 as derived from available pumping test data (Whetstone 2003). Specific yield is modeled as being 0.10 in unconfined portions of the aquifer (Ralston et al 1980).

TABLE 4.3-3
GEOCHEMICAL MODELING SUMMARY

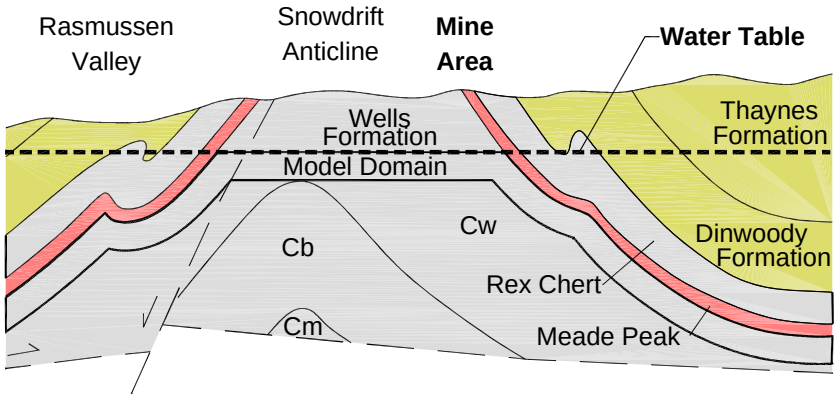
Modeling Step	Assumptions	Precipitating Minerals	Sorption Substrates
Geochemical Modeling of Fully Backfilled Pit			
Step 1 - Pore water chemistry in pit backfill	- Volume weighted average of column test leachates - System slightly removed from atmosphere - Eh = 350 mV - P CO2 = -3.0	- Calcite - Gypsum - Ferrihydrite - Gibsite - Barite - Cr(OH)3 - MnHPO4 - Otavite - Hydroxyapatite	- Ferrihydrite precipitate - Calcite precipitate
Step 2 - Seepage chemistry in unsaturated Wells Limestone	- Initial water chemistry from Step 1 - System removed from atmosphere - Eh = 120 mV - P CO2 = -2.7	- Gibsite - Otavite - Gypsum - Cr(OH)3	- Ferrihydrite in limestone - Calcite in limestone
Step 3 – Seepage chemistry at water table	- Initial water chemistry from Step 2 - System removed from atmosphere - Eh = -60 mV - P CO2 = -2.0	- Gypsum - NiSe - Se0	
Geochemical Modeling of Partially Backfilled Pit			
Step 1 – Runoff chemistry from pit walls	- Volume weighted average of leachates from pit walls - System open to atmosphere - Eh = 550 mV - P CO2 = -3.5	- Ferrihydrite - Gibsite - Barite - Cr(OH)3 - Manganite - Hydroxyapatite - Calcite	- Ferrihydrite precipitate - Manganite precipitate - Calcite Precipitate
Step 2 - Pore water chemistry in pit backfill	- Volume weighted average of column test leachates mixed with chemistry from Step 1		
Step 3 - Seepage chemistry in unsaturated Wells Limestone	- Initial water chemistry from Step 2 - System removed from atmosphere - Eh = 120 mV - P CO2 = -2.7	- Ferrihydrite - Gibsite - Barite - Cr(OH)3 - Hydroxyapatite	- Ferrihydrite in limestone - Calcite in limestone
Step 4 – Seepage chemistry at water table	- Initial water chemistry from Step 3 - System removed from atmosphere - Eh = -60 mV - P CO2 = -2.0		

Rasmussen Ridge



4.3-4a.
CROSS-SECTION NORTHWEST OF
PROPOSED MINE SITE, LOOKING NORTHWEST
SEE FIGURE 3.1-1 FOR LOCATION

Rasmussen Ridge



4.3-4b.
REGIONAL CROSS-SECTION NEAR
PROPOSED MINE SITE, LOOKING NORTHWEST
SEE FIGURE 3.1-1 FOR LOCATION

LEGEND	
Qal	Alluvium
Qw	Hill wash and older alluvium
Ꞧt	Thaynes group
Ꞧw	Woodside Shale / Dinwoody Formation
Cpb	Rex Chert
Cpa	Meade Peak
Cw	Wells Formation
Cb	Brazer Limestone
Cm	Madison Limestone

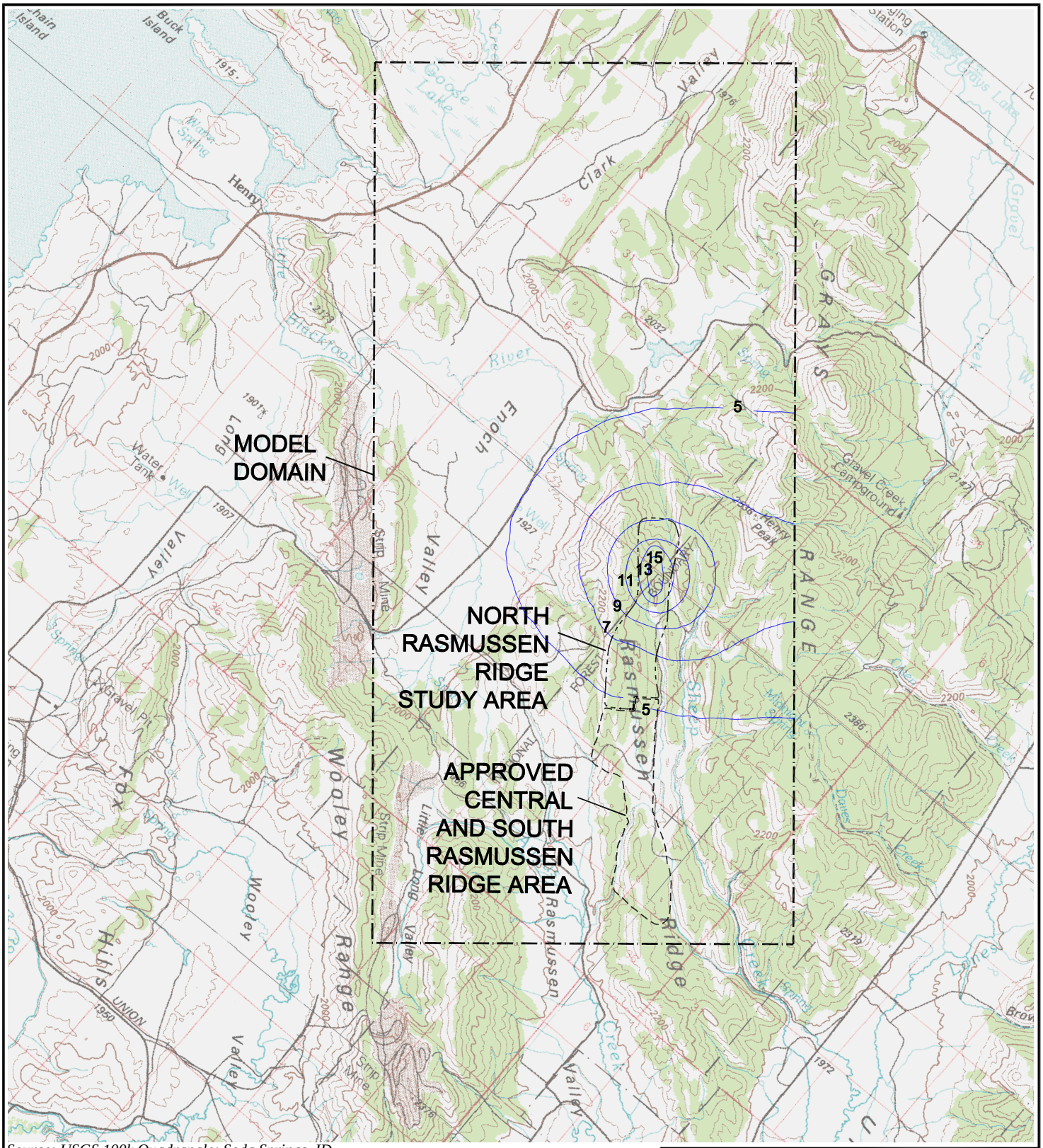
Source: Mansfield 1927

North Rasmussen Ridge Mine EIS Project

FIGURE 4.3-4
CROSS-SECTIONS SHOWING GROUNDWATER MODEL DOMAIN

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 Geo X-sects.dwg
Scale: NTS	Drawn By: ETC



Source: USGS 100k Quadrangle; Soda Springs, ID

LEGEND

5 — *Contour in Feet*

NORTH

0 1.5 3

Scale in Miles

Source: Whetstone 2002

North Rasmussen Ridge Mine EIS Project

FIGURE 4.3-5
POTENTIAL WATER LEVEL MOUNDING IN THE REGIONAL AQUIFER (WELLS FORMATION)

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 HYDRO MOD.dwg
Scale: As Noted	Drawn By:MTM

- Recharge to the regional aquifer is assumed to be equal to 9.5 percent of the average annual precipitation of about 27 inches (Whetstone 2002), and is applied to outcrop areas of the Wells and Thaynes formations where the aquifer is unconfined.
- The effective porosity of the aquifer that is interconnected and transmits water in appreciable quantities is a portion of the total porosity and is assumed to be equal to specific yield (0.1).
- Contaminant transport is governed by physical advection and dispersion. Advection occurs in response to the gradient of the flow field. Dispersion is caused by the irregular nature of the flow path through pores, fractures, and bedding planes, with longitudinal dispersivity equal to 40 feet, transverse dispersivity equal to 4 feet, and vertical dispersivity equal to 0.4 feet (Whetstone 2002; Gelhar et al 1993).
- After solutes enter the aquifer, they behave conservatively without reaction, degradation, attenuation, or sorption to aquifer materials.
- Solutes travel from the floor of the backfilled pit panels through 400 feet of unsaturated rock. The travel time through the unsaturated zone is 3.3 years below the partially backfilled pit and 86.7 years below the fully backfilled pit (Whetstone 2002), which is incorporated into the groundwater transport model by delaying the source term correspondingly (**Table 4.3-4**).

COPCs are added to the groundwater model based on seepage rates predicted by HELP3 (Whetstone 2002) and concentrations from the column leachate tests and geochemical modeling (Maxim 2002b, 2002c). Solutes are added in two recharge zones. Recharge from the fully backfilled pit (zones A1, A2, B1, B2, C-1 and C-2) is applied at an average seepage rate of 0.83 inches per year with concentrations shown in **Table 4.3-4**. Recharge from the partially backfilled pit (zone C3) is applied at an average seepage rate of 88.45 inches per year, with concentrations shown in **Table 4.3-2**. The concentrations of COPCs in seepage were derived by Maxim (2002c). The modeled concentrations in seepage generally decline with time, as subsequent pore volumes of infiltrating water move through the backfill. It would take 1.6 years to flush one pore volume through the partial backfill and 319 years to flush one pore volume through the full backfill to reach the bottom of the pit. Then it would take another 3.3 and 86.7 years, respectively, to reach the water table. The modeled concentration of the source term changes after each pore volume, in accordance with the data from the column leachate tests and geochemical modeling.

TABLE 4.3-4
SEEPAGE RATE AND CONCENTRATIONS FOR GROUNDWATER TRANSPORT MODEL SOURCE TERM

Stress Period	Cum Years	Event	Rate (ft/day)	TDS (mg/L)	Sulfate (mg/L)	Aluminum (mg/L)	Antimony (mg/L)	Cadmium (mg/L)	Manganese (mg/L)	Selenium (mg/L)
I. Fully Backfilled Pit										
1	3.3	Travel through vadose zone from PB pit	0.000578	0	0	0	0	0	0	0
2	4.8	Limestone PV 1 leaches	0.000578	0	0	0	0	0	0	0
3	6.4	Limestone PV 2 leaches	0.000578	0	0	0	0	0	0	0
4	8.0	Limestone PV 3 leaches	0.000578	0	0	0	0	0	0	0
5	9.5	Limestone PV 4 leaches	0.000578	0	0	0	0	0	0	0
6	11.1	Limestone PV 5 leaches	0.000578	0	0	0	0	0	0	0
7	12.7	Limestone PV 6 leaches	0.000578	0	0	0	0	0	0	0
8	14.3	Limestone PV 7 leaches	0.000578	0	0	0	0	0	0	0
9	15.8	Limestone PV 8 leaches	0.000578	0	0	0	0	0	0	0
10	17.4	Limestone PV 9 leaches	0.000578	0	0	0	0	0	0	0
11	86.7	Limestone PV 10 leaches	0.000578	0	0	0	0	0	0	0
12	100.0	ROM PV 1 leaches	0.000190	1859	1229	0.013	0.007	0.005	3.16	0.0011
13	200.0	ROM PV 1 leaches	0.000190	1859	1229	0.013	0.007	0.005	3.16	0.0011
14	300.0	ROM PV 1 leaches	0.000190	1859	1229	0.013	0.007	0.005	3.16	0.0011
15	400.0	ROM PV 1 leaches	0.000190	1859	1229	0.013	0.007	0.005	3.16	0.0011
16	406.0	ROM PV 1 leaches	0.000190	1859	1229	0.013	0.007	0.005	3.16	0.0011
17	500.0	ROM PV 2 leaches	0.000190	1234	799	0.014	0.006	0.004	2.96	0.0011

TABLE 4.3-4 (CONT.)
SEEPAGE RATE AND CONCENTRATIONS FOR GROUNDWATER TRANSPORT MODEL SOURCE TERM

Stress Period	Cum Years	Event	Rate (ft/day)	TDS (mg/L)	Sulfate (mg/L)	Aluminum (mg/L)	Antimony (mg/L)	Cadmium (mg/L)	Manganese (mg/L)	Selenium (mg/L)
II. Partially Backfilled Pit										
1	3.3	Travel through vadose zone from PB pit	0.000578	0	0	0	0	0	0	0
2	4.8	Limestone PV 1 leaches	0.018911	579	173	0.014	0.0083	0.0004	0.460	0.0002
3	6.4	Limestone PV 2 leaches	0.018911	325	73	0.014	0.0099	0.0003	0.160	0.0005
4	8.0	Limestone PV 3 leaches	0.018911	300	61	0.014	0.0080	0.0003	0.120	0.0005
5	9.5	Limestone PV 4 leaches	0.018911	300	61	0.014	0.0080	0.0003	0.120	0.0005
6	11.1	Limestone PV 5 leaches	0.018911	242	55	0.014	0.0063	0.0002	0..110	0.0005
7	12.7	Limestone PV 6 leaches	0.018911	242	55	0.014	0.0063	0.0002	0.0.110	0.0005
8	14.3	Limestone PV 7 leaches	0.018911	289	57	0.014	0.0065	0.0002	0.0.110	0.0005
9	15.8	Limestone PV 8 leaches	0.018911	289	57	0.014	0.0065	0.0002	0.0.110	0.0005
10	17.4	Limestone PV 9 leaches	0.018911	289	57	0.014	0.0071	0.0002	0.0.110	0.0005
11	86.7	Limestone PV 10 leaches	0.018911	298	63	0.014	0.0071	0.0002	0.0.110	0.0005
12	100.0	ROM PV 1 leaches	0.018911	298	63	0.014	0.0071	0.0002	0.0.110	0.0005
13	200.0	ROM PV 1 leaches	0.018911	298	63	0.014	0.0071	0.0002	0.0.110	0.0005
14	300.0	ROM PV 1 leaches	0.018911	298	63	0.014	0.0071	0.0002	0.0.110	0.0005
15	400.0	ROM PV 1 leaches	0.018911	298	63	0.014	0.0071	0.0002	0.0.110	0.0005
16	406.0	ROM PV 1 leaches	0.018911	298	63	0.014	0.0071	0.0002	0.0.110	0.0005
17	500.0	ROM PV 2 leaches	0.018911	298	63	0.014	0.0071	0.0002	0.0.110	0.0005

4.3.1.3 Impacts to Surface Water

Impacts to Flow

The surface water drainages of Reese Canyon Creek, No Name Creek, and the West Fork of Sheep Creek would be affected by the Proposed Action. The mine pits would capture surface water runoff during mining, and this flow would be denied to the drainages. The impacts would lessen after mining ends because surface water would run off from the cap over areas of the pits that are fully backfilled. Only the areas of the pits that were partially backfilled would capture surface water runoff after mining ends. The impacts to surface water runoff can be quantified based on the areas of the fully and partially backfilled panels (**Figure 4.3-6, Table 4.3-5**), assuming there is a direct, proportional relationship between the percentage of drainage area removed and the change in runoff.

Surface runoff to Reese Canyon Creek drainage could decrease by 31 percent during mining. Impacts would decrease to 4 percent after mining ends because all of the panels in the Reese Canyon Creek drainage would be fully backfilled and capped to allow water to run off naturally.

Surface runoff to the No Name Creek drainage could decrease by about 11 percent during mining and 3 percent after mining. Surface runoff to the West Fork of Sheep Creek drainage could decrease by about 37 percent during and after mining. Impacts in runoff to West Fork of Sheep Creek would not change after mining, because the partially backfilled pit would continue to intercept runoff.

TABLE 4.3-5
POTENTIAL IMPACTS TO SURFACE WATER RUNOFF FROM THE PROPOSED ACTION

Drainage	Reese Canyon Creek	No Name Creek	West Sheep Creek
Calculation Location	Impacts calculated at confluence of Reese Canyon Creek with Little Blackfoot River	Impacts calculated at confluence of No Name Creek and its intermittent western tributary	Impacts calculated at confluence of West Sheep Creek with Sheep Creek
During and After Mining			
Drainage area (ft^2)	20,665,760	39,062,630	9,061,190
Surface areas intercepted (ft^2)	6,339,740	4,259,230	3,347,160
Percent change surface runoff	-30.7%	-10.9%	-36.9%

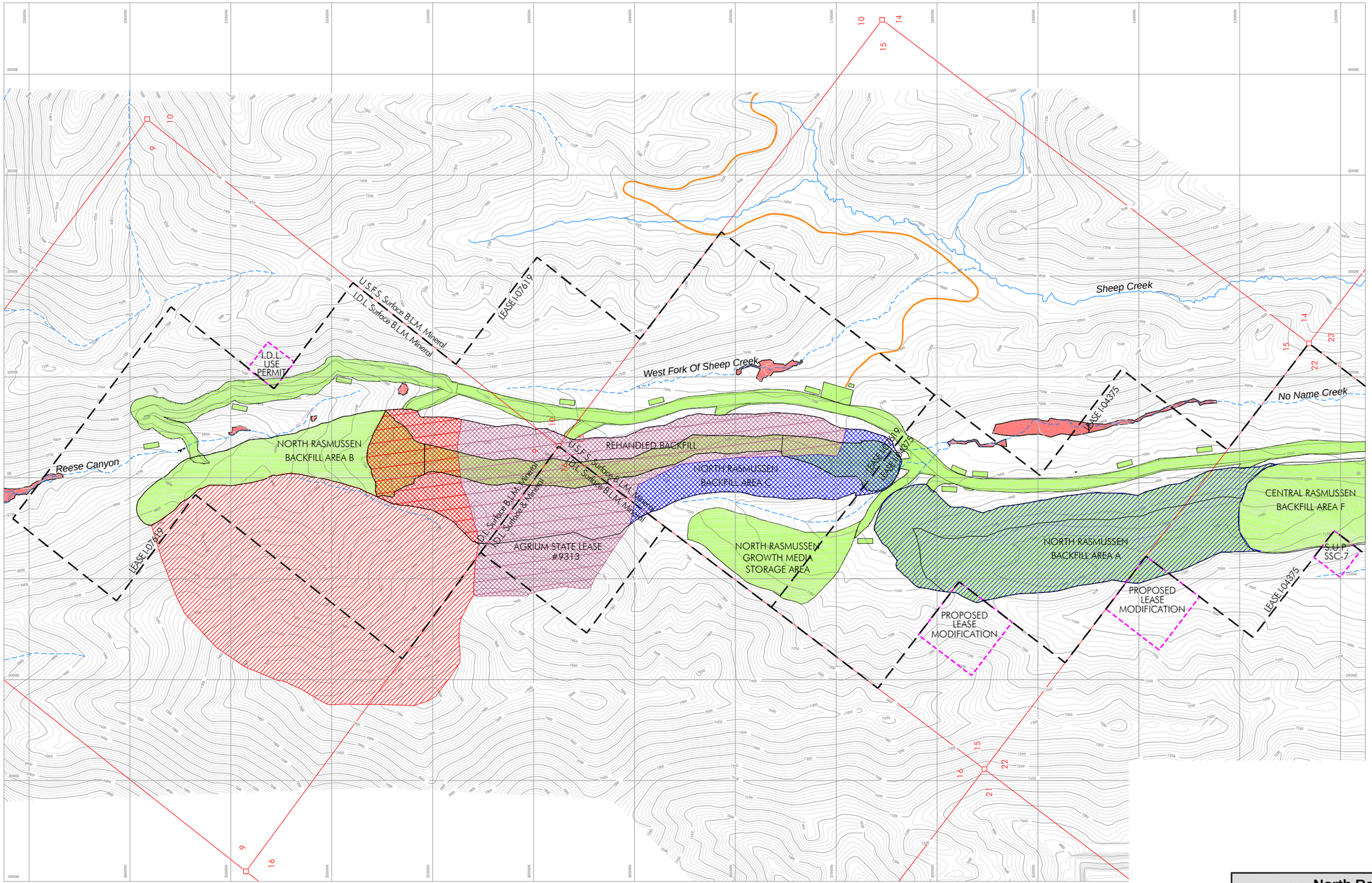
Impacts to Water Quality

The backfilled pits may intercept flow paths of shallow groundwater and may introduce contaminants that may reach springs and seeps. Because the overburden would be placed in the mined-out panels, rather than above ground, no new surface seeps would develop. In addition, the pits would be capped with 8 to 10 feet of relatively inert limestone and chert, and then covered with 2 to 3 feet of growth media. This engineered cover would prevent surface water runoff from coming into contact with reactive materials in the backfilled overburden.

Sediment and Channel Related Impacts

Runoff from haul roads, temporary overburden storage areas, growth media storage areas, pit backfills, and other disturbed areas would have the potential for erosion and subsequent sediment loading to Reese Canyon Creek, No Name Creek, and West Fork of Sheep Creek. Additionally, magnesium chloride used on roads to reduce dust would be entrained in the erosion from the roads. The potential for sediment loading would be controlled because runoff would be directed into sediment basins. Water from the haul roads would be diverted to sediment retention ponds located at 10 different locations adjacent to the road. Culverts and ditching would be used to collect water from the haul roads and divert it into the retention ponds. The ponds would be dredged and the sediment placed in the pit backfill as sediment accumulates in the retention ponds and the storage capacity decreases. These measures would prevent magnesium chloride from degrading vegetation, increasing the salinity of soils, and raising the pH of surface waters. Storm water retention structures would be inspected visually quarterly, annually, and more frequently during spring runoff and after summer thunderstorms, in accordance with Agrium's Multi-Sector General Permit for storm water discharges.

Mining would occur on both sides of No Name Creek where the creek crosses the outcrop. Mining would not proceed through No Name Creek, but rather, would leave a land bridge for the creek. However, because of a one-lane haul road in that location and to minimize sedimentation into the creek, a culvert would be placed across the land bridge to contain any flow in No Name Creek, which is dry for a majority of the year. The culvert would be several hundred feet long and include an energy dissipator below the culvert exit. BMPs for this installation include completion of all construction during the dry season, using silt fences and straw bales or wattles during construction, and also removing the culvert after mining using the same techniques as for installation. The stream channel would be relocated on native ground material to reduce infiltration following postmining reclamation.
The East Road Extension would also cross Reese Canyon Creek. A 24-inch culvert, sized for the 100 year 24 hour storm would be placed in the channel to convey water downstream to maintain the seasonal flow pattern and wetlands during mining. After mining ends, the culvert and fill would be removed and the stream channel would be re-established. These activities would not affect flow in Reese Canyon Creek. Potential impacts to sediment loading during and after construction would be mitigated using BMPs, including silt fences, straw bales or wattles, sediment basins, or other structures.



Source: North Rasmussen Ridge Supplemental Mine and Reclamation Plan, Agrium 2001.
Note: Mine coordinates do not coincide with any map coordinates.

- LEASE I-07619 & I-04375
- LEASE MODIFICATIONS & USE PERMITS
- PERENNIAL STREAMS
- INTERMITTENT STREAMS
- EXISTING ROADS
- RECLAIMED AREAS
- DELINEATED WETLANDS
- WEST FORK SHEEP CREEK: SURFACE WATER & ALLUVIAL WATER INTERCEPTION DURING AND AFTER MINING
- REESE CANYON: SURFACE WATER & ALLUVIAL WATER INTERCEPTION DURING AND AFTER MINING
- REESE CANYON: SURFACE WATER & ALLUVIAL WATER INTERCEPTION DURING MINING
- NO NAME CREEK: SURFACE WATER & ALLUVIAL WATER INTERCEPTION DURING AND AFTER MINING
- NO NAME CREEK: SURFACE WATER & ALLUVIAL WATER INTERCEPTION DURING MINING

0 1000 2000
Scale (ft)

NORTH

North Rasmussen Ridge Mine EIS Project

FIGURE 4.3-6
AREAS OF SURFACE RUNOFF AND ALLUVIAL FLOW POTENTIALLY INTERCEPTED BY THE PIT

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	1164 IMPACT AREA.dwg
Scale: 1" = 1000 FEET	Drawn By: MTM

Source: Agrium 2001

4.3.1.4 Groundwater Impacts

Alluvium

The alluvium is intermittently saturated. On the ridge tops, the alluvium is unsaturated, and much of the precipitation that percolates into the alluvium moves vertically downward to the underlying bedrock. After major precipitation or snowmelt enters the alluvium on the ridgetops some water may also travel laterally. The alluvium is saturated during some or most of the year in the drainage valleys. For example, water was encountered in the alluvium in Reese Canyon while drilling exploration borings NR-00-86, NR-00-77, and NR-00-71. Alluvial monitoring wells higher in the drainages were typically dry during the winter of 2001 and showed water level rises of up to 20 feet during the spring and summer of 2002. Alluvial monitoring wells located lower in the drainages contained water throughout the year, and also showed rising water levels in the spring and summer.

Groundwater flow in the alluvial aquifers would be intercepted by the mine pits. The alluvial flow system is connected with surface flow, seeps, and springs in Reese Canyon, West Fork of Sheep Creek, and No Name Creek. The reduction in flow in the alluvium can be quantified based on the areas of alluvium intercepted by the pit panels (**Figure 4.3-6, Table 4.3-6**).

Alluvium will be covered by backfill only on the east side of Panels A and B. After closure, the alluvium will be exposed at the top of the highwall in Panel C (**Figure 4.3-2(c)**). The area of alluvium to be overlain by backfill is approximately 4.8 acres (209,360 ft^2) in the B-panel area and 6.3 acres (273,160 ft^2) in the A-panel area. Seepage from backfill into alluvium in these areas would account for 0.45% (less than one half of one percent) of the flow in the alluvium in Reese Canyon and 0.25% (one quarter of one percent) of the flow in the No Name Creek above the confluence with its unnamed tributary (**Table 4.3-7**) (Whetstone 2002). Although seepage

TABLE 4.3-6
POTENTIAL IMPACTS TO GROUNDWATER FLOW IN THE ALLUVIUM FROM THE PROPOSED ACTION

Drainage	Reese Canyon Creek	No Name Creek	West Fork of Sheep Creek
Calculation Location	Impacts calculated at confluence of Reese Canyon Creek with Little Blackfoot River	Impacts calculated at confluence of No Name Creek and its intermittent western tributary	Impacts calculated at confluence of West Sheep Creek with Sheep Creek
During and After Mining			
Drainage area (ft^2)	20,665,760	39,062,630	9,061,190
Area of alluvium intercepted by pits (ft^2)	6,339,740	4,259,230	3,347,160
Percent change alluvial flow	-30.7%	-10.9%	-36.9%

TABLE 4.3.7
CALCULATION OF FRACTION OF RECHARGE TO ALLUVIUM FROM BACKFILL SEEPAGE

	Reese Canyon[a]	No Name Creek[b]	West Sheep Creek[c]
Total drainage area (ft^2)	20,665,760	39,062,630	9,061,190
Alluvium areas permanently intercepted (ft^2)	-6,339,740	-4,259,230	-3,347,160
Area of alluvium receiving recharge at background rate (ft^2)	14,326,020	34,803,400	5,714,030
Background recharge rate (in/yr)	2.680	2.680	2.680
Seepage flowing laterally in alluvium (in/yr)	0.26	0.26	0.26
Volumetric recharge rate (gpm)	4.417	10.731	1.762
Area of alluvium overlain by backfill (ft^2)	209,360	273,160	
Seepage rate through backfill (in/yr)	0.8303	0.8303	0.8303
Seepage flowing laterally in alluvium (in/yr)	0.083	0.083	0.083
Total seepage to alluvium from backfill (gpm)	0.021	0.027	0.000
Fraction of alluvial recharge derived from backfill seepage	0.0047	0.0025	0.0000
Fraction of alluvial recharge derived from backfill seepage	0.47%	0.25%	0.00%

Notes: a: Impacts calculated at confluence of Reese Canyon with Little Blackfoot River.
b: Impacts calculated at confluence of No Name Creek and its intermittent western tributary.
c: Impacts calculated at confluence of West Sheep Creek with Sheep Creek.

rates to the alluvium would be low, the concentrations of COPCs in the seepage would be generally high, compared to background concentrations in alluvium. Potential water quality changes in the alluvium were calculated by mass balance (mixing) of the backfill seepage and concentration and the alluvium recharge and concentration. The results of the mass balance evaluation (**Table 4.3-8**) indicate that that concentrations of antimony, cadmium, manganese, nickel, sulfate, and TDS in alluvial groundwater in the No Name Creek area would increase by 0.2% to 37%. Selenium concentrations would increase by 112% and aluminum concentrations would decrease by 0.1% (Whetstone 2002). None of the COPCs would increase above groundwater or surface water standards, except for aluminum, manganese, and nickel, which currently exceed standards in background groundwater. In the Reese Canyon area, the mixing water quality analysis indicates that concentrations of aluminum, antimony, cadmium, manganese, nickel, sulfate, and TDS in alluvial groundwater would increase by 0.4% to 42%. Selenium concentrations would increase by 178% (Whetstone 2002). None of the COPCs would increase above groundwater or surface water standards, except for manganese and nickel, which currently exceed standards in background groundwater. Manganese standards in ground and surface water are based on aesthetic criteria. Nickel standards are applicable to surface water and are based on human health considerations.

Since concentrations at seeps and springs are affected by surface water runoff, alluvial groundwater, and shallow bedrock groundwater, the changes in concentrations calculated for the alluvium do not directly represent concentrations at the seeps and springs. Natural attenuation of selenium and other constituents was not considered in this analysis.

TABLE 4.3-8
CALCULATION OF WATER QUALITY IN ALLUVIUM AFFECTED BY BACKFILL SEEPAGE

NO NAME CREEK:

Constituent	ROM Concentration (mg/L)	Volumetric Seepage Rate from ROM above alluvium in A-Panel Area (gpm)	Alluvium Concentration in NNC Area (mg/L)	Volumetric Recharge Rate for Alluvium in NNC Area (gpm)	Mixed Chemistry (mg/L)	% Change	Groundwater Standard	Exceeds Groundwater Standards?	Surface Water Standards	Source of Surface Water Standards	Exceeds Surface Water Standards?
TDS	1,355	0.0269	210.1	10.73	212.974	1.4%	500	No	n/a	---	n/a
Sulfate	876	0.0269	18	10.73	20.144	11.9%	250	No	n/a	---	n/a
Aluminum	0.192	0.0269	0.344	10.73	0.344	-0.1%	0.2	Yes, as does background groundwater	n/a	---	n/a
Antimony	0.0063	0.0269	0.0032	10.73	0.003	0.2%	0.006	No	0.014	DW	No
Cadmium	0.0127	0.0269	0.0001	10.73	0.0001	31.6%	0.005	No	0.001	CCC	No
Manganese	3.367	0.0269	0.0577	10.73	0.066	14.3%	0.05	Yes, as does background groundwater	n/a	---	n/a
Nickel	1.813	0.0269	0.02	10.73	0.024	22.4%	n/a	n/a	0.0157	CCC	Yes, as does background groundwater
Selenium	0.549	0.0269	0.0012	10.73	0.0026	112.0%	0.02	No	0.005	CCC	No

REESE CANYON:

Constituent	ROM Concentration (mg/L)	Volumetric Seepage Rate from ROM above alluvium in B-Panel Area (gpm)	Alluvium Concentration in Reese Canyon Area (mg/L)	Volumetric Recharge Rate for Alluvium in Reese Canyon Area (gpm)	Mixed Chemistry (mg/L)	% Change	Groundwater Standard	Exceeds Groundwater Standards?	Surface Water Standards	Source of Surface Water Standards	Exceeds Surface Water Standards?
TDS	1,355	0.0206	268	4.42	273.051	1.9%	500	No	n/a	---	n/a
Sulfate	876	0.0206	17.71	4.42	21.700	22.5%	250	No	n/a	---	n/a
Aluminum	0.192	0.0206	0.1	4.42	0.100	0.4%	0.2	No	n/a	---	n/a
Antimony	0.0063	0.0206	0.00229	4.42	0.002	0.8%	0.006	No	0.014	DW	No
Cadmium	0.0127	0.0206	0.00037	4.42	0.0004	15.5%	0.005	No	0.001	CCC	No
Manganese	3.367	0.0206	0.07857	4.42	0.094	19.4%	0.05	Yes, as does background groundwater	n/a	---	n/a
Nickel	1.813	0.0206	0.02	4.42	0.028	41.7%	n/a	n/a	0.0157	CCC	Yes, as does background groundwater
Selenium	0.549	0.0206	0.001429	4.42	0.0040	177.9%	0.02	No	0.005	CCC	No

Rex Chert

Flow in the Rex Chert member would be affected by the proposed action. The mine pit panels would be excavated through the Rex Chert member (**Figure 4.3-2(b)**). Groundwater flow in the Rex Chert would decrease after mining because water infiltrating through the backfill would preferentially flow in the high-permeability backfill rather than entering the Rex Chert, which has a lower permeability. It is estimated that 2.44 inches/year infiltrates into the Rex Chert member in the pre-mining condition, decreasing to 0.05 inches/year for the Rex Chert below the fully backfilled pit (**Table 4.3-9**) and 1.4 inches/year in the exposed wall of the partially backfilled pit. The total volume of infiltrating water decreases, according to the infiltration predicted by the HELP model. The partitioning of the infiltrating water between alluvium and Rex Chert (pre-mining) and backfill and Rex Chert (after mining) was calculated for a unit area using the Darcy equation, Q=KI. Values used for K and I, along with the calculated Q, are shown in **Table 4.3-7**.

Constituents would leach from the run of mine (ROM) backfill into the underlying chert. Concentrations in the ROM leachate would generally be higher than in the alluvium that overlies the chert before mining (**Table 4.1-1**). However, the infiltration rate through the ROM backfill into the chert would be lower than the pre-mining infiltration rate through the alluvium (**Table 4.3-9**); therefore, the total mass loading would be less than in the pre-mining condition for all COPCs except selenium. Mass loading of selenium would increase by approximately 46 percent (**Table 4.3-10**).

The effect on groundwater quality in the Rex Chert would depend on the concentration and volume of leachate, as well as the concentration and volume of the receiving aquifer. The background water quality in the Rex Chert is discussed in Section 3.3.5

Wells Formation

The Wells Formation outcrops on Rasmussen Ridge, along the axis of the Snowdrift structural anticline. The limestone in the Wells Formation would be exposed in the footwall of the pit panels (**Figure 4.3-1**), and is unsaturated at the elevation of the proposed pit. The lowest elevation of proposed pit floor is 6,740 feet, while the estimated water level in the Wells Formation is 6,340 feet (**Figure 4.3-1**). Groundwater flow in the Wells Formation would not be affected during mining.

After mining, a groundwater mound would occur in the Wells Formation as a result of the increased infiltration in the partially backfilled pit area. The partially backfilled pit would collect surface runoff from the pit walls and upgradient undisturbed ground. This water would infiltrate through the limestone backfill, and would flow vertically through the unsaturated zone below the pit floor to the regional water table. The infiltration rate through the partially backfilled pit was evaluated using the EPA HELP3 model, which predicted 88.45 inches of infiltration per year for partially backfilled zone C3 (Whetstone 2002). The infiltration rates would be lower in fully backfilled zones (A1, A2, B1, B2) and partially backfilled zones C1 and C2 after mining (0.83 inches per year) than before mining (2.7 inches per year) as a result of the efficiency of the engineered cover and surface water diversion structures. Infiltration through the exposed pit

TABLE 4.3-9
POTENTIAL REDUCTION IN RECHARGE TO THE REX CHERT RESULTING FROM THE PROPOSED ACTION

Material	K (ft/day)	I (ft/ft)	$q_{saturated}$ ((ft^3/day)/ft^2)	% of Flow	Infiltration (in/year)	Comments
Recharge to Rex Chert Pre-mining (2.7 inches/yr infiltration)						
Alluvium	0.31	0.342	1.07E-01	9.8%	0.26	Alluvium K value based on geomean of all available hydraulic conductivity tests. Gradient based on 20% contact slope
Rex Chert	0.99	1	9.90E-01	90.2%	2.44	Rex Chert K value based on geomean of hydraulic conductivity tests in Rex Chert at N. Rasmussen Ridge (3.49x10^{-4} cm/sec). Gradient is unit vertical gradient.
Recharge to Rex Chert After Mining (0.83 inches/yr infiltration)						
Backfill	22.85	0.766	1.75E+01	94.4%	0.78	Backfill K value from dual ring permeameter tests (8.06x10^{-3} cm/sec). Gradient based on 47° slope of pit wall.
Rex Chert	0.99	1	9.90E-01	5.6%	0.05	Rex Chert K value based on geomean of hydraulic conductivity tests in Rex Chert at N. Rasmussen Ridge (3.49x10^{-4} cm/sec). Gradient is unit vertical gradient.

Notes: K = hydraulic conductivity
I = hydraulic gradient
q_{sat} = saturated flow rate

TABLE 4.3-10
POTENTIAL IMPACTS TO GROUNDWATER FLOW IN THE REX CHERT RESULTING FROM THE PROPOSED ACTION

Constituent	Alluvium Concentration mg/L	Pre-mining Mass Loading lbs/ft^2	ROM Concentration mg/L	Post-mining Mass Loading lbs/ft2	% Difference
TDS	517	1.35E-03	1,961	9.75E-05	-92.8%
Sulfate	108	2.82E-04	1,283	6.38E-05	-77.4%
Antimony	0.006	1.56E-08	0.007	3.48E-10	-97.8%
Cadmium	0.0004	1.04E-09	0.0116	5.77E-10	-44.7%
Manganese	1.13	2.95E-06	3.28	1.63E-07	-94.5%
Nickel	<0.05	1.30E-07	0.63	3.13E-08	-76.0%
Selenium	0.012	3.13E-08	0.918	4.56E-08	45.9%
Aluminum	<0.1	2.61E-07	0.196	9.72E-09	-96.3%

Notes: mg/L = Milligrams per liter
lbs/ft^2 – pounds per square feet

walls would also decrease after mining because more runoff would occur due to the steep slope and barren surface of the walls. The combination of these factors would result in a 336 percent increase in infiltration recharge to the Wells Formation below the footprint of the pit panels (**Table 4.3-11**). The groundwater flow model indicates that the increased recharge could cause

water levels to mound up to 15 feet in the Wells Formation below the partially backfilled pit (**Figure 4.3-5**).

TABLE 4.3-11
POTENTIAL INCREASE IN RECHARGE IN THE WELLS FORMATION RESULTING FROM INCREASED INFILTRATION FROM THE PARTIALLY BACKFILLED PIT

Contributing Areas:		
Area of partially backfilled pit	760,893	Ft^2
Area of exposed walls	3,143,210	Ft^2
Area of fully backfilled pit & C1 & C2	4,939,420	Ft^2
Pre-Mining Condition:		
Pre-mining recharge rate:	2.55	inches/year
Volumetric recharge rate before mining	1,878,985	Ft^3/yr
Post-Mining Condition:		
Post-mining recharge rate for partial backfill:	88.45	inches/year
Post-mining recharge rate for pit wall:	1.4	inches/year
Post-mining recharge rate for full backfill & C1 & C2:	0.83	inches/year
Volumetric recharge rate after mining	6,316,770	Ft^3/yr
Increase in recharge	**336%**	

Water quality in the Wells Formation would also be affected by the Proposed Action. Seepage that infiltrates through the backfill would carry solutes downward through the unsaturated zone into the aquifer.

Calculations of seepage velocity through the 400 feet of unsaturated bedrock between the pit floor and the water table indicate that seepage from the partially backfilled pit portion of the pit under the Proposed Action would reach the water table about 3.3 years after the end of mining. Seepage from the fully backfilled portions of the pit is calculated to reach the water table about 87 years after the end of mining (Whetstone 2002). When they enter the water table, solutes contained in the seepage would mix with groundwater and would be transported north and west by the regional gradient.

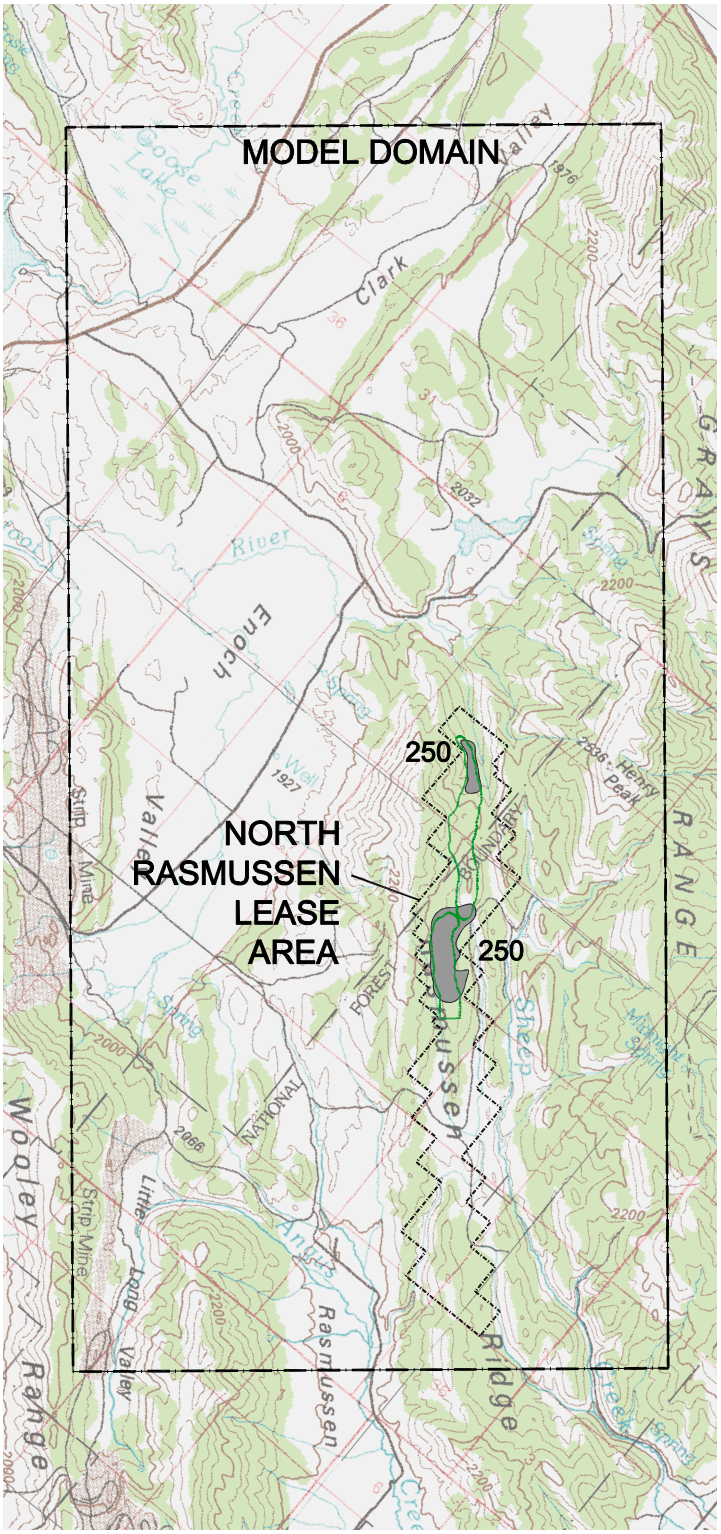
Modeled concentrations for COPCs in the regional groundwater aquifer were calculated at the lease boundary for seven observed points (LL1 to LL7) at 100, 200, 300, 400, and 500 years after the end of mining (**Table 4.3-12**). Model observation points LL1, LL2, and LL3 are located west of the A, C, and B panels, respectively. Observation points LL4 is located northwest of B Panel, and LL5, LL6, and LL7 are located east of B, C, and A panels, respectively.

Concentrations of antimony, sulfate, and TDS in groundwater would exceed Idaho groundwater standards inside the lease boundary, but would not exceed applicable standards outside the lease boundary **(Figures 4.3-7** and **4.3-8)**. Groundwater standards for antimony are based on human health considerations. Standards for sulfate and TDS are based on aesthetic qualities. Note that concentrations of selenium, cadmium, and aluminum would not exceed groundwater standards at any location and, therefore, did not warrant having a plume map prepared. Modeled concentrations of COPCs with time are plotted on **Figure 4.3-9**.

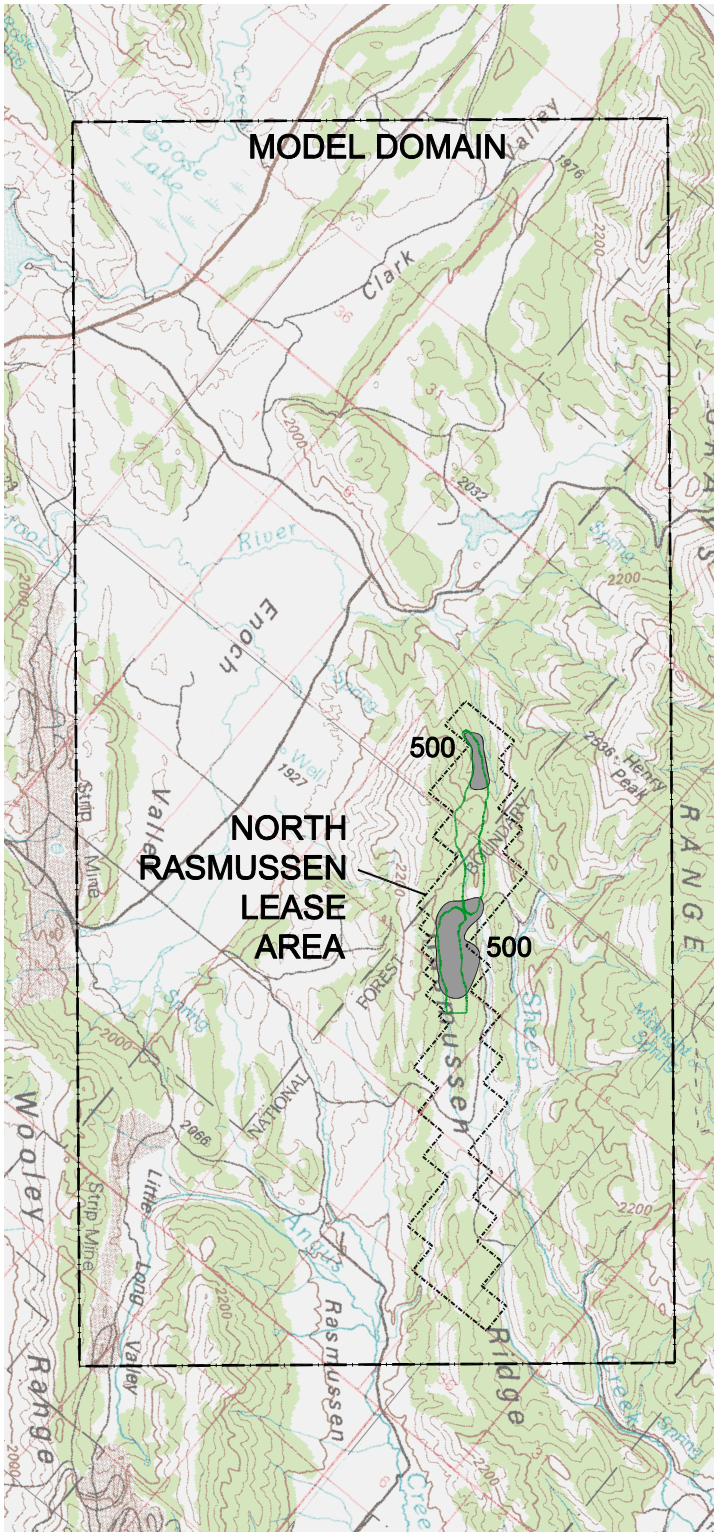
TABLE 4.3-12
MODELED CONCENTRATIONS AT THE WATER TABLE FOR SELECTED LOCATIONS AT THE MINERAL LEASE BOUNDARY

Location	Observation Point	Year	Al (mg/L)	Sb (mg/L)	Cd (mg/L)	Mn (mg/L)	Se (mg/L)	SO_4 (mg/L)	TDS (mg/L)
Southwest of A Panel Backfill	LL1	100	0.01	0.0010	0.0003	0.020	0.001	20	291
		200	0.01	0.0010	0.0003	0.025	0.001	22	408
		300	0.01	0.0010	0.0003	0.0282	0.001	23	422
		400	0.01	0.0010	0.0003	0.029	0.001	23	426
		500	0.01	0.0010	0.0003	0.029	0.001	23	373
Southwest of C Panel Partial Backfill	LL2	100	0.01	0.0016	0.0003	0.029	0.001	24	286
		200	0.01	0.0016	0.0003	0.030	0.001	25	285
		300	0.01	0.0016	0.0003	0.030	0.001	25	289
		400	0.01	0.0017	0.0003	0.030	0.001	25	285
		500	0.01	0.0016	0.0003	0.029	0.001	24	289
Southwest of A Panel Backfill	LL3	100	0.01	0.0015	0.0007	**0.260**	0.001	112	408
		200	0.01	0.0017	0.0008	**0.354**	0.001	149	**649**
		300	0.01	0.0017	0.0008	**0.356**	0.001	149	**660**
		400	0.01	0.0017	0.0008	**0.350**	0.001	147	**661**
		500	0.01	0.002316	0.0007	**0.338**	0.001	105	**509**
Northwest of B Panel Backfill	LL4	100	0.01	0.0010	0.0003	0.020	0.001	20	281
		200	0.01	0.0010	0.0003	0.029	0.001	24	291
		300	0.01	0.00110	0.0003	0.030	0.001	24	296
		400	0.01	0.0010	0.0003	0.029	0.001	24	297
		500	0.01	0.0010	0.0003	0.029	0.001	23	291
Northeast of B Panel Backfill	LL5	100	0.01	0.0023	0.0003	0.045	0.001	31	281
		200	0.01	0.0041	0.00044	**0.154**	0.001	76	284
		300	0.01	0.0043	0.0004	**0.158**	0.001	77	283
		400	0.01	0.0042	0.0004	**0.156**	0.001	76	283
		500	0.01	0.0044	0.0004	**0.159**	0.001	68	286
Northeast of C Panel Partial Backfill	LL6	100	0.01	0.0035	0.0003	**0.058**	0.001	38	285
		200	0.01	0.0039	0.0003	**0.063**	0.001	41	287
		300	0.01	0.0039	0.0003	**0.065**	0.001	41	289
		400	0.01	0.0040	0.0003	**0.067**	0.001	42	288
		500	0.01	0.0040	0.0003	**0.068**	0.001	43	288
Northeast of A Panel Backfill	LL7	100	0.01	0.0010	0.0003	0.023	0.001	21	287
		200	0.01	0.0011	0.0004	**0.081**	0.001	43	294
		300	0.01	0.0013	0.0006	**0.081**	0.001	86	298
		400	0.01	0.0015	0.0007	**0.191**	0.001	114	296
		500	0.01	0.0016	0.0007	**0.264**	0.001	126	290
Idaho Groundwater Standard			0.2	0.006	0.005	0.05	0.05	250	500

Bolded values exceed Idaho groundwater standards contained in IDAPA 58.01.11



SULFATE



TOTAL DISSOLVED SOLIDS

LEGEND

- *Lease Boundary*
- *Proposed Pit*
- 250 *Maximum Contaminant Level*

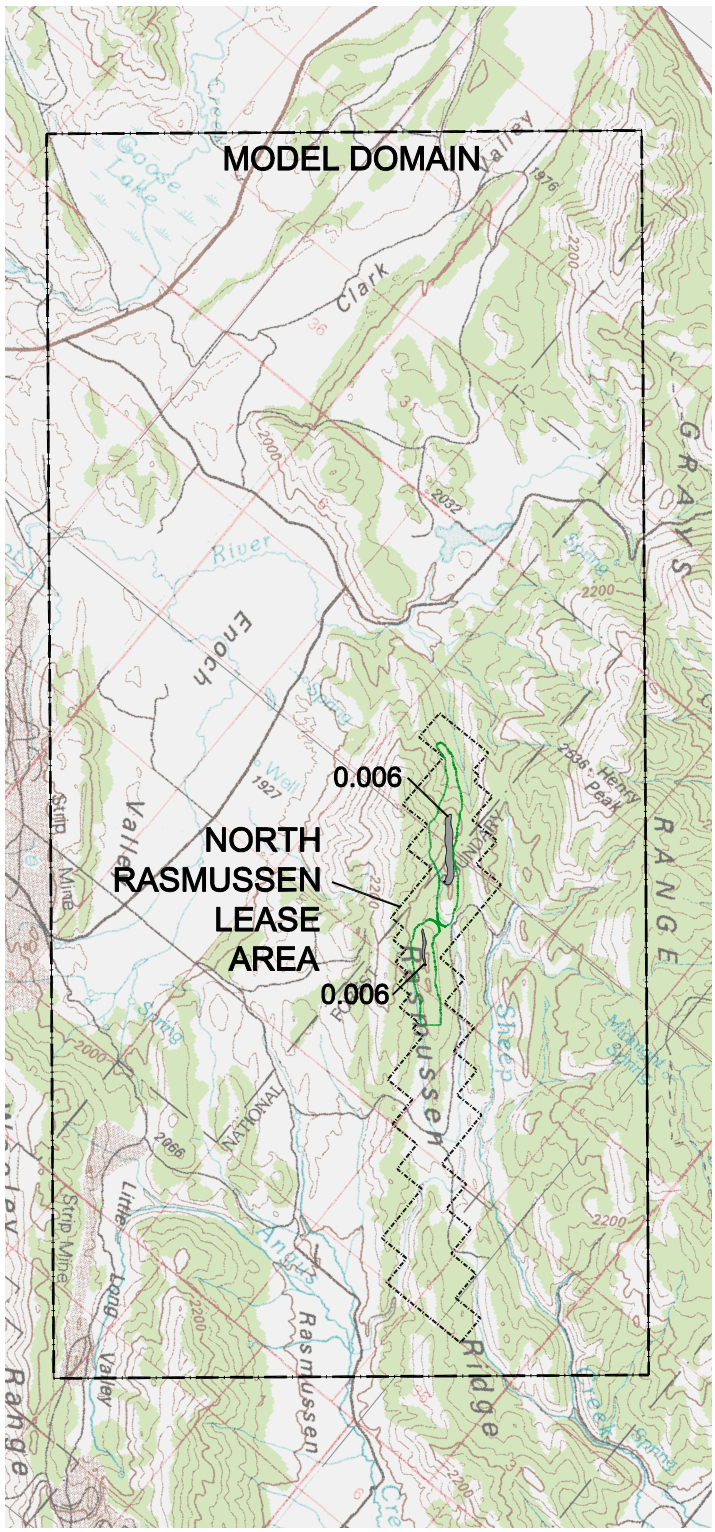
NORTH

0 1.5 3

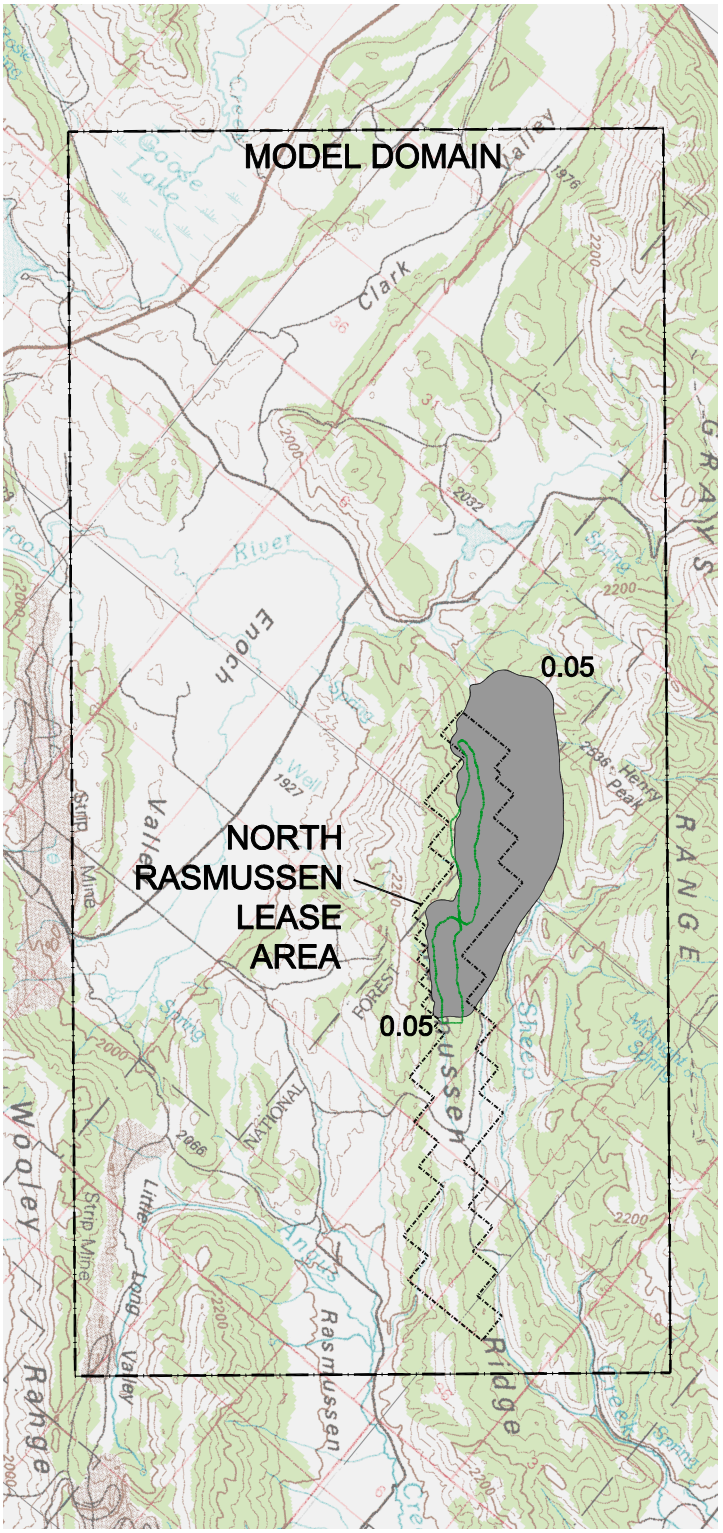
Scale in Miles

USGS 100k Quadrangle; Soda Springs, ID
Source: Whetstone 2002

North Rasmussen Ridge Mine EIS Project	
FIGURE 4.3-7 CONSTITUENT CONCENTRATIONS AT THE WATER TABLE 500 YEARS AFTER MINING	
ANALYSIS AREA: Caribou County, Idaho.	
Date: 02.27.03	Drawing File: 1164 HYDRO WA TAB.dwg
Scale: As Noted	Drawn By:MTM



ANTIMONY



MANGANESE

LEGEND

Lease Boundary

Proposed Pit

0.006 *Maximum Contaminant Level*

NORTH

0 1.5 3

Scale in Miles

USGS 100k Quadrangle; Soda Springs, ID

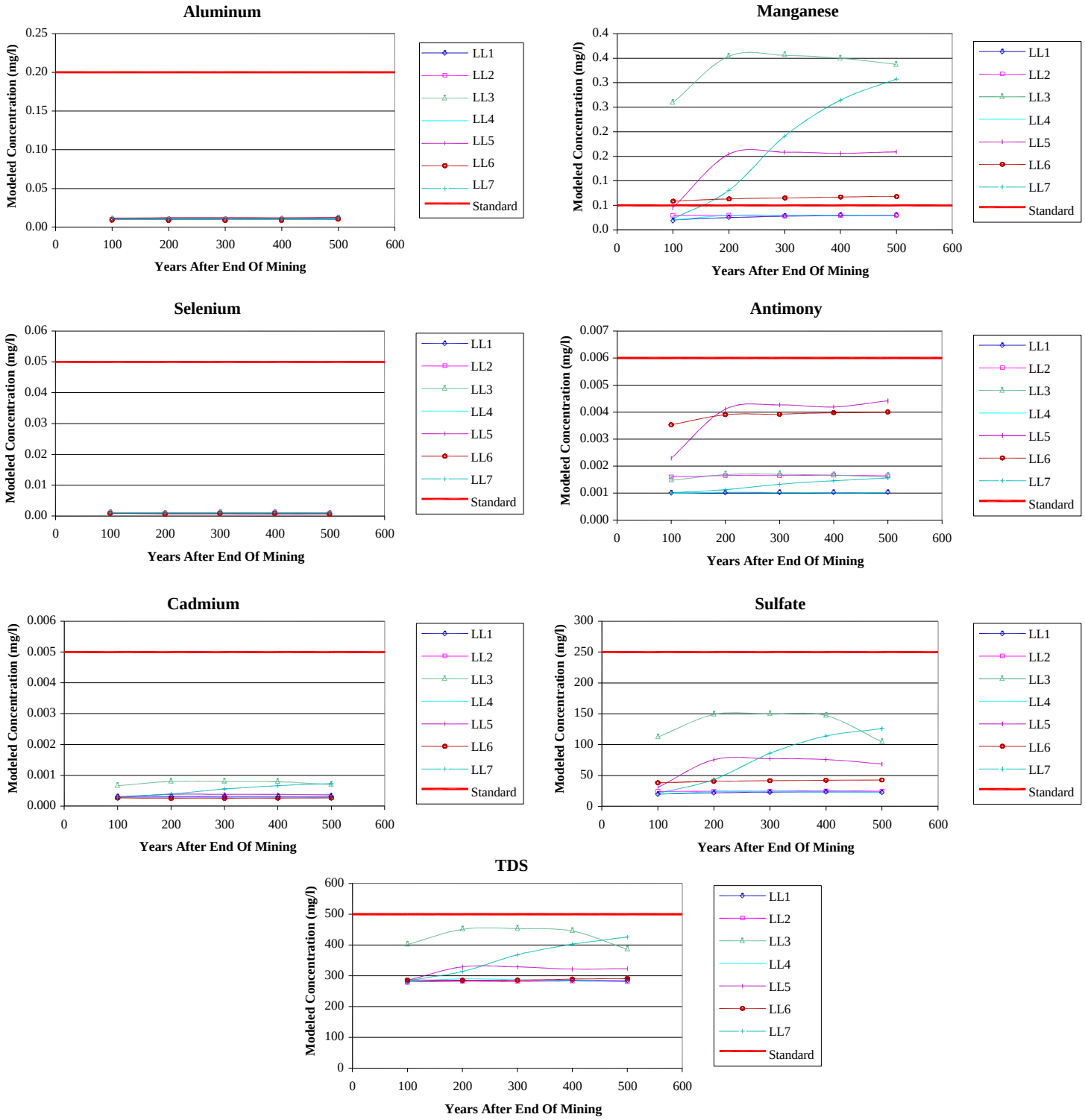
Source: Whetstone 2002

North Rasmussen Ridge Mine EIS Project

FIGURE 4.3-8
CONSTITUENT CONCENTRATIONS AT THE WATER TABLE 500 YEARS AFTER MINING

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 HYDRO WA TAB.dwg
Scale: As Noted	Drawn By:MTM



Source: Whetstone 2002

North Rasmussen Ridge Mine EIS Project	
FIGURE 4.3-9 MODELED CONCENTRATIONS OVER TIME, BASED ON PROPOSED ACTION	
ANALYSIS AREA: Caribou County, Idaho	
Date: 02.27.03	Drawing File: 1164 CON CON.dwg
Scale: NTS	Drawn By: MTM

Results of the model indicate that the plume of manganese would extend about 3,000 feet northwest of the lease boundary and that the concentration of manganese would exceed the applicable aesthetic-based secondary standard for groundwater of 0.05 mg/L. The plume would originate from the backfilled Panels A and B and also from the partially backfilled Panel C **(Figure 4.3-7)**. The plume of manganese would reach its maximum size about 400 years after mining ends and then decrease slightly in later years. Two wells in the area (2 miles and 2.5 miles west of Rasmussen Ridge) provide domestic water. The manganese plume is not expected to reach these wells nor does manganese pose a threat to human health. At the farthest extent of the manganese plume, the depth to groundwater in the Wells Formation is greater than 2000 feet, which would limit the availability of groundwater for human use.

Modeled plumes for sulfate and TDS would reach maximum size and concentration between 200 and 400 years after mining ends, but concentrations would not exceed groundwater standards outside the lease boundary. The plume of antimony would be confined to a small area below the partially backfilled Panel A inside the lease boundary and would not extend outside the footprint of the pit.

The IDEQ requires that groundwater quality cannot be contaminated outside the lease boundary of a phosphate mine under the Idaho Non-degradation standards. This is why observation points were established in the model to correspond with the lease boundary. It is of note that background water quality in the Wells Formation in the project area is not well known and some constituents may naturally exceed numerical groundwater standards. In particular, naturally occurring manganese concentrations of up to 1.1 mg/L have been observed in Wells Formation groundwater at the Dry Valley Mine (Whetstone 2002).

4.3.1.5 Alternative 1 – Proposed Action with Impermeable Capping of Backfilled Area

This alternative involves capping the backfilled overburden with a layer of low permeability material between the seleniferous waste rock and the applied growth media, in order to reduce potential effects of water infiltrating into the backfill, as described in Section 2.3.

To assess potential impacts, infiltration through the partially and fully backfilled panels was evaluated using the EPA HELP3 model for both the clay cap and the synthetic liner cap. Model results indicate that the area-weighted average infiltration for the fully backfilled panels would be 0.362 for the clay cap and 0.198 inches per year for the synthetic liner cap. In neither case is the partially backfilled pit capped, and the resulting infiltration rate is 90.1 and 90.2 inches per year for the two cap designs. These results are shown in **Table 4.3-13**.

TABLE 4.3-13
WATER BALANCE RESULTS OF HELP INFILTRATION MODELING FOR THE CLAY CAP AND SYNTHETIC LINER CAP ALTERNATIVES (IN INCHES/YEAR)

Alternative	Zone	Precipitation Run-on	Runoff	Evapo-transpiration	Lateral Drainage	Infiltration
Clay Cap	NR Backfill Area A	26.84	11.97	14.50	0.04	0.323
Clay Cap	NR Backfill Area B	33.65	18.37	14.73	0.06	0.491
Clay Cap	NR Backfill Area C1	26.84	11.97	14.50	0.05	0.319
Clay Cap	NR Backfill Area C2	26.84	11.96	14.51	0.02	0.353
Clay Cap	NR Backfill Area ED1	26.84	11.97	14.50	0.02	0.345
Clay Cap	NR Backfill Area ED2	31.20	15.37	15.27	0.13	0.436
Clay Cap	NR Backfill Area C3	110.96	0.00	20.87	N/A	90.09
Synthetic Liner Cap	NR Backfill Area A	26.84	11.97	14.50	0.19	0.174
Synthetic Liner Cap	NR Backfill Area B	33.65	18.37	14.73	0.30	0.257
Synthetic Liner Cap	NR Backfill Area C1	26.84	11.97	14.50	0.20	0.170
Synthetic Liner Cap	NR Backfill Area C2	26.84	11.96	14.51	0.12	0.248
Synthetic Liner Cap	NR Backfill Area ED1	26.84	11.97	14.50	0.13	0.233
Synthetic Liner Cap	NR Backfill Area ED2	31.22	15.38	15.28	0.37	0.192
Synthetic Liner Cap	NR Backfill Area C3	111.09	0.00	20.89	N/A	90.20

At these predicted infiltration rates, modeling indicates it would take 119 years for seepage from the clay-capped fully backfilled pit to infiltrate through the approximately 400 feet of unsaturated rock to the underlying regional aquifer, and 218 years for seepage from the synthetic liner capped pit to reach the water table. Seepage from the partially backfilled panel would arrive at the water table in about 3.2 years.

Surface Water Impacts

Flow Impacts. Impacts to surface water flow during mining would be identical to the Proposed Action. After mining, surface water flow would be affected by intercepted runoff in the partially backfilled pit and increased runoff and lateral drainage from the low-permeability cap. Although these effects have not been fully quantified, the result would most likely be a small increase in surface water flow into Reese Canyon Creek and No Name Creek and a decrease in flow in the West Fork of Sheep Creek. The decrease in flow in West Fork of Sheep Creek would be slightly smaller than under the Proposed Action, since the size of the partially backfilled pit would be essentially the same and the portion of the fully backfilled pit would provide more runoff and lateral drainage from the cap than in the Proposed Action.

Water Quality Impacts. The backfilled pits would not affect the quality of surface water runoff, if capped with clay or synthetic liner. No surface seeps would occur, because the overburden is placed below the original ground surface and the cap would prevent most of the water from infiltrating into the backfill. The engineered cover would prevent surface water runoff from contacting reactive materials in the backfill, and chemical impacts to surface water runoff and lateral drainage would not occur.

Groundwater Impacts

Alluvium and Rex Chert. The reduction of flow in the alluvium would be slightly greater than in the Proposed Action, because the low-permeability cap would prevent water from recharging the alluvium and Rex Chert on the northeast margin (hanging wall) of the pit. However, since only 0.02 and 0.05 inches/year of seepage from the backfilled panels are expected to enter the alluvium and Rex Chert in the Proposed Action case, the difference between the Capping Alternative and the Proposed Action is minimal with respect to flow impacts in the alluvium and Rex Chert.

There would be no substantial impact to groundwater quality in the alluvium and Rex Chert, under the Capping Alternative. The low-permeability cap would reduce or limit leachate from seeping into groundwater.

Wells Formation. Impacts to flow in the Wells Formation regional aquifer would be less under the Capping Alternative than under the Proposed Action. Infiltration through the partially backfilled pit (90.1 and 90.2 inches/year) would be slightly higher than for the Proposed Action (88.45 inches/year). Infiltration through the fully backfilled panels would be reduced from 0.83 inches/year for the Proposed Action to 0.36 inches/year for the clay cap or 0.19 inches/year for the synthetic liner cap. The total increase in recharge to the Wells Formation aquifer would be higher for the Proposed Action (336%) than for the clay cap (331%) or the synthetic liner (328%), as shown in **Table 4.3-14**.

TABLE 4.3-14
COMPARISON OF FLOW IMPACTS TO WELLS FORMATION IN THE CLAY CAP AND SYNTHETIC LINER CAP ALTERNATIVE VS. THE PROPOSED ACTION

Alternative	Increase in Recharge to Wells Formation Aquifer	Height of Mound in Wells Formation Aquifer
Proposed Action	336%	Approx 15 ft
Clay Cap Alternative	331%	Approx 15 ft
Synthetic Liner Cap Alternative	328%	Approx 15 ft

Impacts to water quality in the Wells Formation regional aquifer would decrease under the Impermeable Cap Alternative. As in the Proposed Action, seepage that infiltrates through the backfill would carry solutes downward through the unsaturated zone into the aquifer. However, infiltration rates from the fully backfilled panels would be lower than for the Proposed Action, and chemical mass loading would therefore be less.

Modeled concentrations for COPCs in the regional groundwater aquifer for the clay cap alternative were calculated using the MT3DMS transport model at the lease boundary for seven observation points (LL1-LL7) at 100, 200, 300, 400, and 500 years after the end of mining (**Table 4.3-15**). Results indicate that manganese would form a plume in groundwater that exceeds secondary drinking water standards at the lease boundary and would extend outside of the lease boundary northwest from the pit (**Figure 4.3-10**). Secondary drinking water standards are guidelines regulating contaminants that may cause cosmetic effects (staining) or aesthetic effects (taste, odor, color) in drinking water, but which do not affect human health. The manganese plume would reach its maximum size about 220 years after the end of mining and decrease slightly in size in following years. Concentrations of antimony, sulfate and TDS in groundwater, would be above Idaho groundwater standards inside of the lease boundary, but would not exceed applicable standards outside of the lease boundary (**Figure 4.3-11**). Concentrations of selenium, cadmium, and aluminum would not exceed groundwater standards at any location. Modeled COPC concentrations with time are plotted in **Figure 4.3-12**.

Concentrations of COPCs in the regional groundwater aquifer for the synthetic liner cap alternative were modeled similarly. The results indicated that concentrations of all modeled constituents would be lower for the synthetic cap alternative than for the clay cap or the Proposed Action (**Table 4.3-16**). Concentrations of antimony, sulfate and TDS would not exceed applicable standards outside of the lease boundary (**Figure 4.3-13**). Manganese is the only constituent that would exceed applicable groundwater standards at and beyond the mineral lease boundary. The manganese plume in groundwater is shown in **Figure 4.3-14**. Modeled COPC concentrations with time are plotted in **Figure 4.3-15**.

Infiltration would be reduced by a low-permeability cap system using compacted clay or an impervious synthetic liner. These liner systems would have a finite life span of 50 to 100 years, beyond which time the liner would degrade and its effectiveness be reduced. Low-permeability caps would have environmental impacts quite similar to the Proposed Action. However, a compacted clay cap would cost approximately $9.5 million more than the Proposed Action, and a synthetic liner approximately $20.7 million more than the Proposed Action.

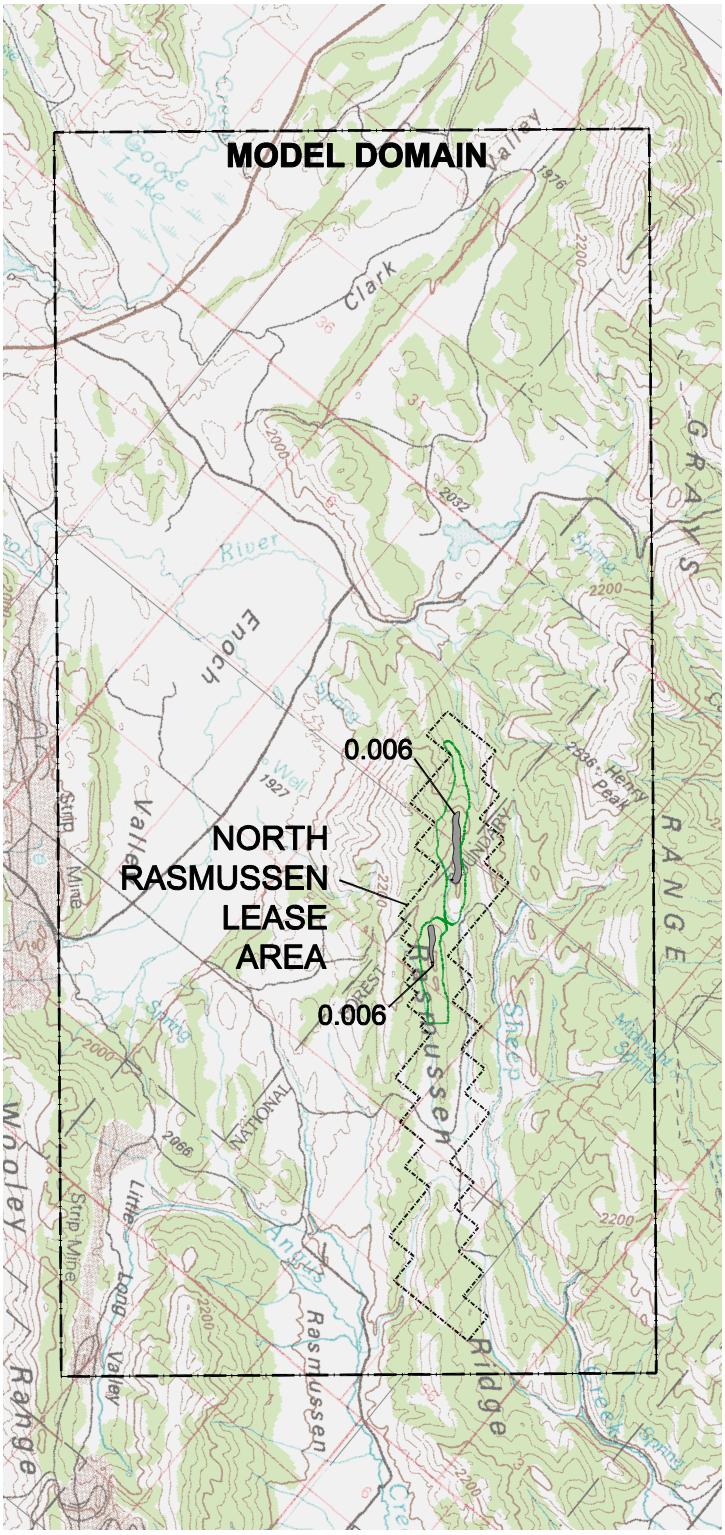
4.3.1.6 Alternative 2 - No-Action

The No Action Alternative would result in the elimination of water resources impacts described in this section of the EIS associated with the Proposed Action. Specifically, the reduction in surface water runoff to Reese Canyon Creek, No Name Creek, and Sheep Creek would not occur. Flow in the alluvium would not be reduced, and a groundwater mound would not form in the Wells Formation regional aquifer. Chemical loading to the Wells Formation aquifer, alluvium, and Rex Chert from the pit backfill would not occur. However, impacts to water

resources from previous and existing operations at Central and South Rasmussen Ridge Mine would still be present.

TABLE 4.3-15
MODELED CONCENTRATIONS AT THE WATER TABLE AT SELECTED LOCATIONS AT THE MINERAL LEASE BOUNDARY FOR THE CLAY CAP ALTERNATIVE

Location	Observation Point	Year	Al (mg/l)	Sb (mg/l)	Cd (mg/l)	Mn (mg/l)	Se (mg/l)	SO4 (mg/l)	TDS (mg/l)
Southwest of A Panel Backfill	LL1	100	0.01	0.0010	0.0003	0.020	0.001	20	281
		200	0.01	0.0010	0.0003	0.020	0.001	20	284
		300	0.01	0.0010	0.0003	0.021	0.001	20	282
		400	0.01	0.0010	0.0003	0.021	0.001	20	283
		500	0.01	0.0010	0.0003	0.022	0.001	21	284
Southwest of C Panel Partial Backfill	LL2	100	0.01	0.0017	0.0003	0.030	0.001	25	284
		200	0.01	0.0017	0.0003	0.030	0.001	25	284
		300	0.01	0.0017	0.0003	0.030	0.001	25	282
		400	0.01	0.0017	0.0003	0.030	0.001	25	285
		500	0.01	0.0017	0.0003	0.030	0.001	25	284
Southwest of A Panel Backfill	LL3	100	0.01	0.0010	0.0003	0.020	0.001	20	282
		200	0.01	0.0014	0.0006	**0.185**	0.001	84	367
		300	0.01	0.0014	0.0005	**0.183**	0.001	83	360
		400	0.01	0.0014	0.0005	**0.185**	0.001	84	365
		500	0.01	0.0014	0.0005	**0.187**	0.001	85	367
Northwest of B Panel Backfill	LL4	100	0.01	0.0010	0.0003	0.020	0.001	20	282
		200	0.01	0.0010	0.0003	0.024	0.001	22	286
		300	0.01	0.0010	0.0003	0.024	0.001	21	281
		400	0.01	0.0010	0.0003	0.024	0.001	22	283
		500	0.01	0.0010	0.0003	0.024	0.001	22	283
Northeast of B Panel Backfill	LL5	100	0.01	0.0024	0.0003	0.043	0.001	30	288
		200	0.01	0.0040	0.0003	**0.099**	0.001	54	302
		300	0.01	0.0042	0.0003	**0.108**	0.001	58	306
		400	0.01	0.0044	0.0003	**0.112**	0.001	60	318
		500	0.01	0.0041	0.0003	**0.106**	0.001	57	298
Northeast of C Panel Partial Backfill	LL6	100	0.01	0.0036	0.0003	**0.059**	0.001	38	289
		200	0.01	0.0040	0.0003	**0.064**	0.001	41	291
		300	0.01	0.0039	0.0003	**0.064**	0.001	41	287
		400	0.01	0.0040	0.0003	**0.065**	0.001	41	290
		500	0.01	0.0039	0.0003	**0.065**	0.001	41	289
Northeast of A Panel Backfill	LL7	100	0.01	0.0010	0.0003	0.020	0.001	20	286
		200	0.01	0.0010	0.0004	**0.025**	0.001	22	281
		300	0.01	0.0011	0.0005	**0.066**	0.001	38	301
		400	0.01	0.0012	0.0005	**0.127**	0.001	62	343
		500	0.01	0.0013	0.0005	**0.153**	0.001	71	348
Idaho Groundwater Standard			0.2	0.006	0.005	0.05	0.05	250	500



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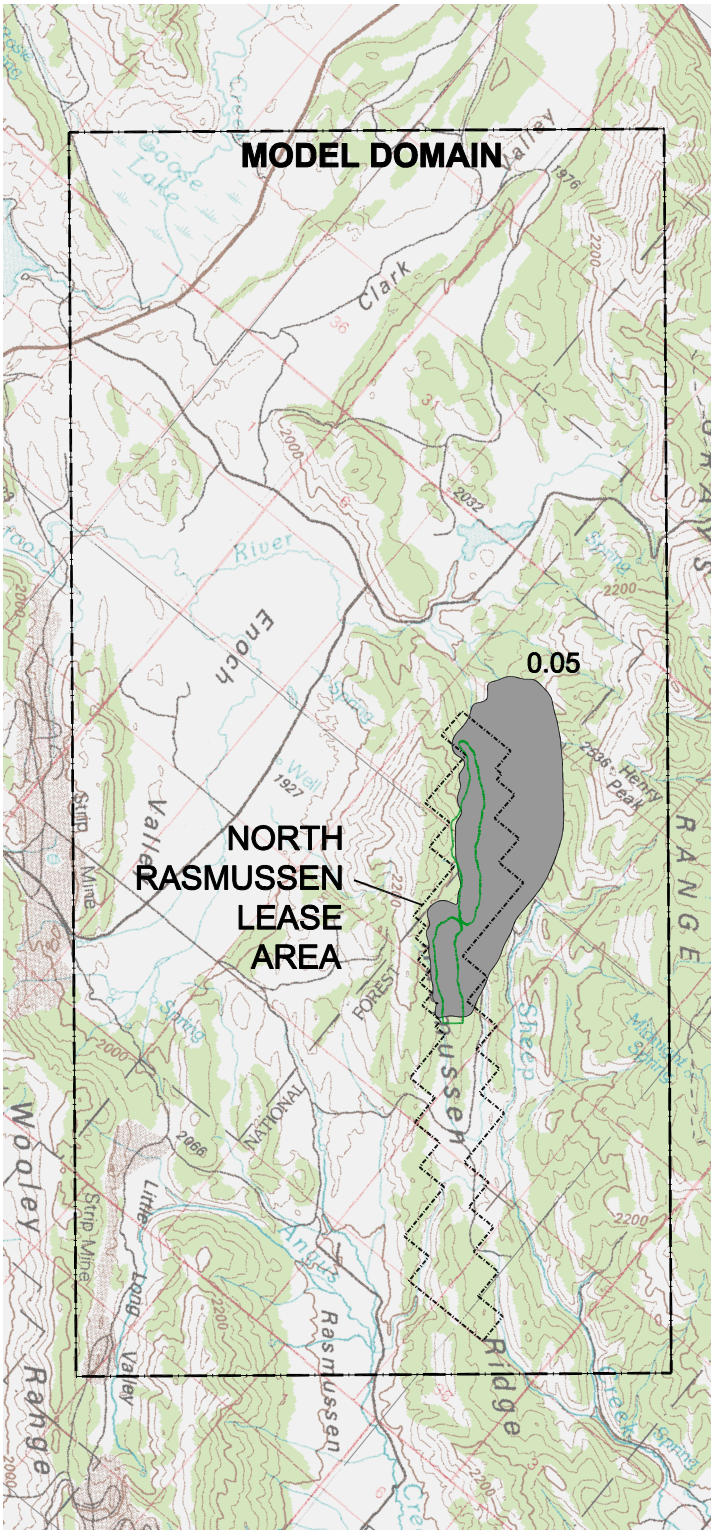


MANGANESE

LEGEND

Lease Area

Proposed Pit

0.006 *Maximum Contaminant Level*

NORTH

0 1.5 3

Scale in Miles

USGS 100k Quadrangle; Soda Springs, ID

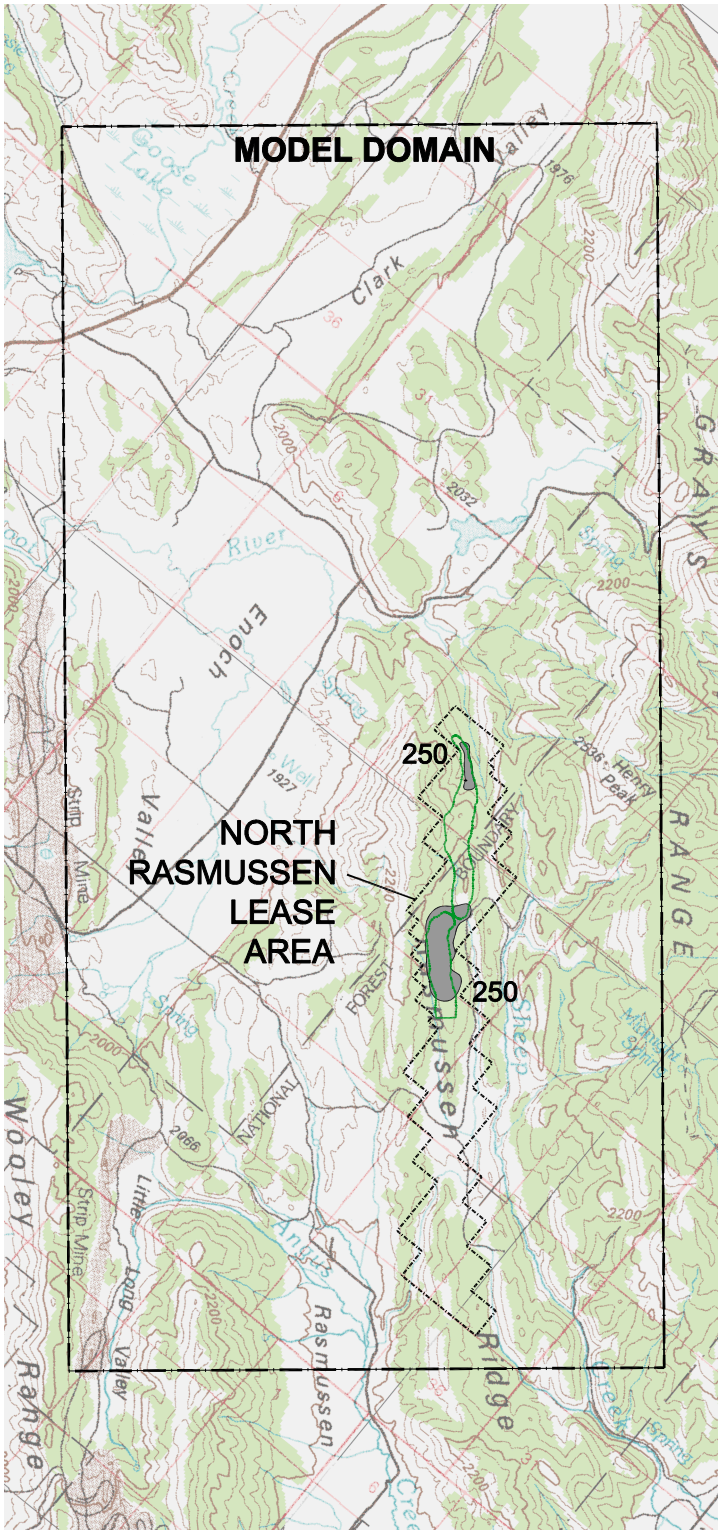
Source: Whetstone 2002

North Rasmussen Ridge Mine EIS Project

FIGURE 4.3-10
PLUME BOUNDARIES AT THE WATER TABLE FOR THE CLAY CAP ALTERNATIVE

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 HYDRO CAP.dwg
Scale: 1" = 1.5 MILES	Drawn By:MTM



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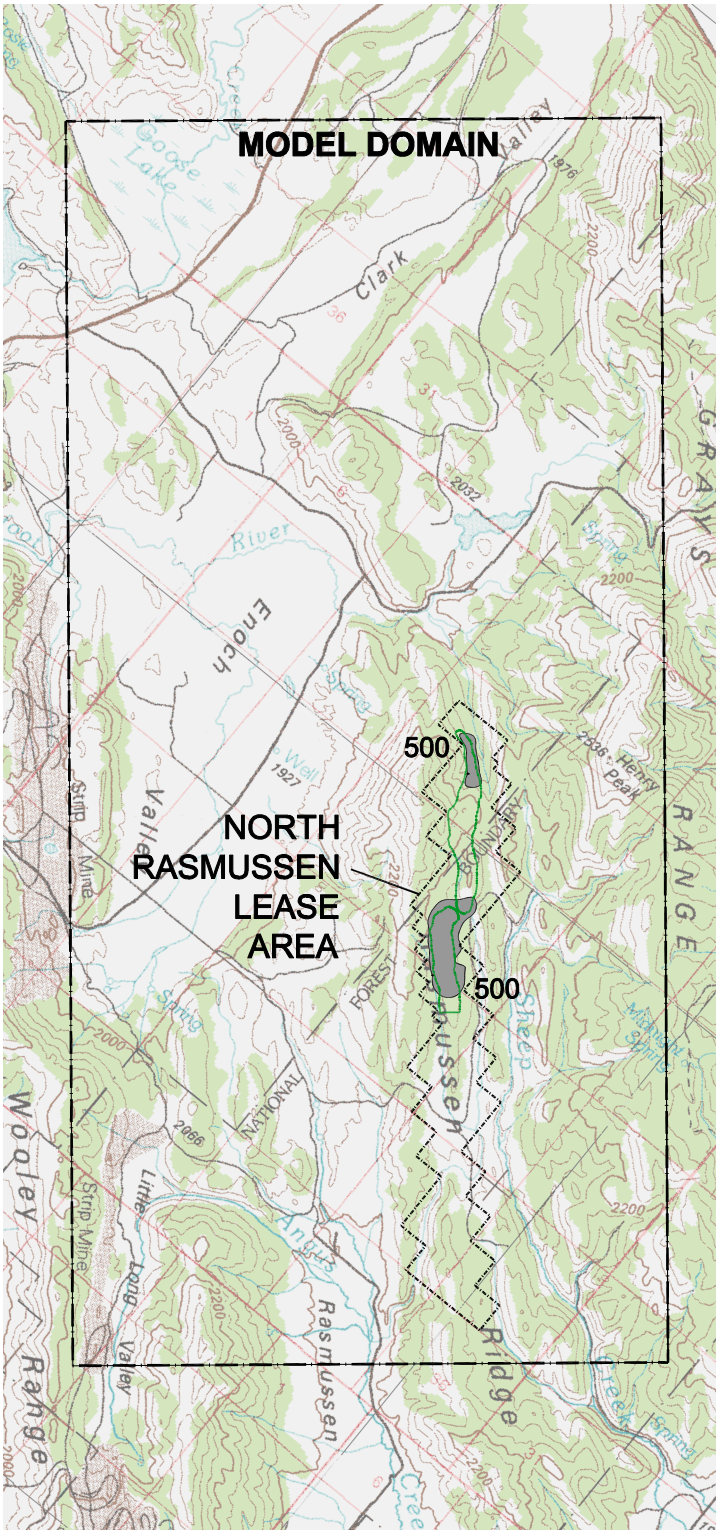


TOTAL DISSOLVED SOLIDS

LEGEND

Lease Area

Proposed Pit

250 *Maximum Contaminant Level*

NORTH

0 1.5 3

Scale in Miles

USGS 100k Quadrangle; Soda Springs, ID

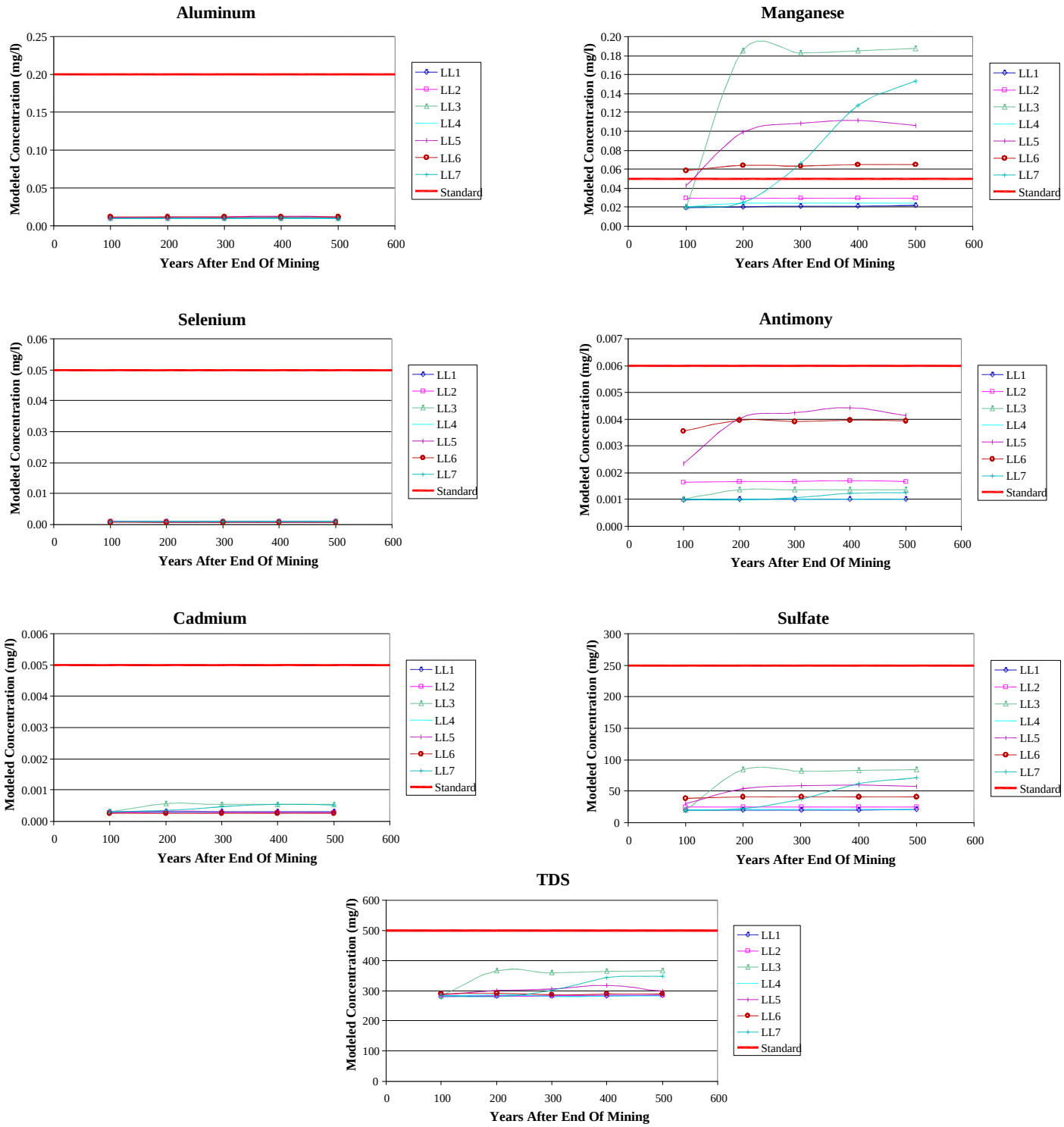
Source: Whetstone 2002

North Rasmussen Ridge Mine EIS Project

FIGURE 4.3-11
PLUME BOUNDARIES AT THE WATER TABLE FOR THE CLAY CAP ALTERNATIVE

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 HYDRO CAP.dwg
Scale: 1" = 1.5 MILES	Drawn By:MTM

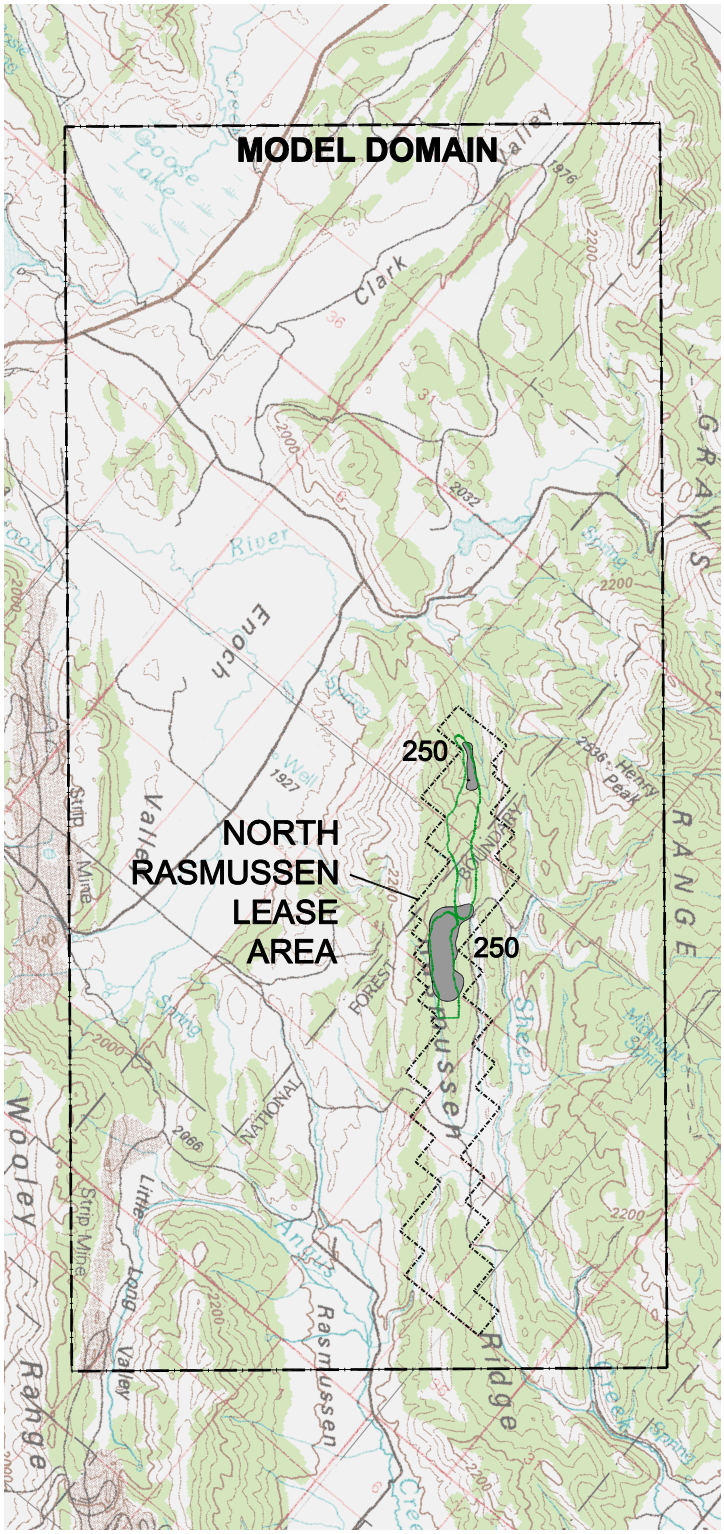


Source: Whetstone 2002

North Rasmussen Ridge Mine EIS Project	
FIGURE 4.3-12 MODEL RESULTS SHOWING CONCENTRATIONS OVER TIME, BASED ON THE CLAY CAP ALTERNATIVE	
ANALYSIS AREA: Caribou County, Idaho	
Date: 02.27.03	Drawing File: 1164 CON CON.dwg
Scale: NTS	Drawn By: ETC

TABLE 4.3-16
MODELED CONCENTRATIONS AT THE WATER TABLE AT SELECTED LOCATIONS AT THE MINERAL LEASE BOUNDARY FOR THE SYNTHETIC LINER CAP ALTERNATIVE

Location	Observation Point	Year	Al (mg/l)	Sb (mg/l)	Cd (mg/l)	Mn (mg/l)	Se (mg/l)	SO4 (mg/l)	TDS (mg/l)
Southwest of A Panel Backfill	LL1	100	0.01	0.0010	0.0003	0.020	0.001	20	282
		200	0.01	0.0010	0.0003	0.020	0.001	20	282
		300	0.01	0.0010	0.0003	0.020	0.001	20	281
		400	0.01	0.0010	0.0003	0.021	0.001	20	283
		500	0.01	0.0010	0.0003	0.021	0.001	21	285
Southwest of C Panel Partial Backfill	LL2	100	0.01	0.0017	0.0003	0.030	0.001	25	285
		200	0.01	0.0017	0.0003	0.031	0.001	25	283
		300	0.01	0.0017	0.0003	0.030	0.001	25	286
		400	0.01	0.0017	0.0003	0.030	0.001	25	283
		500	0.01	0.0017	0.0003	0.030	0.001	25	283
Southwest of A Panel Backfill	LL3	100	0.01	0.0010	0.0003	0.020	0.001	20	282
		200	0.01	0.0010	0.0003	0.020	0.001	20	280
		300	0.01	0.0014	0.0005	**0.185**	0.001	84	365
		400	0.01	0.0014	0.0005	**0.183**	0.001	83	362
		500	0.01	0.0014	0.0005	**0.184**	0.001	83	363
Northwest of B Panel Backfill	LL4	100	0.01	0.0010	0.0003	0.020	0.001	20	282
		200	0.01	0.0010	0.0003	0.020	0.001	20	285
		300	0.01	0.0010	0.0003	0.024	0.001	21	283
		400	0.01	0.0010	0.0003	0.024	0.001	22	285
		500	0.01	0.0010	0.0003	0.025	0.001	22	286
Northeast of B Panel Backfill	LL5	100	0.01	0.0024	0.0003	0.043	0.001	30	288
		200	0.01	0.0039	0.0003	**0.063**	0.001	40	293
		300	0.01	0.0041	0.0003	**0.100**	0.001	54	296
		400	0.01	0.0044	0.0003	**0.110**	0.001	59	313
		500	0.01	0.0045	0.0003	**0.115**	0.001	62	321
Northeast of C Panel Partial Backfill	LL6	100	0.01	0.0036	0.0003	**0.060**	0.001	39	292
		200	0.01	0.0040	0.0003	**0.064**	0.001	41	290
		300	0.01	0.0040	0.0003	**0.064**	0.001	41	289
		400	0.01	0.0040	0.0003	**0.064**	0.001	41	289
		500	0.01	0.0040	0.0003	**0.066**	0.001	42	294
Northeast of A Panel Backfill	LL7	100	0.01	0.0010	0.0003	0.020	0.001	20	282
		200	0.01	0.0010	0.0003	0.020	0.001	20	285
		300	0.01	0.0010	0.0003	0.025	0.001	22	280
		400	0.01	0.0011	0.0004	**0.069**	0.001	39	304
		500	0.01	0.0013	0.0005	**0.132**	0.001	64	350
Idaho Groundwater Standard			0.2	0.006	0.005	0.05	0.05	250	500



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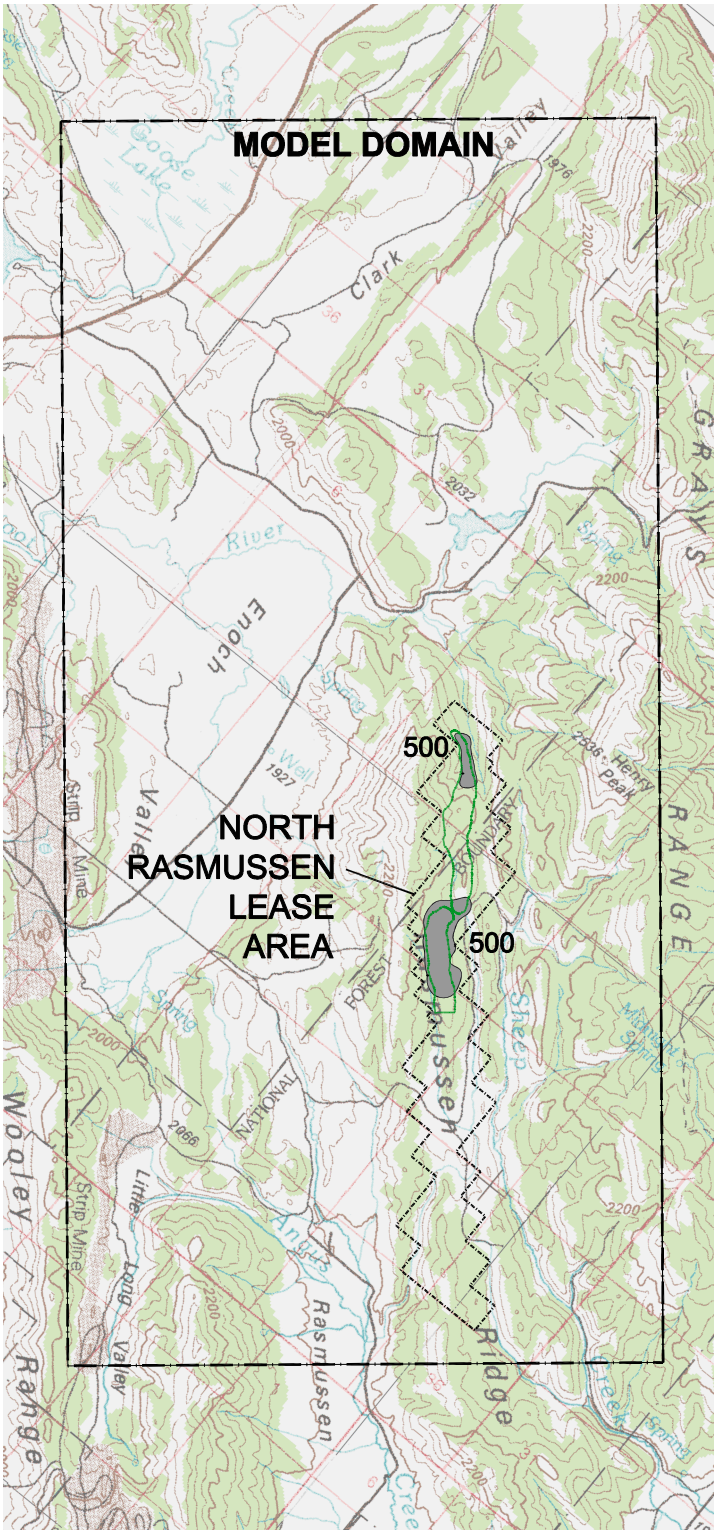


TOTAL DISSOLVED SOLIDS

LEGEND

Lease Area

Proposed Pit

250 *Maximum Contaminant Level*

NORTH

0 1.5 3

Scale in Miles

USGS 100k Quadrangle; Soda Springs, ID

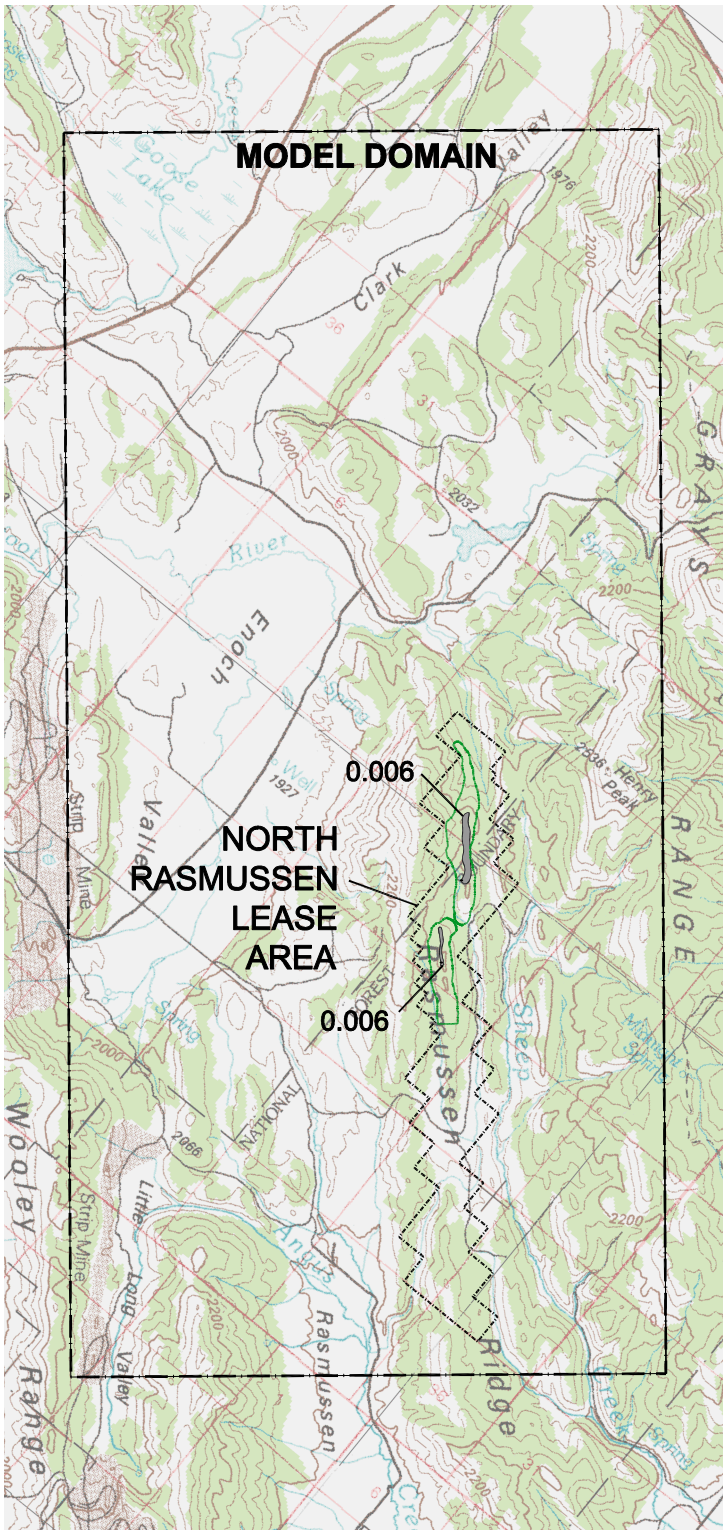
Source: Whetstone 2002

North Rasmussen Ridge Mine EIS Project

FIGURE 4.3-13
PLUME BOUNDARIES AT THE WATER TABLE FOR THE SYNTHETIC LINER CAP ALTERNATIVE

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 HYDRO CAP.dwg
Scale: 1" = 1.5 MILES	Drawn By:MTM



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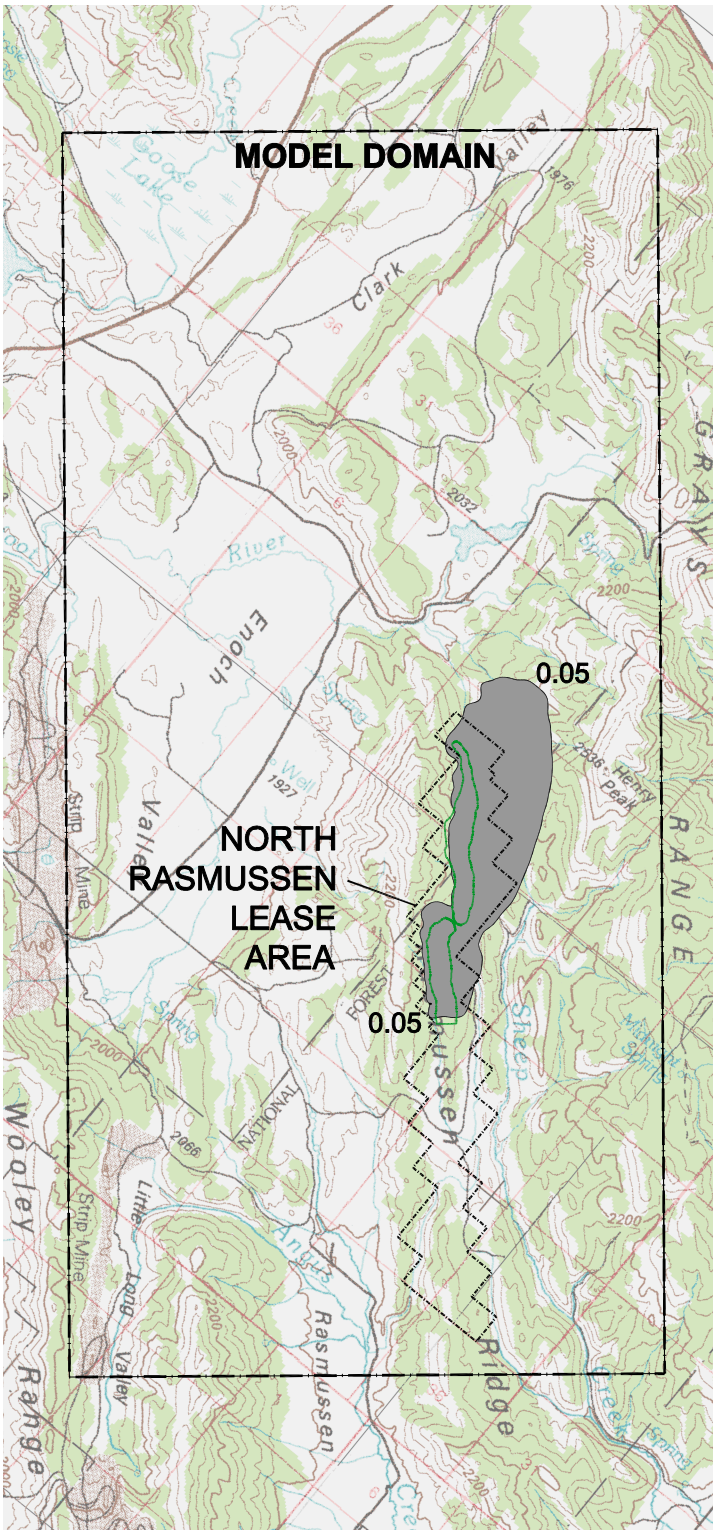


MANGANESE

LEGEND

Lease Area

Proposed Pit

0.006 *Maximum Contaminant Level*

NORTH

0 1.5 3

Scale in Miles

USGS 100k Quadrangle; Soda Springs, ID

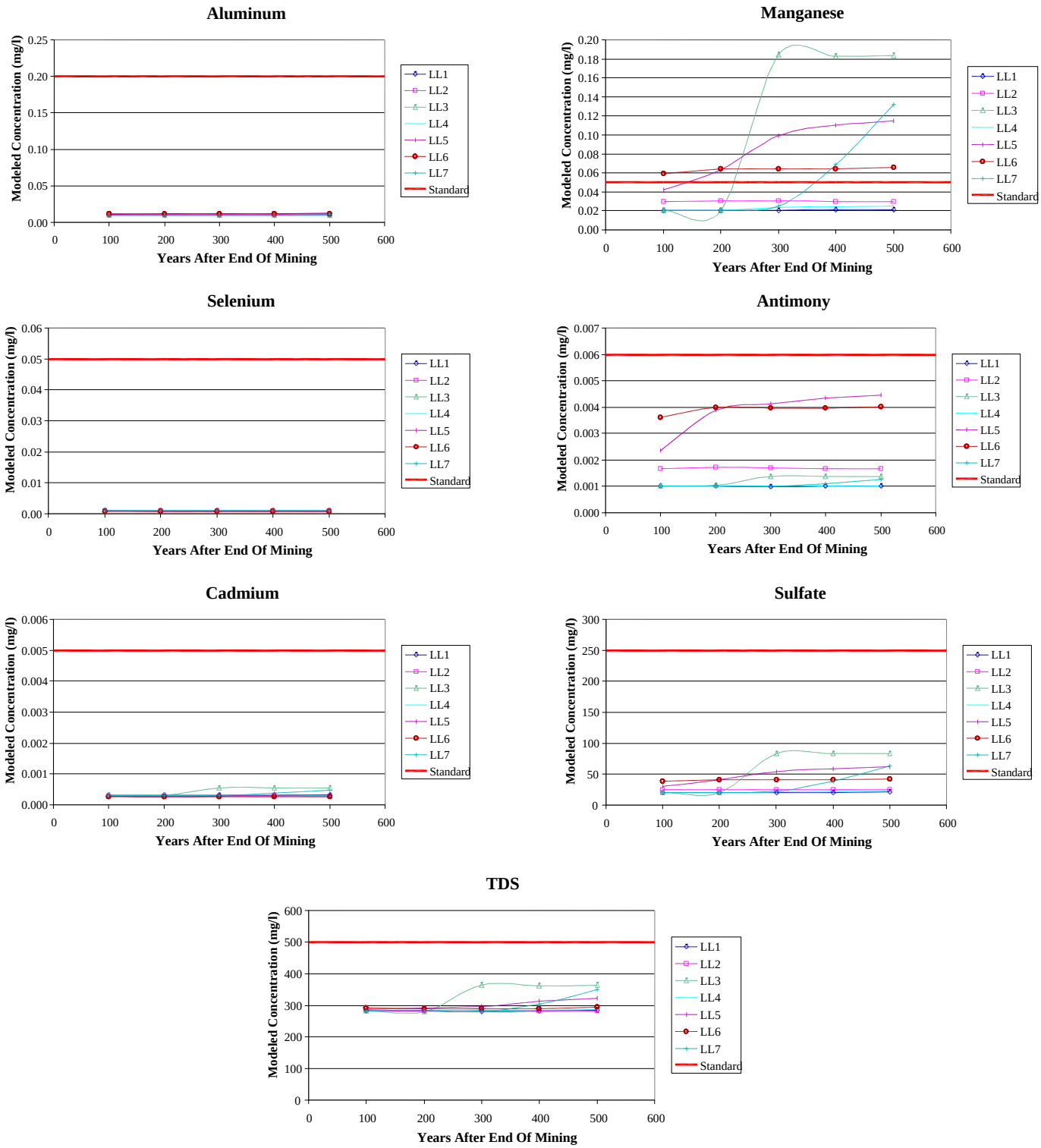
Source: Whetstone 2002

North Rasmussen Ridge Mine EIS Project

FIGURE 4.3-14
PLUME BOUNDARIES AT THE WATER TABLE FOR THE SYNTHETIC LINER CAP ALTERNATIVE

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 HYDRO CAP.dwg
Scale: 1" = 1.5 MILES	Drawn By:MTM



North Rasmussen Ridge Mine EIS Project

FIGURE 4.3-15
MODEL RESULTS SHOWING CONCENTRATIONS OVER TIME, BASED ON THE SYNTHETIC LINER CAP

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Drawing File: 1164 CON CON.dwg
Scale: NTS	Drawn By: ETC

Source: Whetstone 2002

4.3.2 Irreversible and Irretrievable Commitment of Resources

Irreversible impacts to water resources from the Proposed Action would include capture of surface water runoff and shallow alluvial groundwater by the partially backfilled panel, and changes in groundwater level in the Wells Formation.

Flow in Reese Canyon Creek, No Name Creek and West Fork of Sheep Creek drainages would be decreased by capture of surface water runoff by the partially backfilled pit. Runoff into Reese Canyon Creek above the Little Blackfoot River would decrease by 4 percent. Runoff into No Name Creek above its intermittent western tributary would decrease by 3 percent, and runoff into West Fork of Sheep Creek above the confluence with Sheep Creek would decrease by 37 percent. This would be an irreversible commitment of water resources, as surface water runoff would be converted to infiltration to groundwater.

Groundwater flow in intermittently saturated alluvium would be intercepted by the mine pits. Alluvial groundwater flow in Reese Canyon above the confluence with the Little Blackfoot River would decrease by about 31 percent. Alluvial groundwater flow in No Name Creek would decrease by about 10 percent, and alluvial groundwater flow in West Fork of Sheep Creek would decrease by 37 percent.

Capture of surface water runoff and alluvial groundwater by the mine pits would reduce the amount of water available to wetland areas and springs in Reese Canyon and West Fork of Sheep Creek.

Recharge to the Wells Formation would be increased by the capture of surface water and shallow alluvial groundwater by the partially backfilled pit. Deep groundwater levels would increase by about 15 feet in the area of the mine.

4.3.3 Residual Impacts

Overburden placed as backfill in the pit panels would continue to leach metals into the environment. The leachate would affect water quality in the Wells Formation regional aquifer and, to a lesser extent, in the alluvium and Rex Chert. Changes to groundwater quality in the Wells Formation aquifer would include increased total dissolved solids concentration, primarily in the form of manganese, antimony, and sulfate. Over an unknown period of time, concentrations of metals in seepage from the backfill would decline toward a steady-state water chemistry.

4.3.4 Mitigation Summary

Project design features, BMPs, and the proposed Reclamation Plan (see Chapter 2) are the elements of the Proposed Action designed to reduce environmental impacts to water resources. No mitigation measures have been identified to reduce anticipated impacts.

4.4 WATERSHED AND SOILS

4.4.1 Direct and Indirect Impacts on Soils

Impacts to soil resources would occur from physical and chemical changes during mining when salvaged soil is mixed, stockpiled, and stabilized in the growth media storage area. Other direct impacts would occur from residual loss of soil as a result of excavation, movement to stockpiles, redistribution on the backfilled areas, and completion of reclamation. Soil erosion and handling would have potential effects on soil fertility and final success of revegetation. Agrium anticipates salvaging 1,015,716 cu yd of growth media to provide 2 to 3 feet of cover for revegetation.

4.4.1.1 Proposed Action

Physical Impacts

The Proposed Action would result in 269 acres of disturbance, of which 197 acres would be reclaimed. Direct impacts to soil from the Proposed Action would include changes in the physical and chemical characteristics to the parent soil, including mobilization of selenium and some loss to wind and water erosion. Another direct effect of the Proposed Action would be erosion of the growth media after it is redistributed during reclamation. Until the soil is stabilized by successful vegetative growth, wind and water erosion would have greater potential. When revegetation is successful, erosion potential would be substantially reduced.

Mixing the salvaged topsoil and growth media material during recovery and replacement changes the characteristics of the parent soil. Soil forms over time, so that it is not feasible to return disturbed land to previous conditions through reclamation. Despite the loss of characteristics in the parent soil, a suitable growth media base could be placed to create successful seedbed for vegetation establishment. The soil types that would be suitable for use as growth media are presented in **Table 3.4-1**. Direct impacts to soil resources also include compaction of the growth media by equipment during salvage, stockpiling, and replacement. Effects from topsoil compaction include reduced permeability, decreased available water holding capacity, and loss of soil structure.

Salvaging topsoil during open-pit mining operations would remove vegetative cover and disturb soil structure. Conditions that would be present during soil salvage and that would make the potential for water erosion high are soil surface conditions, steep slopes, and the potential for heavy thunderstorms in the summer. Soil loss through water erosion would have the greatest potential to occur during soil salvaging, while a cover crop is established on growth media stockpiles, and during the period between redistribution of the growth media and successful revegetation. Soil losses caused by water erosion would be controlled and reduced with timely establishment of vegetative cover on stockpiles of the growth media and implementation of BMPs and concurrent reclamation practices outlined in the North Rasmussen Ridge Mine and Reclamation Plan.

Wind erosion hazard of stockpiled topsoil is expected to be low given that there are only two soil complexes that exhibit a high wind erosion potential (WEG of 3). These soil types are C and D, which are alluvial soils found on stream terraces and flood plains in all three creeks in the disturbance area. No D complex soils would be disturbed by any project activities. Timely revegetation of reclaimed disturbed areas concurrent with salvage would reduce the potential for soil erosion by improving vegetative ground cover while mining operations continue on to subsequent areas.

The expected relative amount of erosion would be a function of the total area disturbed at any time and the length of time of the disturbance. Based on Agrium's mine sequence for Panels A and B and the plan to reclaim disturbed areas through concurrent backfill and salvage, 30 acres of land would be disturbed by construction of the mine pit at any time during the mine sequence. Backfill slopes would be shaped under the Proposed Action to a final 3.0h:1.0v slope, reducing steep areas and thus decreasing erosion potential caused by steep slopes. At closure, all erosion from the unreclaimed pit walls would reside on the pit floor.

Biological Impacts

Biological and chemical modifications to the soil would occur when topsoil mixes with subsoil during salvage and stockpiling, thereby changing the physical and chemical characteristics and soil productivity of what would eventually serve as the growth media during reclamation. Potential soil productivity of the stockpiled growth media would be affected by mixing of the topsoil and subsoil during salvage and movement to the temporary growth media storage area. Mixing of topsoil and subsoil would be minimized by direct placement of these materials on reclaimed areas. Minimizing mixing enhances the success rate of residual native seeds and rhizomes. These biological elements along with bacterial and fungal strands would be destroyed by prolonged storage. Total loss of productivity would occur in the 72 acres of pit walls that are not reclaimed.

Chemical Impacts and Mobilization of Selenium

Soil structure would be altered during salvaging and redistribution, which could oxidize selenium in the soil and mobilize it in the surface environment. Mobilization would result in increased availability of selenium and other trace metal elements for uptake by vegetation. The availability of selenium for plant uptake would depend on the presence or absence of soluble forms of selenium. Increased amounts of soluble selenium in the growth media could increase the selenium content of vegetation on reclaimed areas. During salvage and redistribution, selenium in subsurface soil can be exposed to the environment, increasing the potential for oxidation processes that increase the amount of soluble selenium. Soluble selenium in the growth media is mobile and subject to bioaccumulation in plants and leaching out of the growth media to surface run-off or infiltration (BLM 2001). The effects of concentrations of soluble selenium on vegetation, livestock, fisheries, and other wildlife are described in more detail in Sections 4.5, 4.6, 4.7, and 4.9.

Indirect chemical impacts caused by disturbance of soil from the Proposed Action include changes in water quality as a result of sedimentation from the erosion of exposed slopes.

Physical and chemical changes caused by disturbance to the soil structure, soil loss, reduced fertility, and reduced biological functions could result in decreased productivity of vegetative cover. The implementation of BMPs, as discussed in the North Rasmussen Ridge Supplemental Mine and Reclamation Plan (Agrium 2001), as well as concurrent salvage and backfilling and use of stockpiled topsoil, would minimize the indirect impacts to other resources from erosion and changes in characteristics of the soil. The BMPs would minimize erosion and minimize soil loss from the site thereby retaining the chemical and biological components of the soils on site, even if in a disturbed state.

4.4.1.2 Alternative 1 - Proposed Action with Impermeable Capping of Backfilled Area

The direct and indirect impacts under Alternative 1 would be similar to the Proposed Action except for the number of acres of soil disturbed. However, Alternative 1 would involve construction of a layer of impermeable material, clay or synthetic, between the seleniferous waste rock and the applied growth media. This impermeable layer would limit or reduce the potential effects of water that infiltrates into the backfill. Both types of impermeable cap would require a layer of screened limestone below the growth media to act as a natural drain for run-off water from the pit backfill area. Additional disturbance likely would be required under Alternative 1 for a surface mining operation and mine roads needed to supply clay material for the impermeable cap. The acreage affected by this new disturbance has not been quantified, but likely would be about 25 acres. Use of clay for the impermeable cap would require mining clay from land privately owned by Agrium. Use of a synthetic material for the impermeable cap would increase the cost of implementing Alternative 1 substantially; however, an external clay mine would not be required. A clay layer is estimated to cost approximately $9.5 million more than the Proposed Action, and a synthetic layer approximately $20.7 million more than the Proposed Action.

Construction of this impermeable layer would require shallower backfill slopes than the proposed 3.0h:1.0v slope to avoid slope failure. This layer therefore would require an external waste rock dump outside of the pit perimeter to contain the extra volume of waste rock that could not be backfilled. The total area of disturbance outside the perimeter of the pit for the external waste rock dump would increase by 26 acres. Land for the external overburden dump would likely include forested lands and other habitats, both on and off the leases. Additional miscellaneous operations required for the external waste rock dumps would include purchase of timber, pre-stripping and hauling of slash and growth media, and water management and silt retention structures for erosion control. Additional impacts to soil and watershed resources would occur as a result of these miscellaneous operations. The general direct impacts to soils and watershed resources would include increased erosion potential caused by removal of vegetation, loss of soil from increased movement of growth media and slash, and some damage to the structure of the soil from construction of the silt retention structures (although the structures themselves would substantially mitigate potential loss of soil). Indirect impacts would include potential sedimentation in various streams within the watersheds.

4.4.1.3 Alternative 2 – No Action

The No Action Alternative would preclude mining in the North Rasmussen Ridge area. The No Action Alternative would involve continued mining at the Central Rasmussen Ridge mine until all ore was recovered. Approximately 231 acres would ultimately be disturbed, with 196 acres, or 85 percent of the disturbed area, reclaimed after ore recovery is complete. The final 35 acre portion of the Central Rasmussen Ridge Mine pit would not be backfilled, but would remain in an unreclaimed state as per the approved mine plan. The open pit would lead to potential direct effects to soils and watershed resources in the project area from wind and water erosion.

4.4.2 Direct and Indirect Impacts on Watersheds

Impacts to watersheds would occur from the project through disturbance to soils and vegetation and alterations to topography. Other factors could also affect watershed conditions including wildfire, fire suppression, fishing, livestock grazing, road construction, and timber harvesting.

4.4.2.1 Proposed Action

Disturbances from the Proposed Action would affect the vegetative community and the erosion process on the site, and the hydrology and water quality of receiving streams. Hillslope erosion has been the major erosion force in the area watersheds (Maxim 2002e). Sediment produced by erosion has already indirectly influenced stream channel condition and water quality via increased erosive force and channel deposition in the Angus Creek and Sheep Creek subwatersheds where the project is located. Since 1982, stormwater control measures (BMPs) at mines in the subwatersheds have been implemented to minimize the impacts of erosion. Mining impacts have been minimal in the Sheep Creek drainage (Maxim 2002e). Potential impacts from the Proposed Action on the Angus Creek and Sheep Creek subwatersheds are expected to be minimal in that the Proposed Action only would disturb approximately 1.4 percent of the area in the two watersheds.

4.4.2.2 Alternative 1 – Proposed Action with Impermeable Capping of Backfilled Area

The direct and indirect impacts under Alternative 1 would be similar to the Proposed Action except for the amount of disturbed area. Alternative 1, using a compacted clay layer for the low-permeability cap, would disturb additional area for an external waste rock dump (26 acres) and a clay quarry (25 acres). If a synthetic membrane is used, the alternative would only disturb the 26 acres for the external waste rock dump. In both cases, all areas would be reclaimed except for the pit walls. The additional disturbance proposed for Alternative 1 would occur in the Angus Creek subwatershed, which is considered the most heavily affected subwatershed in the study area (Maxim 2002e).

4.4.2.3 Alternative 2 – No Action

The No Action Alternative would preclude disturbance of the vegetation community and soils on North Rasmussen Ridge and minimize future effects on the Sheep Creek and Angus Creek subwatersheds. However, mining would continue at the Central Rasmussen Ridge Mine until ore was exhausted. The final portion of the Central Rasmussen Ridge pit would not be backfilled and could contribute to wind and water erosion of soils and exposure and oxidation of selenium sources from the pit wall that may increase the available soluble sources of selenium for plant uptake. Potential indirect impact would include increased sedimentation in the No Name Creek drainage that is tributary to Sheep Creek and may increase the potential for selenium exposure to plants and animals in the subwatershed.

4.4.3 Irreversible and Irretrievable Commitment of Resources

Soil loss caused by natural erosion or compaction induced by mining would be irretrievable and irreversible. Approximately 72 acres of land associated with the pit walls in Panel B would not be reclaimed under both the Proposed Action and Alternative 1. Soils from the 72 acres would be salvaged and spread on other areas during reclamation. New man-made features, such as the North Rasmussen Ridge Mine pits, or surficial deposits (pit backfill areas, waste rock dumps and growth media storage areas) created during mining and modified during reclamation, would be irreversible and irretrievable engineered features at the conclusion of project activities under the Proposed Action.

Loss of soil fertility and reduced biological function, vegetative productivity, and land use potential would be irretrievable but not irreversible. It is generally thought that microorganisms will naturally reestablish themselves in salvaged and replaced growth media. The time required for soil reestablishment depends upon a number of factors: physical and chemical characteristics and water dynamics of the growth media, the manner in which topsoil salvage and storage was handled during mining, the rate of vegetation establishment, and the rate of natural inoculation of the growth media (BLM and Forest Service 2002).

Soils will be salvaged from all soil complexes on site, except for wetland soils. Soils would be salvaged from depths ranging from 9 to 60 inches. The soils would be collected by bulldozer, loaded into trucks, and transported to the growth media storage area. Approximately 1,015,716 cu yd would be salvaged. The growth media would be sufficient to cover all reclaimed areas with 2 to 3 feet of cover for revegetation.

No irretrievable or irreversible commitment of watershed resources has been identified for the Proposed Action.

Under Alternative 1, the extraction of clay or limestone for use in constructing the impermeable cap would be irreversible and irretrievable.

4.4.4 Residual Impacts

Loss of soil or interruption of natural soil development, decreased permeability, decreased available water holding capacity, breakdown of soil structure, and loss of organic matter content would be reversed over an undetermined amount of time by renewal of natural development after soil has been redistributed and reclaimed. The potential exposure of seleniferous materials in waste rock could have residual impacts on the topsoil growth media; however, BMPs identified in the North Rasmussen Ridge Supplemental Mine and Reclamation Plan (Agrium 2001) would substantially reduce the impacts.

The residual impacts under Alternative 1 would be similar to the Proposed Action, with the following exceptions. Placement of an impermeable cap would greatly reduce exposure of meteoric water to ore and waste shale zones that contain potentially seleniferous materials. This procedure would further limit the residual impacts associated with exposure of water to seleniferous materials to less than the impacts anticipated under the Proposed Action.

No additional residual adverse effects for watershed resources have been identified for the No Action Alternative.

4.4.5 Mitigation Summary

Project design features, BMPs, and the Proposed Reclamation Plan (see Chapter 2) are the elements of the Proposed Action designed to reduce environmental impacts to soils and watersheds.

The following mitigation measures are proposed to reduce impacts. Mixing soils of high fragment content with soils of fewer fragments would dilute coarse fragments and maximize vegetative growth. Timing soil salvage operations to coincide with direct placement on areas to be reclaimed would also maximize the potential for soil production and reduce soil loss.

4.5 VEGETATION, RIPARIAN AREAS, AND WETLANDS

Under the Proposed Action, center waste shales containing elevated concentrations of selenium would be selectively placed in middle and deep areas of the open pit. This material would then be covered with 8 to 10 feet of non-seleniferous limestone and chert overburden to reduce the potential for selenium uptake by deep-rooted vegetation. Impacts from establishment of noxious weeds may result from ground disturbance. Ecotoxicological impacts to native and planted vegetation are considered minor based on the high toxicological thresholds and planned BMP actions.

4.5.1 Direct and Indirect Impacts

4.5.1.1 Proposed Action

Vegetation types and associated acreages affected by the Proposed Action are summarized in **Table 4.5-1**. This table is based on information from the baseline vegetation study (Maxim 2001c).

Under the Proposed Action, all disturbed areas that are amenable would be reclaimed. Vegetation would be re-established by the first growing season following cessation of mining to reduce the exposure time of bare, unvegetated surfaces to potential erosion and the effects of the surrounding environment. Of the 269 acres disturbed under the Proposed Action, 197 acres, or 73 percent of the total disturbed area, would be reclaimed.

TABLE 4.5-1
VEGETATION TYPES AND ESTIMATED AFFECTED ACREAGES UNDER THE PROPOSED ACTION

Vegetation Types	Affected Acres
Aspen	0
Conifer	68.6
Mixed Aspen Conifer	192.5
Sagebrush	8.1
TOTAL	**269.2**

According to the proposed reclamation plan, disturbed areas would be reclaimed using a USFS-approved seed mixture primarily made up of grasses. Some shrubs and trees would also be planted in backfill areas in the pit. Reclaimed areas would represent a shift in the composition of the plant community from conifer, aspen/conifer mix, and sagebrush communities to a plant community dominated by perennial grasses.

Under the Proposed Action, potentially seleniferous material would be selectively placed in the middle and deep layers of the open pit. Potentially seleniferous material includes center waste shale and the hanging wall and footwall mud. Eight to ten feet of non-seleniferous limestone and chert overburden would then be used to cover the seleniferous material. The chert and limestone would serve as a barrier to limit the potential for selenium uptake by plants. An average of 2 to 3 feet of growth media would be placed on top of the overburden layer to facilitate establishment of vegetation. Selenium uptake by plant species used in reclamation, as well as any that become naturally established later, is not likely to cause adverse effects to plant populations. However, it may pose a problem to herbivorous wildlife, cattle and sheep if selenium indicator or bioaccumulator plants begin to thrive on uncovered or insufficiently covered seleniferous waste rock materials (Section 4.6).

The placement of growth media on top of the limestone and chert overburden has been used to reclaim several areas at the south and central areas of Rasmussen Ridge Mine. Three studies have been undertaken at the Rasmussen Ridge Mine to document uptake of selenium by vegetation growing on reclaimed waste rock dumps. In 1999, TRC collected 24 vegetation samples from the slopes of the reclaimed South Rasmussen Dump (TRC 1999). In 1999, Maxim collected five samples from the top of this same waste rock dump. This dump was revegetated in 1995 and 1996. Selenium values in vegetation samples ranged from less than 0.5 to 2.9 milligrams selenium per dry weight kilogram of vegetation (mg/kg), with a mean value of 1.3 mg/kg and a median value of 1.1 mg/kg. Three vegetation samples taken from run of mine waste rock had selenium concentrations that exceeded 2.0 mg/kg, but concentrations of total selenium in all three of these samples were below 5.0 mg/kg.

In 2001, Greystone collected 22 vegetation samples from the North Dump, that was comprised only of limestone and chert, and reclaimed in 1998 and 1999. Concentrations of selenium in vegetation samples ranged from 0.43 mg/kg to 3.00 mg/kg and all vegetation samples contained less than 5.0 mg/kg selenium dry weight (Greystone 2002).

The BLM and the USFS have established interim guidelines for levels of selenium in vegetation growing on reclaimed sites. According to the interim standards, the following conditions must be met:

- Fifty percent of vegetation measured over the surface of the reclaimed mine area must contain concentrations of selenium less than 5 mg/kg dry weight.

- Forty-five percent of vegetation measured over the surface of the reclaimed mine area may contain selenium at concentrations ranging between 5 mg/kg and 10 mg/kg dry weight.

- No more than 5 percent of vegetation measured over the surface of the reclaimed mine area may contain concentrations of selenium greater than 10 mg/kg dry weight, and no more than 0.5 percent of the vegetation measured over the surface of the reclaimed area can exceed 20 mg/kg selenium dry weight.

The results of the previous analyses of vegetation indicate that both the reclaimed North Dump and the South Rasmussen backfill meet all of these vegetation standards. A number of studies at the Rasmussen Ridge Mine have documented uptake of selenium by vegetation growing on reclaimed waste rock dumps. Data are available for selenium levels in soil and vegetation samples collected from the South Rasmussen backfill and North Dump. The results of these studies are summarized in **Table 4.5-2**.

TABLE 4.5-2
CONCENTRATIONS OF SELENIUM IN SOIL AND VEGETATION IN SAMPLES COLLECTED FROM THE RECLAIMED NORTH DUMP AND SOUTH RASMUSSEN BACKFILL

Sample ID	Total Se in Soil (mg/kg)	Extractable Se in Soil (mg/kg)	Corresponding Veg Sample(s) ID	Total Se in Veg (mg/kg)	Vegetation Species
South Rasmussen Backfill					
1	2.0	<0.001	1	0.2	Orchardgrass
2	<1.0	0.016	2	1.0	Alfalfa
3	<5.0	0.017	3	<1.0	Timothy
4	1.0	0.021	4	<1.0	Thickspike wheatgrass
5	<1.0	0.021	5	<1.0	Alfalfa
North Dump					
SS-1	2.31	0.02	VS-1A	1.32	Perennial bunchgrass
SS-1	2.31	0.02	VS-1B	1.50	Annual forb
SS-2	2.41	0.02	VS-2A	0.68	Perennial bunchgrass
SS-2	2.41	0.02	VS-2B	0.56	Sagebrush
SS-3	2.73	0.01	VS-3	0.43	Perennial bunchgrass
SS-4	2.10	0.01	VS-4	0.53	Perennial bunchgrass
SS-5	1.63	0.01	VS-5	0.51	Perennial bunchgrass
SS-6	2.55	0.01	VS-6	0.46	Perennial bunchgrass
SS-7	2.25	0.01	VS-7A	0.51	Perennial bunchgrass
SS-7	2.25	0.01	VS-7B	0.54	Sagebrush
SS-8	2.95	0.01	VS-8A	0.67	Perennial bunchgrass
SS-8	2.95	0.01	VS-8B	1.85	Sagebrush
SS-9	2.53	0.03	VS-9	3.00	Perennial bunchgrass
SS-10	1.85	0.01	VS-10	0.53	Perennial bunchgrass
SS-11	1.82	0.01	VS-11A	0.78	Perennial bunchgrass
SS-11	1.82	0.01	VS-11B	1.34	Annual forb
SS-12	3.45	0.03	VS-12	1.12	Perennial bunchgrass
SS-13A	1.52	0.02	VS-13A	0.57	Perennial bunchgrass

TABLE 4.5-2 (CONT.)
CONCENTRATIONS OF SELENIUM IN SOIL AND VEGETATION IN SAMPLES COLLECTED FROM THE RECLAIMED NORTH DUMP AND SOUTH RASMUSSEN BACKFILL

Sample ID	Total Se in Soil (mg/kg)	Extractable Se in Soil (mg/kg)	Corresponding Veg Sample(s) ID	Total Se in Veg (mg/kg)	Vegetation Species
SS-13B	1.70	0.01	VS-13B	0.55	Alfalfa
SS-14A	2.70	0.02	VS-14A	0.87	Perennial bunchgrass
SS-14B	1.52	0.03	VS-14B	1.20	Alfalfa
SS-15	3.98	0.02	VS-15	0.74	Smooth brome
South Rasmussen Backfill					
			V-1	0.5	Intermediate wheatgrass
			V-2	1.7	Intermediate wheatgrass
			V-3	1.3	Intermediate wheatgrass
			V-4	<0.5	Intermediate wheatgrass
			V-5	<0.5	Orchard grass
			V-6	<0.5	Orchard grass
			V-7	0.8	Intermediate wheatgrass
			V-8	0.7	Intermediate wheatgrass
			V-9	1.1	Intermediate wheatgrass
			V-10	1.1	Intermediate wheatgrass
			V-11	1.0	Intermediate wheatgrass
			V-12	0.6	Intermediate wheatgrass
			V-13	1.8	Intermediate wheatgrass
			V-14	1.9	Intermediate wheatgrass
			V-15	2.6	Intermediate wheatgrass
			V-16	1.0	Intermediate wheatgrass
			V-17	1.5	Intermediate wheatgrass
			V-18	1.6	Intermediate wheatgrass
			V-19	2.6	Intermediate wheatgrass

TABLE 4.5-2 (CONT.)
CONCENTRATIONS OF SELENIUM IN SOIL AND VEGETATION IN SAMPLES COLLECTED FROM THE RECLAIMED NORTH DUMP AND SOUTH RASMUSSEN BACKFILL

Sample ID	Total Se in Soil (mg/kg)	Extractable Se in Soil (mg/kg)	Corresponding Veg Sample(s) ID	Total Se in Veg (mg/kg)	Vegetation Species
			V-20	<0.5	Intermediate wheatgrass
			V-21	0.9	Intermediate wheatgrass
			V-22	2.9	Intermediate wheatgrass
			V-23	1.1	Intermediate wheatgrass
			V-24	1.8	Intermediate wheatgrass

SS = soil sample
VS or V = vegetation sample

The results of these studies indicate that topsoil materials used for reclamation of both the South Rasmussen Backfill and North Dump are generally considered marginally suitable for use in reclamation based on their concentrations of total selenium. In all but three samples, total selenium levels in soil samples are below the draft USFS guideline of 5.0 mg/kg. Soil is considered suitable for use in reclamation based on concentrations of extractable selenium. Concentrations of extractable selenium in all soil samples were below 0.1 mg/kg. In spite of the marginal concentrations of total selenium, vegetation samples contained less than 5 mg selenium/kg dry weight vegetation. The results of the previous vegetation analyses indicate that both reclaimed areas meet all of the USFS Draft Guidelines.

Under the Proposed Action, a grass seed mixture has been developed to encourage uptake of water from the upper soil horizon and minimize rooting depths. The majority of the rooting mass for the selected grass species would occur within the top 3 feet of soil. The majority of roots would therefore be present in the layer of growth media, with potentially seleniferous materials located at greater depths. Native trees and shrubs would also be planted as part of the reclamation program. The rooting depths for these species are greater than the grass to be used in the reclamation seed mixture. A number of deep-rooting native species currently present in the study area could also become established in reclaimed areas as a result of natural succession processes. These species and reported maximum rooting depths are summarized in **Table 4.5-3.**

TABLE 4.5-3
MAXIMUM ROOTING DEPTHS REPORTED FOR TREES PRESENT IN STUDY AREA [1]

Species	Maximum Rooting Depths Reported (feet)
Subalpine fir	>13
Lodgepole pine	>10.8
Douglas-fir	32.8
Quaking aspen	>9.8

[1] BLM and USFS 2002

As shown in **Table 4.5-3**, the rooting depths reported for Douglas-fir and subalpine fir exceed 13 feet (8 to 10 feet overburden plus 2 to 3 feet of growth media). However, the majority of root mass for shrubs and trees is expected to occur between the surface and 13 feet below the ground surface. Therefore, the risk of selenium accumulation in future shrub or forest communities would be low.

The proposed seed mixture is mostly grass species and indicates that grasses are likely to dominate the reclaimed area for several decades after planting. Wyoming big sagebrush also could invade the replanted areas and dominate the sites in 20 to 50 years. Sagebrush transpires much less water than do grasses, as they have a leaf area index that is less than one-quarter that which was used in the infiltration modeling. This would mean that substantially more water would infiltrate in the 30 to 100-year time frame than is currently predicted by infiltration modeling. Given the level of uncertainty in the predictive modeling, the difference in infiltration is not expected to dramatically affect the fate and transport of COPCs into the groundwater.

Most of the merchantable timber that exists in the North Rasmussen Ridge areas was logged in the 1980s. Plant communities with timber resources include conifer and mixed aspen/conifer vegetation types. Under the Draft Forest Plan for the Caribou Targhee National Forest (USFS 2001), the lease area is designated as a forest restoration prescription. Areas under this designation contribute to the Allowable Sale Quantity and are consequently considered a potential timber resource. However, the study area is not considered a cost-effective timber producing area (an area with high potential for production of wood fiber), and therefore has not received a “timber management area” prescription. The baseline survey characterized the conifer forest as having a relatively open canopy and numerous downed trees, which indicates that timber resources in the study area are likely of limited quality and quantity.

Noxious Weeds

The removal of native vegetation would increase the potential for expansion of non-native plants, including noxious weeds. Non-native plants colonize disturbed areas and, once established, may reduce the diversity in native plant communities. Several species of noxious weeds have already become established within the mining lease area, including Canada thistle and yellow toadflax. Known occurrences of Canada thistle and yellow toadflax, along with other noxious weeds, are

currently monitored and chemically treated, as required, on an annual basis at the Rasmussen Ridge Mine.

Wetlands

Wetlands located along No Name Creek, Sheep Creek, and Reese Canyon Creek are all outside of the proposed disturbance footprints and are, therefore, not expected to be disturbed by mining. Any sediment loading carried by surface water runoff may create the possibility that selenium would reach the wetlands. Selenium tends to accumulate more in still-water environments, such as wetlands and around beaver dams as a result of changes in reduction-oxidation potential, acid-base potential changes, and reduced oxygen levels. Wetland vegetation and aquatic and terrestrial wildlife that use wetland habitat could thus be exposed to selenium. Under the Proposed Action, the open pit or East Haul Road would intersect small portions of the Reese Canyon Creek and No Name Creek drainages. Culverts would be placed to maintain flow in these drainages. Culverts would be installed during the dry season and no wetlands would be affected. Flow after culverts are installed is expected to maintain wetland hydrology below the disturbance. A wetlands function and values assessment characterized the Sheep Creek and Reese Canyon wetlands as important for groundwater discharge and recharge. The Proposed Action would not disturb any wetlands and, through the use of culverts, is not expected to adversely affect any wetlands functions. Some minor reductions in flow to these wetlands would occur as a result of runoff being retained by the pits and sediment control structures.

4.5.1.2 Alternative 1 – Proposed Action with Impermeable Capping of Backfilled Area

Alternative 1 would affect 320 acres. Alternative 1 would result in a larger disturbance footprint than the Proposed Action because a 4:1 slope would be used to construct the cap, thus reducing the storage capacity and requiring construction of an external dump. The total disturbance of the external dump would be an additional 26 acres and 25 acres for a clay quarry. Plant communities affected by Alternative 1 would primarily include aspen/conifer and conifer forest. A small portion of sagebrush would also be affected under Alternative 1. Construction of the waste rock storage facility would also require additional permitting and reclamation efforts.

Similar to the Proposed Action, Alternative 1 would use selective placement of potentially seleniferous material. In addition to selective placement of material, Alternative 1 also includes construction of an impermeable cap. The potential for plant roots to encroach on seleniferous materials would be reduced by construction of an engineered layer. The impermeable cap would also reduce the potential for water to infiltrate the seleniferous material and thus minimize leaching of selenium through the soil column into underlying groundwater. Therefore, the cap would limit the potential for uptake of selenium by plants. Deep rooting Douglas-fir would not be planted under this alternative.

4.5.1.3 Alternative 2 – No Action

Alternative 2, No Action, would result in no additional impacts in the study area. The No Action alternative would preclude mining and any associated disturbance at North Rasmussen Ridge.

Mining would continue at Central Rasmussen Ridge until all ore is removed. According to the approved mine plan for Central Rasmussen Ridge, 35 acres would not be reclaimed because material would not be available to backfill a portion of the Central Rasmussen Ridge open pit. There would not be any impacts from selenium contamination associated with this alternative relative to the Proposed Action. However, the unreclaimed acreage at the Central Rasmussen Ridge mine could contribute selenium to the environment and affect vegetation. Under this alternative, the Central Rasmussen Ridge Mine and Reclamation Plan would be modified to address potential environmental effects from closure without complete backfill.

4.5.2 Irreversible and Irretrievable Commitment of Resources

Approximately 72 acres of vegetation would be lost permanently under the Proposed Action. Permanent loss of vegetation would occur in areas of pit disturbance that would not be reclaimed when the mine closes. The majority of permanent loss of vegetation would occur in existing mixed aspen/conifer forest. The loss of timber within the project area and for the haul road would be an irreversible commitment of resources because of the long period required for regeneration of this type of forest. Even with planting and natural succession, it is expected that these forests would require 100 to 200 years to recover to their current structure and level of complexity.

There is not likely to be irreversible or irretrievable commitment of resources as a result of selenium impacts on vegetation. Native vegetation that would remain within the project area and adjacent to the project area probably has a relatively high toxicological threshold for selenium because of local adaptation. A study showed vegetation sampled near a seep contained an order of magnitude more selenium than vegetation sampled 160 meters from the seep, suggesting some selenium immobilization may have occurred along the flow path (Mackowiak et al 2002). No studies in the literature based on field data provide evidence of selenium toxicity thresholds for plants (Skorupa 1998). Reclamation of mined areas would cover seleniferous waste rock materials, thus preventing exposure to planted native and non-native grasses.

4.5.3 Residual Impacts

A residual adverse impact would occur if existing forests were not eventually replaced through reclamation and subsequent natural succession.

4.5.4 Mitigation Summary

Project design features, BMPs, and the proposed Reclamation Plan (see Chapter 2) are the elements of the Proposed Action designed to reduce environmental impacts to upland vegetation, riparian areas, and wetlands. Additional mitigation measures are not deemed necessary.

4.6 TERRESTRIAL WILDLIFE

The Proposed Action would disturb wildlife habitat during construction and mine operations. Potential effects to wildlife would also include habitat loss and potential effects from exposure to

selenium. The majority of habitat affected would be restored to habitat that would be dominated by perennial grasses with limited trees and shrubs.

4.6.1 Direct and Indirect Impacts

4.6.1.1 Proposed Action

The Proposed Action would result in the permanent loss of wildlife habitat as well as a shift in the composition of plant communities. The Proposed Action would result in the temporary loss of 269 acres of wildlife habitat (192 acres of mixed aspen/conifer, 69 acres of conifer, and 8 acres of sagebrush/grassland). Within the project area, this represents a loss of 37 percent of mixed aspen/conifer, 16 percent of conifer, and 3 percent sagebrush habitat. No aspen or riparian habitat would be lost under the Proposed Action. Following reclamation, the Proposed Action would result in the permanent loss of 72 acres (27 percent) of wildlife habitat. Permanent habitat loss would result from mainly rock highwalls. Approximately 197 acres of wildlife habitat would be reclaimed under the Proposed Action. The majority of permanent habitat lost would include mixed aspen/conifer and conifer forest. Reclamation would result in a shift in the composition of the plant community from aspen, conifer, and sagebrush to communities dominated by perennial grasses.

Mammals

Big Game

Habitats located adjacent to and within the project area may experience a reduction in usage during mine operations. However, some individuals may also show some habituation to mine activities and would continue to use these areas. Construction and use of haul roads would result in increased traffic and would improve access to North Rasmussen Ridge. Traffic would not likely result in any increase in wildlife mortalities and injuries, because wildlife usage of this area may already be reduced in response to current mining activities associated with Central Rasmussen Ridge. Studies (Thomas et al. 1979, Lyon 1983) have also shown that increased densities of open roads and increased human activity reduce the effectiveness of elk habitat. No new public access roads would be constructed.

Based on previous revegetation efforts, the forage production on reclaimed lands would increase from the current range of 400 pounds to 800 pounds of usable forage per acre dry weight to between 1,200 to 1,600 pounds dry weight per acre. An increase in grass productivity would be beneficial to elk, which tend to prefer grass forage. However, loss of shrub habitat would reduce the quality of deer habitat.

The Proposed Action is not expected to directly affect critical winter deer or elk range. No critical winter deer or elk habitat is located within the study area. Critical winter deer and elk habitat is located just east of the proposed disturbance but would not be directly affected by the Proposed Action. Indirect effects on critical winter deer and elk habitat would be similar to existing conditions since vehicle and human activity associated with the Proposed Action would be similar to current levels. Although detailed records have not been kept, mine personnel report that two deer have been killed on the site in the last five years.

Collins (1991) reported that there were no known elk or deer migration routes in the Rasmussen Ridge area. However, the 1997 Central Rasmussen Ridge Mine Environmental Assessment (BLM 1997) noted that there was a known deer migration route that crossed the Central Rasmussen Ridge Mine area. This corridor extended from the Sheep Creek area to Soda Hills. In the case that deer found a migration route that may be affected by the North Rasmussen Ridge project, it is expected that deer may be further displaced and would have to find an alternative migration route between Sheep Creek and Soda Hills. During the winter months, this diversion could have a negative effect on energy reserves, although this effect is not expected to be a major one.

The Proposed Action would result in the loss of some moose foraging and cover habitat. No riparian areas that may be used as moose foraging habitat would be lost under the Proposed Action. However, approximately 261 acres of moose habitat (comprised of mixed aspen/conifer and conifer forest) would be lost under the Proposed Action. The loss of moose foraging and cover habitat would not be substantial due to the large home range of moose and the availability of other quality habitat outside of the project area.

Carnivores

The Proposed Action would result in the temporary and permanent loss of habitat for carnivores. Impacts to species that have large ranges, such as black bear, coyote, badger, bobcat, and mountain lion would likely be negligible due to habitat availability outside the project area. Local badger and weasel populations would be directly affected because of their smaller ranges and burrowing behavior. The Proposed Action may result in some mortalities or displacement of carnivores due to increased activity associated with construction and mining. No indirect effects resulting from loss of prey base are expected based on the availability of prey within and outside the project area. Prey populations would also recover quickly following cessation of mining operations.

Bats

Bats are sensitive to impacts, including effects associated with new mining disturbances. It is expected that the Proposed Action would have minor effects on local bat populations. Conversion of some forest habitat to grasslands would represent a loss of foraging and roosting habitat. However, this habitat loss would not be critical due to the availability of foraging and roosting habitat within and outside the project area. Noise and vibration from blasting may also have indirect effects on bats using the area.

Raptors

Raptors that occur in the study area would be directly and indirectly affected by the Proposed Action. Direct disturbances would include loss of foraging habitat, temporary reduction in prey base, and loss of historical nesting territory. The Proposed Action would initially reduce habitat for a number of prey species, including mice, voles, ground squirrels, and rabbits. However, additional foraging habitat exists within and adjacent to the project area. Based on prey availability within and adjacent to the project area, effects of the Proposed Action on raptors would not affect population liabilities and would therefore not be critical. Prey populations would also recover quickly following cessation of mining operations. Some raptor mortalities

may occur from raptor/vehicle collisions when raptors feed on road kill, especially during periods of high vehicle activity such as the construction period.

Upland Game Birds

Two upland game birds, the blue grouse and ruffed grouse, were observed during baseline studies. Habitat for the blue grouse and ruffed grouse would be disturbed under the Proposed Action. Habitat for the blue grouse in the study area includes conifer forest, mixed aspen/conifer forest, and mixed shrub. Ruffed grouse habitat in the study area includes aspen and mixed aspen/conifer forests. Habitat lost would include approximately 37 percent of mixed aspen/conifer forest, 16 percent conifer forest, and 3 percent of sagebrush within the project area. Loss of habitat for the blue and ruffed grouse would be long-term since final reclamation would emphasize establishment of communities dominated by perennial grasses. However, this habitat loss would not likely affect blue grouse and sage grouse population viability due to the availability of additional habitat within and outside the project area.

Sage grouse and sharp-tailed grouse were not observed during baseline studies. Although they were not observed, baseline studies indicated that both species could occur in the study area. However, habitat for the sage grouse and sharp-tailed grouse is considered marginal to non-existent. Approximately 8.1 acres of mixed sagebrush/grasslands would be lost under the Proposed Action. Since the quality of this habitat was deemed marginal for sage and sharp-tailed grouse and since this represents only a six percent loss of habitat available within the project area, the effects of habitat loss are not expected to be critical. Rasmussen Valley west of Rasmussen Ridge has historically supported sage grouse strutting grounds, but these areas would not be affected by the Proposed Action.

Waterfowl

Direct and indirect effects to waterfowl under the Proposed Action would be limited. The Proposed Action would not result in the removal of any riparian or wetland habitat. Riparian areas and wetlands may be indirectly impacted by increased sedimentation and erosion during mine operations. However, indirect impacts to waterfowl habitat, including intermittent drainages and wetlands, are expected to be limited by implementation of BMPs and by restricting construction during periods of seasonal water flow. Creation of a pit lake at North Rasmussen is not expected under the Proposed Action.

Migratory Birds

Migratory birds use all habitat types within the project area. The Proposed Action would result in the temporary loss of 197 acres and the long-term loss of 72 acres of songbird habitat. Bird species associated with mixed aspen/conifer would be most affected. Potential direct effects associated with the Proposed Action would include direct mortality, forced movement, and stress related to increased noise and human activity. Loss of habitat could also result in a reduction of species diversity. Studies in Rocky Mountain forests have found, for example, that resident species are generally less abundant in recent clear-cut and undercut forests. Indirect effects include increased competition between displaced individuals and neighboring birds.

Amphibians and Reptiles

Surface disturbance activities associated with the Proposed Action would result in some mortalities and habitat loss to amphibians and reptiles. Construction of a new haul road could also increase mortalities and could isolate population segments. The isolation of population segments would be a short-term impact since the natural drainage would be restored following cessation of mine operations. Surface disturbances such as road embankments and the open pit would represent non-natural barriers that would restrict movement of amphibians and reptiles. Increased sediment loads that could affect amphibians and reptiles are not expected because BMPs would be implemented under the Proposed Action.

USFS Management Indicator Species

The USFS Caribou National Forest has identified three wildlife species as management indicator species (**Table 3.8-1**); potential impacts are discussed below:

- Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*)
- Sage grouse (*Centrocercus urophasianus*)
- Northern goshawk (*Accipiter gentilis*)

Suitable habitat for the Columbian sharp-tailed grouse exists downslope and somewhat near, but not within, the study area. No direct or indirect impacts to this species are anticipated. Potential impacts to Columbian sharp-tailed grouse are discussed in additional detail in Section 4.8.

Suitable habitat does not exist within or near the study area for the sage grouse. Although strolling grounds are located in the Rasmussen Valley, no strutting grounds are known to be present in the project area. No direct or indirect impacts to this species are anticipated from activities within the study area.

The northern goshawk occurs in the study area and may be affected through loss of foraging habitat. However, these effects would not likely be significant due to the large range of Northern goshawks and potential impacts to Northern goshawk are discussed in additional detail in Section 4.8 the availability of other foraging habitat within and outside the project area.

Selenium

An indirect effect, chronic selenium poisoning, may occur to carrion-feeders and predators (such as bobcat, mountain lion, coyote, and raptors) via bioaccumulation and biomagnification of selenium in animal tissues gained from contaminated forage or water. Impacts to terrestrial wildlife may occur via selenium uptake in plant forage if seleniferous mine waste rock is left exposed or is not covered with a layer of non-seleniferous topsoil during or after the life expectancy of the Proposed Action of 8 years. Big game species (mule deer, elk, and moose) are known to forage on vegetation in the project area, and black bear and badger are known to forage and dig in soil in the project area. Other species, including upland game birds, songbirds, small mammals, reptiles, and amphibians, can also be affected. These species might be susceptible to acute or chronic selenium poisoning if local populations spend a significant amount of time in

the project area. However, big game and black bear tend to range over large areas, and their behavior would tend to reduce risk of exposure and subsequent adverse impacts. The maximum tolerance level for selenium is estimated to be 2 milligrams selenium per kilogram of food for large mammals such as cattle, sheep, horses, and pigs (NRC 1980). Levels that exceed the maximum tolerance level can cause chronic selenium toxicity. The pooling of water in depressions above these seleniferous materials, if present, would allow ingestion of water and consuming vegetation and insects that grow in or inhabit the water. Mammals and birds may use downgradient seeps and springs as sources of drinking water in the fall, when some creeks are dry. Selenium poisoning has been confirmed in many salamanders at the Gay Mine at the Fort Hall Indian Reservation (Idaho) and the nearby Smoky Canyon Mine. Concentrations in some individuals are 10 to 100 times the normal level in animal tissue (USGS 2001a, 2001b). Selenium in exposed seleniferous waste rock can be leached through the soil to underlying alluvial water, the source of some seeps and springs. Concentrations of 0.5 milligrams selenium per liter of drinking water are considered toxic to large mammals such as cattle (Gough et al 1979). This potential effect is expected to be minor because of the low concentration of selenium in soils and plants on reclaimed areas (see sections 4.4 and 4.5).

The latest water quality sampling event for the potentially affected water bodies was in 2000 (Maxim 2001b). The concentrations of selenium that range from less than the practical quantitation limit of 0.001 to 0.004 mg/L are just below the state water quality standard for aquatic life of 0.005 mg/L. There is a potential for the concentrations of selenium to cause adverse impacts through bioaccumulation and biomagnification in the aquatic food chains. These impacts would occur to waterfowl that feed in or raise young in these water bodies. Based on the historical trend of increased phosphate mining of 1 to 2 percent per year (BLM and USFS 2002) and elevated levels of selenium in the Blackfoot River, concentrations of selenium in the surface waters and sediment of the Blackfoot River watershed could increase. However, BMPs and other controls implemented in recent years have led to reductions in impacts from sediment caused by mining and timber production (BLM and USFS 2002).

4.6.1.2 Alternative 1 – Proposed Action with Impermeable Capping of Backfilled Area

Alternative 1 would result in a larger disturbance footprint because a 4:1 slope would be used to construct the cap, thus reducing the storage capacity of the open pit. As a result of the reduced storage capacity, an external waste rock dump would be constructed for the surplus waste rock together with a clay quarry would remove an additional 51 acres of wildlife habitats. Alternative 1 would result in the removal of an additional 17 percent of wildlife habitat compared to the Proposed Action. Construction of the waste rock dump and clay quarry would represent a temporary loss of an additional 51 acres of wildlife habitat compared to the Proposed Action. Habitat lost through construction of the waste dump would affect mostly mixed aspen/conifer and conifer forest as well as small portions of sagebrush habitat.

The potential for plant roots to encroach on seleniferous materials would be reduced by construction of an engineered layer. The impermeable cap would also reduce the potential for water to infiltrate seleniferous material, which would reduce the potential for mobilization of selenium. Installation of an impermeable cap on the overburden pile would likely reduce

leaching of selenium to alluvial water and subsequent contamination of seeps and springs. The impermeable cap would also reduce the potential for selenium to be mobilized to reach surface pools and surface water runoff. However, since the impermeable cap would not be installed until after mining has been completed, it would not reduce the effects that would occur during mine operations discussed under the Proposed Action. Therefore, the impacts to threatened and endangered species under Alternative 1 would be the same as the Proposed Action until the impermeable cap is in place.

4.6.1.3 Alternative 2 – No Action

Alternative 2, No Action, would result in no additional impacts in the study area. The No Action alternative would preclude mining and any associated disturbance at North Rasmussen Ridge. The No Action alternative would maintain the current status of wildlife and wildlife habitat in and around the study area. According to the approved mine plan for Central Rasmussen Ridge, 35 acres would not be reclaimed under the no action alternative because material would not be available to backfill a portion of the Central Rasmussen Ridge open pit, which represents a permanent loss of wildlife habitat within the Central Rasmussen Ridge area. The open pit at Central Rasmussen Ridge Mine would have exposed ore and waste rock remaining in the hanging wall. A pit lake could also form in the Central Rasmussen pit, which may pose a risk to wildlife such as waterfowl.

There would be no new impacts to terrestrial wildlife from selenium if the No Action alternative were adopted at the North Rasmussen Ridge Mine site. Existing concentrations of selenium in surface waters may seasonally fluctuate similar to current seasonal patterns. The assumed bioaccumulation and biomagnification of selenium in aquatic life and to terrestrial food chains (amphibians and waterfowl) would continue at the present rate for the near future if the No Action alternative were adopted.

4.6.2 Irreversible and Irretrievable Commitment of Resources

The loss of conifer, mixed aspen/conifer forest, and sagebrush habitat is considered an irreversible commitment of resources and would have long-term minor impacts on many wildlife species. Although the reclamation plan would help to re-establish grassland vegetation in disturbed areas after mining operations end, it would take a long time for forest habitat to re-establish its current level of maturity and complexity. Reclamation would, however, provide habitat in the meantime for species common to early successional areas. Recovery of early succession prey species, such as deer mice and other rodents, would also help to re-establish a prey base for predators. Recovery of species that depend on the forest such as hairy woodpeckers, forest raptors, and pine martens would not occur for hundreds of years. Therefore, the loss of biological diversity in and around the project area would also be considered an irreversible commitment of resources. However, this commitment of resources would represent the loss of 37 percent, 16 percent, and 3 percent of mixed aspen conifer, conifer, and sagebrush habitat within the project area, respectively. No aspen or riparian habitat resources would be irreversibly committed under the Proposed Action.

It is possible that some terrestrial wildlife may be adversely affected by selenium contamination during the life of the Proposed Action or Alternative 1. These impacts are anticipated to be limited in magnitude and areal extent and, therefore, represent a minor irretrievable commitment of resources that is offset by the value of the phosphate minerals extracted.

4.6.3 Residual Impacts

No residual adverse effects on terrestrial wildlife are expected beyond those described in Section 4.6.2.

4.6.4 Mitigation Summary

Project design features, BMPs, and the proposed Reclamation Plan are the elements of the Proposed Action designed to reduce environmental impacts to terrestrial wildlife. The following mitigation measures are proposed to reduce impacts. Based on previous revegetation efforts, the forage production on reclaimed lands would increase from the current range of 400 pounds to 800 pounds of usable forage per acre dry weight to between 1,200 to 1,600 pounds dry weight per acre. Reclaimed areas would have a higher productivity, which would help to re-establish summer range for big game species.
Impacts to raptor habitat would be avoided, for example, removal of raptor nests would be avoided to the extent feasible. However, some impacts to foraging habitat, such as development of the open pit, would be unavoidable. In these cases, mitigation would be implemented, including the following:

- Conduct a detailed raptor survey prior to construction to identify any raptor nests within areas to be cleared.
- Locate the proposed project components to avoid loss or modification of nesting habitat, and use of appropriate buffer areas;
- Enhance foraging habitat to increase attractiveness to raptors as part of the reclamation effort; and
- Improve existing nesting sites.
- In the case that raptor nests are identified within the Study area, the District or Forest Biologist would be contacted.
- Develop a plan to mitigate any impacts associated with raptor nest removal with the District or Forest Biologist.

4.7 FISHERIES AND AQUATIC RESOURCES

4.7.1 Direct and Indirect Impacts

4.7.1.1 Proposed Action

Under the Proposed Action, the East Haul Road would intersect intermittent portions of Reese Canyon Creek and No Name Creek. The Proposed Action would result in 150 linear feet of disturbance in Reese Canyon Creek. Culverts would be placed to maintain flow in the drainage.

Culverts would be installed during the dry season and are therefore not expected to have any impacts on downstream aquatic habitat. Flow following culvert installation is expected to maintain the existing surface hydrology. The East Haul Road extension would also parallel a portion of the lower segment of the West Fork of Sheep Creek. The extension is not, however, expected to affect the stream because BMPs to prevent erosion and sedimentation would be implemented.

Construction is not expected to have adverse impacts on No Name Creek, Reese Canyon Creek, or Sheep Creek since these activities would occur during no-flow periods. No Name Creek is an intermittent stream that is commonly dry during summer, fall, and winter (Maxim 2001a). Reese Canyon Creek is a spring-fed stream that is also dry during some periods of the year. During Maxim's August 2000 survey, the stream was dry in some reaches and had low flow in others. Sheep Creek is located outside of the disturbance footprint for the Proposed Action and would therefore not be directly affected by construction.

Reese Canyon Creek, No Name Creek, and Sheep Creek could be affected by development of the open pit and road construction. Clearing of vegetation within the study area could contribute to increased amounts of siltation in local drainages. An increase in the amounts of suspended sediment in runoff could adversely affect fish and aquatic invertebrates if discharged to local streams. However, implementation of the proposed BMPs, including construction of sediment ponds, establishment of buffer areas around drainages, and use of erosion control measures, would help to prevent sediment and runoff water from discharging into streams. BMPs would also be implemented to control runoff and sedimentation from the East Haul Road extension. No impacts to aquatic habitats are expected as a result of erosion or sedimentation after BMPs have been implemented. However, runoff trapped in the pit or sediment control structures would reduce surface flow in these drainages which could impact downstream aquatic habitat.

There may be an adverse ecological impact if selenium bioaccumulates in the food chains of local aquatic communities. Selenium, in particular, is especially toxic to fish and is highly bioaccumulative in aquatic food chains. The presence of other project-related trace metals is not expected to cause adverse impacts to fisheries and aquatic resources because they are not as toxic as selenium, nor are they found in relatively high concentrations. Montgomery Watson (2000) concluded that selenium was the major element of concern associated with phosphate mining in the Blackfoot River watershed when compared with other elements (such as cadmium, manganese, nickel, vanadium, and zinc).

In a study on cutthroat trout fed varying selenium-enhanced diets ranging from 1.4 to 10 ppm seleno-methionine, no clinical signs of selenium toxicity were observed nor were differences in reproductive performance, i.e. fecundity, egg hatchability, noted, although in all dietary groups, egg fertility and hatchability were lower than that observed in eggs from wild cutthroat trout. Groups of fish fed a non-selenium control diet for 32 weeks after having been fed diets containing various increased levels of selenium for 48 weeks returned to near baseline levels, indicating depuration of whole body levels of selenium over this time (Hardy and Moller 2002).

Adverse impacts to the fisheries and aquatic resources of Sheep Creek, Reese Canyon Creek, and No Name Creek, as well as their related downstream water bodies (Angus Creek and Blackfoot

River), may occur via several exposure scenarios. Surface water runoff may carry rock particles that contain selenium to the creeks via erosion gullies and road ditches. Selenium can reside in streambed sediments and the water column to be taken up directly by rooted aquatic plants, plankton, invertebrates in sediment, aquatic insects, and fish. Although the state chronic water quality standard is 5 micrograms of selenium per liter of water, the literature estimates low to moderate hazards to aquatic life at concentrations of 2 to 5 micrograms selenium per liter of water (Lemly 1996; Skorupa 1998).

The Proposed Action and Alternatives were evaluated for compliance with the 1995 INFISH, which was adopted as part of the Caribou National Forest Plan in 1995. INFISH is designed to protect riparian areas and fisheries from degradation as a result of new or existing activities. Riparian Habitat Conservation Areas (RHCA) were established adjacent to designated fisheries or streams to protect the riparian areas and fisheries. No Name Creek is considered an INFISH category 4 stream – seasonally flowing or intermittent. The RHCA for No Name Creek is 50 feet wide on either side of the stream (USFS 1998).

Under INFISH, proposed activities that could degrade RHCAs must be evaluated to assess compliance with the interim Riparian Management Objectives (RMOs) and mineral management standards and guidelines. The study area contains six mineral management standards and guidelines, and analysis indicates that the project is in compliance with all six under the interim strategy.

4.7.1.2 Alternative 1 – Proposed Action with Impermeable Capping of Backfilled Area

Similar to the Proposed Action in the pit backfill, Alternative 1 would use selective placement of potentially seleniferous material. In addition to selective placement of material, Alternative 1 also includes construction of an impermeable cap. The potential for plant roots to encroach on seleniferous materials would be reduced by construction of an engineered, impermeable layer. The impermeable cap would also reduce the potential for water to infiltrate seleniferous material, which would reduce the potential for mobilization of selenium. Installation of an impermeable cap on the overburden backfill would likely reduce leaching of selenium to alluvial water and subsequent contamination of seeps and springs. The impermeable cap would also eliminate contamination by selenium from exposed seleniferous waste rock of surface pools and surface water runoff that leads to nearby creeks. However, installation of the impermeable cap after mining has been completed would not reduce the risks discussed under the Proposed Action that are associated with exposed seleniferous rock during the 8-year life of the project.

4.7.1.3 Alternative 2 – No Action

Alternative 2, No Action, would result in no additional impacts in the North Rasmussen Ridge site. No Action would preclude mining and any associated disturbance at North Rasmussen Ridge. No Action would maintain the current status of aquatic wildlife populations and fisheries in and around the study area.

There would be no new impacts to fisheries and aquatic resources from selenium if the No Action alternative is selected at the North Rasmussen Ridge Mine site. However, there is potential for a pit lake to form in the remaining Central Rasmussen Ridge pit. Exposed ore and waste rock in the Central Rasmussen Ridge pit could mobilize selenium into that lake. Existing concentrations of selenium in surface waters may seasonally exceed the state water quality standard for the protection of aquatic life. Bioaccumulation and biomagnification of selenium from aquatic life through terrestrial food chains (amphibians and waterfowl) would continue at the present rate for the near future if the No Action alternative is adopted.

4.7.2 Irreversible and Irretrievable Commitment of Resources

There would not be an irreversible or irretrievable commitment of resources as a result of changes in the physical habitat within or near the project area related to either the Proposed Action or Alternative 1. However, it is possible that the Proposed Action or Alternative 1 may contribute to a continuing decline of water quality, associated fisheries, and aquatic resources within the Blackfoot River watershed as a result of contamination by selenium, considering the impacts of other phosphate mines in the area. Degradation of water quality is considered an irretrievable commitment of resources. The decrease in quality of fisheries may become an irreversible commitment of resources if certain sensitive fish species or their primary prey species (invertebrates) are extirpated from any streams. Reclamation of the open pit and haul roads should permanently stabilize these areas and would minimize the potential for the release of sediment to Reese Canyon Creek, No Name Creek, and Sheep Creek. Road culverts placed in the Reese Canyon Creek and No Name Creek drainages would be removed after mining operations end. Both drainages would then be re-contoured to approximate their original topography.

4.7.3 Residual Impacts

No residual effects on fisheries and aquatic resources are expected beyond those described in Section 4.7.2.

4.7.4 Mitigation Summary

Project design features, BMPs, and the proposed Reclamation Plan (see Chapter 2) are the elements of the Proposed Action designed to reduce environmental impacts to fisheries and aquatic resources. Additional mitigation measures are not deemed necessary.

4.8 THREATENED, ENDANGERED, AND SPECIAL STATUS SPECIES

4.8.1 Direct and Indirect Impacts

Refer to the Biological Assessment and Biological Evaluation documents (Greystone 2003a and b) available from the BLM and USFS for more detailed information on the following species.

4.8.1.1 Proposed Action

Threatened and Endangered Wildlife Species

Yellowstone Population of Gray Wolf

Wolves could potentially travel through the study area or near the study area, but their foraging range is very extensive and makes the selenium exposure potential insignificant. Predation by the gray wolf on contaminated prey that has ranged outside of the study area is a reasonable possibility, although biomagnification via this particular food chain is minimal. Such predation would probably occur very infrequently, due to the extremely large foraging range. The loss of forest habitat and associated potential prey related to the Proposed Action would be insignificant to the gray wolf. The study area would have a high level of human activity for the project duration and wolves are expected to avoid such areas. Thus, no adverse effects to the gray wolf are expected to occur because of the Proposed Action. The determination for the gray wolf is that the Proposed Action is not likely to jeopardize the continued existence or adversely modify proposed critical habitat of the gray wolf. The gray wolf is not expected to frequent the study area or Rasmussen Ridge, due to the high levels of human and mechanized activity. Insignificant effects (i.e., unmeasurable) may occur via the consumption by the gray wolf of selenium-contaminated prey near the study area.

Canada lynx

Although Canada lynx may pass through the study area, they would not be expected to frequent areas subject to regular, high levels of human and mechanized activity. Predation by the Canada lynx on selenium-contaminated prey that have ranged outside of the study area is a reasonable possibility, although biomagnification via this particular terrestrial food chain is minimal. Such predation would occur very infrequently, due to the large foraging range. Therefore, the Canada lynx is not likely to encounter toxic exposures to selenium. The Proposed Action would eliminate much of the habitat on Rasmussen Ridge that the Canada lynx might use as linkage between preferred habitats. The high levels of human activity associated with the Proposed Action would create a deterrent effect that extends much beyond the ground footprint of the study area. The determination for the Canada lynx is that the Proposed Action may affect, but is not likely to adversely affect, the species. The Canada lynx is not expected to frequent the study area or Rasmussen Ridge, due to the high levels of human and mechanized activity. Insignificant effects (i.e., unmeasurable) may occur via the consumption by the Canada lynx of selenium-contaminated prey near the study area.

Bald Eagle

The Proposed Action is not anticipated to negatively affect the bald eagle because the study area does not include, nor would it impact, known winter roost sites, breeding territories, or winter feeding areas. However, a large elk wintering area that is adjacent to the east side of the study area could attract bald eagles due to elk mortalities caused by severe weather. Predation by the bald eagle on selenium-contaminated terrestrial prey or carrion outside of the study area is a reasonable possibility, although biomagnification via this particular terrestrial food chain is considered minimal. Additionally, the bald eagle may consume fish and waterfowl within the Blackfoot River watershed that contain selenium bioaccumulated via food chain pathways. Such

predation would probably occur infrequently, due to the large foraging range of the bald eagle, and current levels of selenium in fish and waterfowl are not expected to adversely affect the bald eagle or other predators. Therefore, no incidental take to bald eagles is expected to occur because of the Proposed Action. The determination for the bald eagle is that the Proposed Action would have no effect. Insignificant effects (i.e., unmeasurable) may occur via the infrequent consumption by the bald eagle of selenium-contaminated prey and carrion near the study area and within the Blackfoot River watershed.

Yellow-billed cuckoo

The yellow-billed cuckoo is listed as a candidate species by USFWS. No populations of yellow-billed cuckoo were observed in the study area during baseline studies. The yellow-billed cuckoo is not expected to occur in the study area because area elevations are at the limit of its range. According to USFS information, the only potential yellow-billed cuckoo habitat within the Caribou-Targhee National Forest is located on the Palisades Ranger District. Data indicate that only a few breeding pairs of yellow-billed cuckoo remain in Idaho, primarily in southwestern Idaho. The Proposed Action is not likely to adversely affect the yellow-billed cuckoo since it is not expected to occur in the study area.

USFS Sensitive Plant Species

Cache's beardtongue is considered to be endemic to the Bear River Range, southwest of Montpelier, Idaho. No populations of the species were observed in the study area, nor considered likely to occur. The Idaho CDC did not list any documented occurrences of Cache's beardtongue in or near the study area (Maxim 2001c). As a result, Cache's beardtongue is not expected to occur in the study area.

Payson's bladderpod was not found in the study area and limited potential habitat was identified (Maxim 2001c). Based on the results of baseline studies and the marginally suitable habitat in the study area, potential adverse effects to Payson's bladderpod are unlikely, since no populations are known to occur in the study area.

Starveling milkvetch was not observed and no potential habitat was identified during baseline studies. Based on the results of baseline studies, no adverse effects to starveling milkvetch are likely since no populations are known to occur in the study area.

USFS Sensitive Wildlife Species

Spotted Bat

Suitable roosting habitat for the spotted bat does not exist within the project area. The spotted bat was not observed or captured during bat survey efforts at the project area during the summer of 2000 (Maxim 2001b). It is unlikely that the spotted bat uses the project area for roosting or foraging. The spotted bat would not likely be affected by food chain uptake of selenium, but would be impacted by loss of foraging habitat within the project area. The Proposed Action may adversely impact individuals, but not likely result in a loss of viability on the planning area, nor cause a trend to federal listing or a loss of species viability over its range. The Proposed Action's effects on the spotted bat are expected to be insignificant.

Townsend's big-eared bat

There are no known habitats suitable for day or night roosting within or near the project area. The species was not observed or captured during bat survey work conducted in 2000 (Maxim 2001b). The lack of detections and habitat in the project area suggest that the Proposed Action would not adversely affect populations, including food chain uptake of selenium. The Proposed Action may adversely impact individuals, but not likely to result in a loss of viability on the planning area, nor cause a trend to federal listing or a loss of species viability over its range. The Proposed Action's effects on the Townsend's big-eared bat are expected to be insignificant.

Wolverine

No evidence of wolverine presence was observed during biological field surveys in 2000 (Maxim 2001b), and there has not been a local sighting since 1977. The nearest sightings are from the Preuss Range and the Bear River Range, 27 miles south and about 23 miles south, respectively (BLM and FS 2001). Suitable habitat for this species does occur, however, within the project area. Although wolverines may pass through the project area, wolverines would not be expected to frequent areas subject to high levels of regular human activity. The Proposed Action would cause the loss of potential wolverine habitat. No direct or indirect impacts to this species are anticipated from potential selenium contamination of surface soils, surface water, or vegetation. The Proposed Action may adversely impact individuals, but not likely to result in a loss of viability on the planning area, nor cause a trend to federal listing or a loss of species viability over its range. The Proposed Action's effects on the wolverine are expected to be insignificant (non-measurable).

Trumpeter Swan

No trumpeter swans were observed during baseline studies and no suitable habitat for this species exists within or adjacent to the project area (Maxim 2001b). The use of the project area by trumpeter swans is considered unlikely based on the lack of habitat. The Proposed Action would not create additional potential trumpeter swan habitat, such as pit lakes or tailings ponds. Food chain uptake of selenium and consequent impacts are not expected to occur because of the Proposed Action. The Proposed Action would have no impact on the trumpeter swan.

Harlequin Duck

Suitable habitat for harlequin duck does not exist within the project area, and this species was not observed within the project area during biological surveys conducted in 2000 (Maxim 2001b). Harlequin ducks may use local fast-flowing streams during migration stopovers, but are not expected to nest locally or remain in the project area for extended periods, as its breeding range does not include Rasmussen Ridge. The Proposed Action would have no impact on the harlequin duck.

Northern Goshawk

The project area represents potential northern goshawk foraging habitat. Northern goshawk surveys were conducted using amplified goshawk vocalizations in May and July of 2000 (Maxim 2001b). Several individuals were observed, even though no nests were located, thus supporting the possibility that nesting pairs may occur within or near the project area. The Proposed Action

would result in the loss of approximately 269 acres of potential foraging habitat for northern goshawk. Displacement of northern goshawk could result in increased competition between displaced goshawks and other resident predators. Increased competition could cause increased mortalities and/or decreased reproduction rates. The Proposed Action may adversely impact individuals, but not likely to result in a loss of viability on the planning area, nor cause a trend toward federal listing, or a loss of species viability over its range. The Proposed Action's effects on the northern goshawk would be insignificant.

Columbian Sharp-tailed Grouse

This grouse species is not expected to occur within the project area, due to the lack of suitable habitat (i.e., extensive grassland or shrub habitats). Of the marginally-suitable habitat that is present, only a small percentage of the total habitat present in the project area would be affected by the Proposed Action. Previous survey efforts did not document the occurrence of this species in the project area (Maxim 2001b). Columbian sharp-tailed grouse have been observed seven miles south of the project area. The Proposed Action would have no impact on the Columbian sharp-tailed grouse.

Boreal Owl

Potentially suitable habitats within the project area were surveyed for boreal owl during the spring of 2001, but no boreal owls were heard or observed during this survey effort (Maxim 2001b). Species occurrence, although unlikely, is possible within the project area, due to the existence of suitable habitat. The Proposed Action may result in adverse effects to the boreal owl due to habitat loss, but not from food chain uptake of selenium. The Proposed Action may adversely impact individuals, but not likely to result in a loss of viability on the planning area, nor cause a trend to federal listing or a loss of species viability over its range.

Flammulated Owl

Results of surveys conducted during the spring of 2001 reported audible detections of owls vocalizing within the project area. However, no nest locations were documented as part of the baseline studies (Maxim 2001b). The Proposed Action would result in the loss of aspen, conifer, and aspen/conifer mix habitat, and these areas represent potential flammulated owl habitat. Removal of occupied flammulated owl habitat would result in displacement of flammulated owls, causing increased competition between displaced owls and other resident predators. Increased competition could result in increased mortalities and/or decreased reproduction rates. The Proposed Action may adversely impact individuals, but not likely to result in a loss of viability on the planning area, nor cause a trend to federal listing or a loss of species viability over its range.

Great Grey Owl

No audible or visual observations of this owl were made during survey efforts for the species conducted in the spring of 2001 (Maxim 2001b). This species is likely to occur within the project area, because of the occurrence of suitable habitat within and adjacent to the project area and a nesting occurrence several miles east of the study area recorded by the Idaho Conservation Data Center. Loss of forest and forest edge habitats would reduce potential great gray owl foraging habitat. Displacement of great gray owls would result in increased competition between

displaced owls and other resident predators. Increased competition could result in increased mortalities and/or decreased reproduction rates. The Proposed Action may adversely impact individuals, but not likely to result in a loss of viability on the planning area, nor cause a trend toward federal listing or a loss of species viability over its range.

Three-toed Woodpecker

No evidence of three-toed woodpecker was observed in 2000, although potential habitat exists within the project area (Maxim 2001b). Individuals of the species responded to calls at the nearby Smoky Canyon Mine and a pair was observed six miles south of the Smoky Canyon Mine (BLM 2001). Effects to three-toed woodpeckers would include habitat loss through conversion of aspen and conifer stands to stands of grass and interspersed shrubs and young trees. The Proposed Action may adversely impact three-toed woodpecker populations if they exist within or adjacent to the project area. The Proposed Action may adversely impact individuals, but not likely to result in a loss of viability on the planning area, nor cause a trend to federal listing or a loss of species viability over its range.

Sage Grouse

No sage grouse leks would be affected by the Proposed Action. The proposed loss of 8 acres of sagebrush habitat (considered marginal for sage grouse) would represent a long-term but reversible loss, as sagebrush is expected to reinvade the reclaimed area over two or three decades. The Proposed Action is not expected to have any effect on sage grouse.

Spotted Frog

The spotted frog was not observed during biological surveys of the project area conducted in 2000 (Maxim 2001b), although suitable habitat exists near the project area within the riparian corridor of the potentially affected creeks, including beaver ponds. This species has not been found on the Caribou National Forest (Green 1997 in Keysor 2002b). Groves and others (1997, pg. 12, in Keysor 2002b) do not identify southeast Idaho as part of the predicted range of the spotted frog. Increased sediment loads can affect amphibians such as the spotted frog, as can the use of herbicides near waterbodies. Salamanders, another amphibian species, have been adversely affected by selenium contamination at the nearby Smoky Canyon Mine and another phosphate mine in southeast Idaho (USGS 2001a, 2001b). The Proposed Action may adversely impact individual frogs, but is not likely to result in a loss of viability on the planning area, nor cause a trend toward federal listing or a loss of species viability over its range.

Yellowstone Cutthroat Trout

Potential effects to Yellowstone cutthroat trout because of the Proposed Action include loss of habitat quality or quantity and reproductive impairment from uptake of selenium and its toxic effects. The Proposed Action is not expected to have direct effects on fisheries located in the lower reaches of Sheep Creek, but may contribute to cumulative selenium contamination in downstream water bodies. Under the Proposed Action, a number of Best Management Practices would be implemented to limit the potential migration of selenium and other trace metals or contaminants to existing surface water resources. Surface water concentrations of selenium have been measured as high as 100 times greater than the state chronic water quality standard in nearby Smoky Creek, a creek that has been impacted by the Smoky Canyon Mine (BLM 2001,

Appendix B). Concentrations of cadmium, lead, and zinc also measured greater than the state chronic water quality standards for aquatic life. These impacts to Smoky Creek have occurred despite extensive mitigation measures. The Proposed Action may adversely impact individuals, but is not considered likely to result in a loss of viability on the planning area, nor cause a trend toward federal listing or a loss of species viability over its range.

Bonneville Cutthroat Trout

The Bonneville cutthroat trout was not documented during baseline studies and is not expected to occur within the study area (Maxim 2001a). The species does not occur in the Snake River Basin. Therefore, the Bonneville cutthroat trout does not occur in the study area. As a result, no adverse effects are expected for Bonneville cutthroat trout. The Proposed Action would have no impact on the Bonneville cutthroat trout.

4.8.1.2 Alternative 1 – Proposed Action with Impermeable Capping of Backfilled Area

Alternative 1 would affect 320 acres. The additional surface disturbances associated with the external waste rock facility and clay quarry under Alternative 1 would represent an additional loss of foraging habitat for a number of species, including the northern goshawk, flammulated owl, and three-toed woodpecker. Determination statements for threatened and endangered species would be the same under Alternative 1 as under the Proposed Action.

Similar to the Proposed Action, Alternative 1 would use selective placement of potentially seleniferous material. In addition to selective placement of material, Alternative 1 also includes construction of an impermeable cap. The impermeable cap included in Alternative 1 would further reduce the potential for exposure to selenium for threatened, endangered, or sensitive plant and wildlife species.

Some additional habitat would be lost under the Alternative 1, while risks of selenium exposure would be reduced. In both cases, these changes would not be enough to warrant a change in determination statements.

The contribution to cumulative impacts from selenium contamination to threatened and endangered species would be less than under the Proposed Action after the impermeable cap is in place. Contamination of the Blackfoot River watershed by this alternative would be the same as under the Proposed Action until the impermeable cap is in place.

4.8.1.3 Alternative 2 – No Action

Alternative 2, No Action, would result in no additional impacts in the study area. The No Action alternative would preclude mining and any associated disturbance at North Rasmussen Ridge. The No Action alternative would maintain the status of threatened, endangered, and sensitive wildlife populations in and around the study area. According to the approved mine plan for Central Rasmussen Ridge, 35 acres would not be reclaimed under the No Action alternative because material would not be available to backfill a portion of the Central Rasmussen Ridge pit, which would represent a permanent loss of wildlife habitat within the Central Rasmussen Ridge

area. The Central Rasmussen Ridge pit could potentially form a pit lake. Exposed ore and waste rock in that pit could potentially mobilize selenium into the lake.

Existing concentrations of selenium in surface waters may seasonally exceed state chronic water quality standards and water consumption toxicity thresholds for aquatic life and terrestrial wildlife. Bioaccumulation and biomagnification of selenium from aquatic life through terrestrial food chains (amphibians and waterbirds) would continue at the present rate for the near future if the No Action alternative is adopted.

4.8.2 Irreversible and Irretrievable Commitment of Resources

The loss of conifer, mixed aspen/conifer forest, and sagebrush habitat represents an irreversible commitment of resources through the long-term loss of foraging habitat for some threatened, endangered, and sensitive species. Although the reclamation plan would help to re-establish vegetation in disturbed areas after mining operations end, it would take many years for disturbed areas to re-establish the current level of maturity and complexity. Local recovery of species that depend on the forest, such as flammulated and boreal owls, northern goshawks, great gray owls, and three-toed woodpeckers, would be limited until these forests become re-established.

4.8.3 Residual Impacts

The primary residual impacts to threatened, endangered, and sensitive species would be the loss of forest habitat. Development of a mature forest that may be used by flammulated and boreal owls and possibly as foraging habitat for northern goshawks, great gray owls, and three-toed woodpeckers would only occur after an extended period. Even with planting and natural succession, it is expected that these forests would require decades to recover to their current structure and level of complexity.

4.8.4 Mitigation Summary

Project design features, BMPs, and the proposed Reclamation Plan (see Chapter 2) are the elements of the Proposed Action designed to reduce environmental impacts to threatened, endangered or sensitive species. Additional mitigation measure are not deemed necessary.

4.9 GRAZING MANAGEMENT

4.9.1 Direct and Indirect Impacts

4.9.1.1 Proposed Action

The Proposed Action would affect (has already affected) two USFS grazing allotments as well as state and private allotments currently leased by the Idaho Citizens Grazing Association. Grazing has been temporarily suspended on mine leases, including approximately 79 acres would be directly affected in the Rasmussen Valley Cattle Allotment and 130 acres in the Sheep Creek Sheep Allotment. The Proposed Action has also affected 60 acres of state and private lands. State and federal lands outside mine lease holdings would continue to be used to graze livestock.

Over the short term, availability of forage for livestock or wildlife would be reduced. However, the long-term effect on the availability and quality of forage is expected to be neutral or improved. A total of 269 acres would be removed from production during mining, although the number of animals grazing on the allotment may not be reduced. The acres removed from production could result in additional grazing pressure on the remaining areas of the allotments that are not affected by the proposed development.

Currently, Unit 1A of the Rasmussen Valley Cattle Allotment cannot be used for grazing, due to mining activity. The Proposed Action would extend the mine through the north end of this unit. Before mining began, this unit supported 205 cattle for 48 days, which is 23 percent of the grazing use on this allotment. This unit contains about 2000 acres that are no longer practical to graze because of mining activities. Even though the mine directly disturbs only a small portion of the total area within the unit, it does affect the whole unit. Permitted cattle numbers may be reduced by about 85 head due to the mining activity. It is unlikely that sheep numbers would have to be reduced.

The potential for plant roots to take up selenium into the above-ground edible parts of the plant from seleniferous waste rock would be reduced by the application of layers of limestone rock and chert over the seleniferous waste rock. Comments in the vegetation section (section 4.5.2) describe wetland plants and legumes having higher levels of selenium than dryland plants and non-legumes. Selenium toxicity thresholds in plants have not been demonstrated (Skorupa 1998). No grazing would occur during the active life of the mine.

4.9.1.2 Alternative 1 – Proposed Action with Impermeable Capping of Backfilled Area

Alternative 1 would affect the same USFS grazing allotments as well as state and private allotments currently leased by the Idaho Citizen's Grazing Association. Alternative 1 would result in a larger disturbance to grazing allotments when compared with the Proposed Action. The total disturbance would be increased by 51 acres through construction of an external waste rock facility and a clay quarry. If a synthetic liner is used, additional disturbance would only be 26 acres.

4.9.1.3 Alternative 2 – No Action

Alternative 2, No Action, would result in no additional impacts in the study area. No Action would preclude mining and any associated disturbance at North Rasmussen Ridge. Mining would continue at Central Rasmussen Ridge until all ore is removed. According to the approved mine plan for Central Rasmussen Ridge, 35 acres would not be reclaimed because material would not be available to completely backfill the open pit. Alternative 2 would not contribute any additional selenium contamination that could affect quality of grazing.

4.9.2 Irreversible and Irretrievable Commitment of Resources

About 72 acres of grazing resources are likely to be permanently lost as a result of implementation of the Proposed Action or Alternative 1, as forage plants would not be re-

established on the pit walls of the partially backfilled portion of Panel B. Additionally, 35 acres at Central Rasmussen Ridge would not be reclaimed.

4.9.3 Residual Impacts

No residual impacts are expected beyond the irreversible losses of forage identified in the previous section. Until vegetation becomes re-established, grazing forage for livestock would be reduced.

4.9.4 Mitigation Summary

Project design features, BMPs, and the proposed Reclamation Plan (see Chapter 2) are the elements of the Proposed Action designed to reduce environmental impacts to livestock grazing.

The following mitigation measures are proposed to reduce impacts. Based on past revegetation efforts, the forage production on reclaimed lands is expected to increase from an average of 400 to 800 pounds of usable forage per acre air dry weight to between 1,200 to 1,600 pounds per acre air dry weight. When mining reclamation is completed, and cattle are again allowed to graze the area, it would be necessary to build a fence along the ridge between No Name Creek and Sheep Creek. This fence would keep the cattle off the sheep allotment.

4.10 RECREATION

The area of analysis for recreation is bounded on the east by Sheep Creek, on the north and west by the boundary of the National Forest, and on the south by the Blackfoot River Road, with emphasis on the North Rasmussen Ridge Mine area. The potential effect of construction and operation of the proposed North Rasmussen Ridge Mine on recreation has two aspects: the first is the amount of recreation opportunity that is created by the proposed project and the second is the amount of recreation opportunity that is removed from recreational use. Local residents in Caribou County value forest land for recreation in part because of the proximity to their homes. The main issue identified in the scoping process is the potential change in access for recreation in the analysis area.

4.10.1 Direct and Indirect Impacts

4.10.1.1 Proposed Action

Existing recreation uses in the analysis area include the Mill Canyon campground and dispersed recreation. The Mill Canyon campground would not be disturbed by mining because the proposed mine would be located at least 5 miles from the campsite. Traffic on the existing haul road from the proposed mining operations would not affect the campsite.

Dispersed recreational use of these lands is limited as a result of restricted public access. Access into the North Rasmussen Ridge Mine would be restricted to ensure the safety of the public and mine employees. Haul roads constructed within the lease area would be closed to the public and would be reclaimed once the roads are no longer needed. The proximity of the proposed North

Rasmussen Ridge Mine to existing mining operations indicates that little dispersed recreation would be displaced by implementation of the Proposed Action. In general, adequate opportunities for recreation exist on public lands in the Soda Springs Ranger District to absorb any activity that might be displaced by the North Rasmussen Ridge Mine.

Construction, reclamation, and operations at the North Rasmussen Ridge Mine would not change current traffic levels on USFS roads that access the Rasmussen Ridge area, or on roads that provide access to any other USFS lands in the analysis area. The mining equipment and vehicles required would be located on site for the duration of mining. Traffic by employees of the mine on the existing access road that connects with the Blackfoot River Road would continue at current levels throughout the life of the mine.

Existing hunting opportunities in the analysis area would not be substantially affected by the proposed mining operations. Hunters would continue to have access to the southern portion of the analysis area, including the Mill Canyon campground, and along FDR roads 506 and 346. Hunting opportunities would still be available outside of the closed area and throughout the rest of the analysis area.

There would be no direct effects to recreational fishing because of the proposed mining operations as no closures are proposed for areas that currently support fish. Potential effects to the fisheries resource are described in the section on wildlife resources.

Once mining operations have ceased and public access is reopened, recreational opportunities would again be available in most of the area that was closed for public safety. Backfill area C would continue to be closed for safety. This alternative would be consistent with Forest-wide and Soda Springs Ranger District standards and guidelines for dispersed recreation and ROS classes of Semi-Primitive Motorized and Roaded Natural.

4.10.1.2 Alternative 1 – Proposed Action with Impermeable Capping of Backfilled Area

Alternative 1 is similar to Proposed Action in the siting of most project facilities and the life of the project. The impacts to access on local roadway network would be identical to the impacts that would be experienced in the Proposed Action.

4.10.1.3 Alternative 2 – No Action

Existing mining operations have resulted in closure of certain areas for public safety. Portions of the closed area were formerly used by the public, primarily for hunting. Because of the ephemeral nature of the streams and drainages, there has been no effect to recreational fishing in the existing closure area. These conditions would be expected to continue under the No Action Alternative until operations at the Central Rasmussen Ridge Mine area have ceased and the area is reopened for public access.

4.10.2 Irreversible and Irretrievable Commitment of Resources

No irreversible or irretrievable commitment of recreation resources would be expected from implementation of the Proposed Action or alternatives.

4.10.3 Residual Impacts

Minor residual impacts to recreation resources would be expected from implementation of the Proposed Action or alternatives. Hunters and others who have used the North Rasmussen Ridge area would find the topography and vegetation have changed after reclamation is complete.

4.10.4 Mitigation Summary

Project design features, BMPs, and the proposed Reclamation Plan (see Chapter 2) are the elements of the Proposed Action designed to reduce environmental impacts to recreation. The following mitigation measures are proposed to reduce impacts. After mining and reclamation are completed, all area roads that were closed by the mining operation would again be open for public access. The rim of the pit walls would be posted with signs, fences, or other barriers to warn recreationists of the potential hazard of falls.

4.11 VISUAL RESOURCES

4.11.1 Direct and Indirect Impacts

4.11.1.1 Proposed Action

Short-term, localized effects to the visual character of the landscape would result from removal of vegetation, including timber, and exposure of soils of contrasting color and texture during construction and mining associated with the Proposed Action. Short-term effects to visual resources would occur over the life of the project. The Proposed Action would be located in an area that is generally unseen by public viewers. The activities associated with the Proposed Action would be visible in the background distance zone from a limited portion of Henry Cutoff Road. Because of the adjacent hilly terrain, disturbances associated with the Proposed Action would not be visible from the other public roads in the area. The potential viewers of the study area would be a limited number of local ranchers, mine personnel, USFS employees, and occasional visitors, such as hikers and hunters.

The visual quality objective (VQO) for the study area as defined in the Forest Plan is Modification or Maximum Modification. The VQOs of Modification or Maximum Modification allow the greatest change in the landscape, including management activities that dominate the original characteristic landscape. The corresponding SIO would be low.

The study area is considered to have typical scenic attractiveness, defined as ordinary or common scenic quality. Because the landscape of the study area is generally not visible to the average observer and is in the background view from Henry Cutoff Road, the constituent

analysis of the area results in a concern level of 3, or of low visual public concern (USFS VMS Map).

The Scenic Class of the study area ranges from 5 to 6, or of low public value. Areas of existing modification to the natural landscape include views of the existing mine activities of the South and Central Rasmussen Ridge Mines.

After mine closure is complete, long-term visual impacts would be reduced by reclamation and revegetation. Reseeded areas may appear as a somewhat different color and texture compared with the background landscape. The existing characteristic landscape would not be retained. The reclaimed landscape may mimic surrounding topography and vegetative cover would be predominantly grasses.

4.11.1.2 Alternative 1 – Proposed Action with Impermeable Capping of Backfilled Area

Potential environmental effects from implementation of Alternative 1 would be essentially the same as for the Proposed Action. Alternative 1 would require an external waste rock facility that would encompass an additional 26 acres on the southwest side of Panel A. The outer face of the waste rock facility would be an area of different color and line that would not be present under the Proposed Action. However, the facility would be only 1,500 feet long and would not constitute a large structure when viewed from a distance. The visual effect of Alternative 1 would be acceptable in the Modification VQO. Additional visual effects on the sagebrush/grass community would result from the clay quarry (about 25 acres) associated with the source for one of the cap materials.

4.11.1.3 Alternative 2 – No Action

Under implementation of Alternative 2, there would be no mining or associated disturbance at North Rasmussen Ridge. The existing mine at the Central Rasmussen Mine would continue to be visible under the No Action alternative. The VQO of the Central Rasmussen Ridge Mine area is Modification and allows management activities to visually dominate the original characteristic landscape.

When reclamation is complete, there would be minimal long-term modification of the visual resources of the reclaimed areas compared with the undisturbed landscape as seen in background views along a portion of Forest Road 243.

4.11.2 Irreversible and Irretrievable Commitment of Resources

The existing characteristic landscape would not be retained. The reclaimed landscape may mimic surrounding topography and vegetative cover would be predominantly grasses. Irreversible commitment of resources could occur if re-establishment of plants through reclamation is unsuccessful.

4.11.3 Residual Impacts

After reclamation is complete, minimal residual impacts to the visual quality of the study area would be expected as a result of implementation of any of the alternatives. There would be minimal modification of the visual resources in background views along a limited number of public roadways from the contrasting color and texture of the disturbed areas compared with the undisturbed landscape. Under any of the alternatives, the areas to be disturbed are not generally visible from traveled roadways.

4.11.4 Mitigation Summary

Project design features, BMPs, and the proposed Reclamation Plan (see Chapter 2) are the elements of the Proposed Action designed to reduce environmental impacts to visual quality. Additional mitigation measures are not deemed necessary.

4.12 LAND USE, ACCESS AND TRANSPORTATION

4.12.1 Direct and Indirect Impacts

4.12.1.1 Proposed Action

Land Use

Under the Proposed Action, short-term effects to land use in the North Rasmussen Ridge Mine area would occur from displacement of the existing land uses by mining-related facilities and activities over the 8-year life of the project. Surface disturbances associated with the Proposed Action are summarized in **Table 2.2-2**. Short-term effects to land use associated with the Proposed Action would be displacement of a total of 269 acres of rangeland, consisting of 98 acres of state and 171 acres of USFS lands. The state and federal lands outside the mining leases that would not be directly affected by active mine operations would continue to be used to graze livestock.

For this alternative, all disturbed areas that are amenable to reclamation would be reclaimed and revegetated as described in Section 2.2.3.4, Reclamation. After reclamation is complete, long-term disturbances would displace a total of 72 acres of rangeland, consisting of 37 acres of state land and 35 acres of USFS land. Approximately 27 percent of the total disturbance cannot be reclaimed, such as areas of exposed highwall or steep cut slopes. Under the proposed North Rasmussen Ridge Supplemental Mine and Reclamation Plan (Agrium 2001), disturbed areas would be reclaimed using non-seleniferous material and a seed mixture primarily made up of grasses. After reclamation is successful, the rangeland (in terms of forage production and carrying capacity) may be improved compared with existing conditions, as analyzed in Section 4.9, Grazing Management.

Access and Transportation

Under the Proposed Action, public access and the volume of traffic on existing transportation facilities would remain similar to the current conditions related to the existing Central Rasmussen Ridge Mine. Ore produced from the North Rasmussen pits would continue to be hauled by truck to the Wooley Valley rail loading facility (tipple). The haul routes would include using the East Road Extension (a new haul road), the existing West Road, and the existing haul road from the mine to the tipple. One new haul road would be constructed to provide access to the North Rasmussen pit and to accommodate ore and waste rock haulage. This new road would be constructed by extending the approved East Road from the Central Rasmussen Ridge Mine northward and parallel to the proposed North Rasmussen pit. The new haul road would be constructed primarily within the boundary of the lease and would not be open to the public. There are no public access crossings along the proposed route for the new haul road. As haul and access road is no longer needed for mining, it would be reclaimed to USFS and IDL specifications. Accordingly, additional opportunities for public access to the study area are unlikely to result from the Proposed Action.

Little or no increase in vehicular traffic is anticipated to occur under the Proposed Action. The existing 400 employees at the Central Rasmussen Ridge Mine would continue mining at the North Rasmussen Ridge Mine and would commute daily on the local roads over the 8-year life of the project. Employees would commute from Soda Springs, Montpelier, and other communities via U.S. Highway 30 and State Highway 34. In addition, a limited number of contract personnel may be employed temporarily for a short-term construction phase of the project.

4.12.1.2 Alternative 1 – Proposed Action with Impermeable Capping of Backfilled Area

Under Alternative 1, short-term surface disturbance would displace 320 acres of existing rangeland. Long-term disturbances would affect 72 acres of rangeland. The total surface disturbance associated with Alternative 1 would be increased by 51 acres compared to the Proposed Action because of the use of an external waste rock dump and a clay quarry. Approximately 23 percent of the total disturbance associated with this alternative would not be reclaimed.

Under Alternative 1, the potential effects to public access and traffic volume on the existing transportation facilities would be the same as were analyzed for the Proposed Action.

4.12.1.3 Alternative 2 – No Action

Under Alternative 2, there would be no mining or associated disturbance at North Rasmussen Ridge. This alternative would involve continued mining at the Central Rasmussen Ridge Mine until all ore was recovered. As shown in **Table 2.1-1**, this alternative would involve short-term disturbance of 231 acres. After mine closure, 85 percent of the short-term disturbance would be reclaimed and revegetated. Long-term disturbance would affect 35 acres that would not be

reclaimed because material would not be available to backfill the open pit at Central Rasmussen Ridge (**Figure 2.1-2**).

Under Alternative 2, public access, the volume of traffic, and road conditions would remain unchanged from the current state until closure of the Central Ridge Rasmussen mining area. Ore produced from the Central Rasmussen pits would be hauled by truck to the Wooley Valley rail loading facility. The existing 400 employees at the Central Rasmussen Ridge Mine would continue to commute daily on the local roads. Employees would commute from Soda Springs, Montpelier, and other communities via U.S. Highway 30 and State Highway 34. After closure and reclamation are complete, vehicular traffic to the study area would likely decline.

4.12.2 Irreversible and Irretrievable Commitment of Resources

There would be irreversible or irretrievable impacts to land use under implementation of any of the alternatives because unreclaimed areas would be permanently removed from rangeland uses. Under the Proposed Action, 72 acres of rangeland cannot be reclaimed because of the steep cut slopes. For Alternative 1, 72 acres of rangeland would not be reclaimed. Under implementation of Alternative 2, 35 acres of the Central Rasmussen pit would not be backfilled and would remain in an unreclaimed state as per the approved mine plan.

There would be no irreversible or irretrievable impacts to access or transportation resources as a result of implementation of any of the alternatives.

4.12.3 Residual Impacts

Residual impacts to land use resources would result from any of the alternatives because the unreclaimed areas would be permanently removed from rangeland and recreational uses. These residual adverse impacts would be minor when compared with the overall availability of rangeland and recreational resources in the regional area.

There would be no residual adverse impacts to access or transportation resources as a result of implementation of any of the alternatives.

4.12.4 Mitigation Summary

Project design features, BMPs, and the proposed Reclamation Plan (see Chapter 2) are the elements of the Proposed Action designed to reduce environmental impacts to access, transportation, and land use. After mining ends, Sheep Creek Road would be reopened to the public, pending IDFG and USFS approval.

4.13 CULTURAL AND NATIVE AMERICAN CONCERNS

4.13.1 Direct and Indirect Impacts

The entire area of potential effect of the Proposed Action and the alternatives has been inventoried for the presence of cultural resources. No eligible cultural resources have been found

in the project area. The North Rasmussen phosphate occurs in the Meade Peak Member of the Permian Aged Phosphoria Formation, which is overlain by the Rex Chert Member of the same formation. Chert and porcellanite facies of the Phosphoria Formation farther east in the Bighorn and Pryor Mountains produce distinctive cherts and porcellanites that were highly valued by prehistoric populations as raw material for manufacturing stone tools. In general, the chert and porcellanite that occurs in the chert facies of the Phosphoria Formation in extreme western Wyoming, Utah, and southeastern Idaho is fossiliferous and impure (Miller 1991). These western varieties of Phosphoria cherts have not been consistently identified in archaeological assemblages. Cultural resource inventories in the project area have not identified any culturally modified Phosphoria chert or porcellanite. The chert and porcellanite in these deposits that were reasonably accessible to primitive technology were not of adequate quality to be attractive.

If any eligible cultural resources were present within the area of proposed mine, ground-disturbing activities, including surface storage of waste rock, would destroy the cultural resources. There could also be indirect impacts to nearby resources. No eligible cultural resources have been identified in the project area, and no direct or indirect impacts would occur.

4.13.1.1 Proposed Action

All of the areas of proposed disturbance have been inventoried for cultural resources, and no historic properties that may require avoidance, monitoring or mitigation have been identified.

4.13.1.2 Alternative 1 – Proposed Action with Impermeable Capping of Backfilled Area

This alternative is essentially the same as the Proposed Action except for the construction of a layer of impermeable material between the seleniferous waste rock and the applied growth media. Differences in design would increase the surface area that would be disturbed outside the perimeter of the pit by 51 acres. However, no historic properties have been identified in this proposed additional area, and no adverse impact is anticipated.

4.13.1.3 Alternative 2 – No Action

The No Action Alternative would preclude mining and development in the North Rasmussen Ridge area, but approved mining at the Central Rasmussen Ridge Mine would continue. No eligible cultural resources have been identified in this area, and there would be no adverse effect to known historic properties.

4.13.2 Irreversible and Irretrievable Commitment of Resources

No eligible cultural resources have been identified in the project area. Consequently, there would be no irreversible and irretrievable commitment of resources.

4.13.3 Residual Impacts

This project would not result in residual impacts to cultural resources.

4.13.4 Mitigation Summary

Because no cultural resources have been identified in the project area, no mitigation measures would be necessary.

4.14 SOCIOECONOMICS

4.14.1 Direct and Indirect Impacts

4.14.1.1 Proposed Action

The analysis area for the socioeconomic environment is Caribou and Bear Lake counties. Actions or decisions that influence the economic feasibility of the mining operations would also be reflected in the socioeconomic environment. Mine economics have an effect on employment; property tax payments; royalties going to schools, roads and bridges; net proceeds of mining tax revenues; and local purchases by Agrium and its employees and Washington and its employees.

Implementation of the Proposed Action would allow open pit operations to continue for an estimated 8 additional years based on the proposed mine plan (Agrium 2001). Implementation of the North Rasmussen Ridge Mine project would result in sustained employment at the mine, allow for further diversification of the local economy, enhance community stability, and provide for continued payment of local, state, and federal taxes by Agrium, its employees, Washington, and its employees. Local government fiscal conditions in particular depend on sustained economic activity and continued revenues from sales and use taxes and property taxes. Without implementation of the proposed expansion project, existing operations at the Central Rasmussen Mine are estimated to continue at current levels through 2003, when reserves in the Central Rasmussen pit would be exhausted, limiting the volume of ore available to Agrium's fertilizer plant. As a result, approximately 400 mine and plant employees would be laid off, revenues from property taxes would be lost, and payment of other taxes and the purchase of goods and services would be reduced.

The Proposed Action would not cause adverse impacts to the socioeconomic resources of Caribou and Bear Lake counties. The proposed action requires no new workforce, and generates only moderate tax revenues. Consequently, no increases in housing or community service demands would occur and existing and planned facilities would not be adversely affected. The operation of the project would add revenue to the Caribou County tax base. Economic benefits to Bear Lake County would be limited to the circulation and recirculation of personal income earned as wages paid to employees. A major percentage of the current workforce resides in Bear Lake County. No additional employees would be hired for the proposed mine expansion, and no impacts to the counties from additional pressure on county services and housing would be expected.

Population

It is anticipated that the project workforce would consist of local contract workers who have been employed in ongoing mining operations at the Central Rasmussen Ridge Mine. No changes in employment or population are anticipated as a direct result of the Proposed Action. There would be no increase in population as a direct impact from the ongoing operations at the Central Rasmussen Ridge Mine or the proposed operations at the North Rasmussen Ridge Mine. The labor pool in Caribou and Bear Lake counties would be able to meet the needs for additional workers in the event that additional contract employees would be required for any phase of the proposed project.

Economy and Employment

Short-term impacts to socioeconomic resources would be relatively minor. It is unlikely that the Proposed Action would have a perceptible impact on the economy of Caribou County. The primary economic sectors are services and agriculture. The services sector consists largely of recreation and tourism-related establishments. Proposed activities would not affect tourist visits to the region. The initial development phases of the proposed project would require purchases of equipment and supplies; however, the economic benefits to the affected counties would be limited.

Long-term impacts would be beneficial for the life of the proposed mine. There would be beneficial impacts to the county tax base as a result of the North Rasmussen Ridge Mine operations. Caribou County would receive revenues from property taxes, fees, and permits. Additional personal income would be generated for residents in Caribou County, Bear Lake County, and the State of Idaho by circulation and recirculation of dollars paid out as salaries, business expenditures, and as state and local taxes.

No property taxes would be paid on the mine, as the proponent does not own the mining property. However, property taxes on Agrium's fertilizer plant and other mining property would be an estimated $1.2 million in 2002. In 1999, Caribou County received more than $7 million in total property taxes. It is anticipated that property tax revenues would be slightly higher for 2002, so that Agrium would contribute an estimated 15 percent of total property taxes in the county.

Royalties on the mined ore are paid to federal agencies at about $0.75 to $0.85 per wet ton mined. A certain amount then comes back to the communities to be used for schools, roads, and bridges. Between 2004 and 2011, the estimated range of production would be 1.1 million to 1.9 million tons of ore per year. The estimated royalties paid to the county would range between $0.8 million to $1.4 million for each year of production at the North Rasmussen Ridge Mine.

Expenditures made for equipment, energy, fuel, operating supplies, and other products and services benefit businesses in the counties and the state. The estimated purchases made directly by Agrium in 2002 for initial development phases would be about $300,000. In addition, Agrium's annual payments to the contractor include purchases of diesel fuel, parts, and supplies.

Housing

No changes in employment or population are anticipated as a direct result of implementation of the Proposed Action. Any additional employees are likely to be local hires; therefore, it is unlikely that there would be any demand for additional temporary or permanent housing within or near the analysis area. In the event that additional contract workers are hired from outside of the affected counties, housing needs likely can be met with the existing supply, depending on the vacancy rates during the period of operations. The majority of available housing units in the project area are located in the communities of Soda Springs and Montpelier. In Soda Springs, the rental vacancy rate in 2000 was 28.9 percent, and the homeowner vacancy rate was 2.2 percent. The 2000 rental vacancy rate in Montpelier was 25.8 percent, and the homeowner vacancy rate was 16.4 percent. No adverse impacts to housing availability and services are therefore expected. There would be sufficient rental units to house the project workforce.

Community Services

Construction, operation, and maintenance of the proposed project would not increase or decrease the need for police, fire, medical, or other community resources in the project area. The project would not cause an increase in the local population in Caribou and Bear Lake counties; therefore, no increases for county and community services are anticipated. The local population increases considerably on an annual basis during the tourist season, and the counties are accustomed to meeting the needs of the seasonal increases in population.

No increases in employment or population are anticipated from implementation of the Proposed Action or Alternative 1. Therefore, increases in existing levels of domestic water usage in Caribou or Bear Lake Counties are not expected, and no effects on existing domestic water facilities would occur. In addition, existing organized public water systems would not be used for any portion of mining operations. Therefore, no effect on domestic water systems would occur. Wastewater disposal requirements in Caribou County or the cities of Soda Springs or Montpelier are not anticipated to increase with implementation of either action alternative.

Similarly, no county-wide effects on solid waste collection or disposal are anticipated as a result of increases in the population. Solid waste generated at the project site would continue to be hauled from the site and disposed of at an approved landfill.

Community effects on law enforcement, fire protection, medical facilities, schools, parks and recreation, or public libraries are not anticipated with implementation of any action alternative.

4.14.1.2 Alternative 1 - Proposed Action with Impermeable Capping of Backfilled Area

Alternative 1 includes all of the socioeconomic effects described under the Proposed Action. Impacts to the socioeconomic structure of Caribou and Bear Lake counties, including population, housing, and employment, are identical for the Proposed Action. Impermeable capping of backfilled waste rock may require additional expenditures for supplies or equipment, but any

additional revenues realized from these purchases by vendors within the counties or the state would not be greatly different than purchases made for the Proposed Action.

4.14.1.3 Alternative 2 - No Action

Selection of the No Action Alternative would result in a decline in employment at the existing Central Rasmussen Ridge Mine beginning in 2003 based on current mine economics. It is likely that many of those workers currently employed by Agrium and Washington would relocate if other local employment were not available, resulting in a slight reduction in the overall county population.

The projected loss of employment could lead to negative effects on overall stability of the community. Although many current Agrium and Washington employees could be hired at other mining projects in the area, a substantial number would become unemployed and might leave the area to seek other employment. Large fluctuations in employment would not provide for a stable community environment.

The No Action Alternative would generally have no effect on existing public utilities and services. However, tax-based revenues and other sources of municipal funding related to mining operations would be negatively affected if the Central Rasmussen Ridge Mine closes. Subsequently, Caribou County's ability to fund certain utilities and services could be jeopardized. This effect may be less if employees find jobs at other mine operations in the county, which would be unlikely.

Selection of the No Action Alternative would result in a reduction in sales, use, and property tax revenues generated by Agrium mining operations. There would be losses in revenues from taxes paid by Agrium, its employees, Washington, its employees, and by secondary businesses and their employees, resulting in a decrease in Caribou and Bear Lake County's overall revenues

4.14.2 Irreversible and Irretrievable Commitment of Resources

There would be no irreversible or irretrievable commitment of social or economic resources associated with the Proposed Action or alternatives.

4.14.3 Residual Impacts

The Proposed Action and Alternative 1 would not have residual effects on social or economic resources. Alternative 2, No Action, could result in some social dislocations and economic changes in county and local revenues beginning in 2003, when mining at the Central Rasmussen Ridge Mine would cease.

4.14.4 Mitigation Summary

No specific mitigation measures for socioeconomic resources have been identified.

4.15 ENVIRONMENTAL JUSTICE

On February 11, 1994, Executive Order 12898, "Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations" was published in the Federal Register (59 FR 7629). The order requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations. The Proposed Action is an expansion of an existing facility that is surrounded by National Forest System lands, and would not affect any area made up of low-income housing or affect low-income populations.

The U.S. Census identified 714 residents, or 9.6 percent of the total population, who live below the poverty level in the urban areas of Caribou County. Residents who live below poverty level were not identified for rural areas between Soda Springs and the Rasmussen Ridge Mine. The proposed project is on federal leases and is not located within the corporate limits of any urban community or in any populated rural area. The Proposed Action would not affect any area that contains populations living under the poverty level.

The population of Caribou County is predominantly white (96.0 percent, according to the 2000 Census). The Hispanic population accounted for 4.0 percent. Other minority groups in Caribou County constitute a small percentage of the total population. No areas were identified in the county that consisted of predominantly minority populations. Neither the Proposed Action nor Alternative 1 would disproportionately affect minority populations.

4.16 HAZARDOUS MATERIALS AND WASTE

4.16.1 Direct and Indirect Impacts

4.16.1.1 Proposed Action

An accidental spill of hazardous materials or wastes associated with the Proposed Action is unlikely to pose environmental or public health and safety risks. As shown in **Table 2.2-6**, most of the hazardous materials to be used for the Proposed Action would be stored in above-ground tanks in the existing shop area at the Central Rasmussen Ridge Mine. The capacity of the existing secondary containment facilities is adequate to hold the entire contents of the largest tank within the storage area, including freeboard for precipitation. Fuel leaks from the truck filling area would be contained in the haul road retention pond D and would not likely reach No Name Creek or other drainages. Less than 100 kilograms of hazardous waste (waste solvents) would be generated per month. Compliance with the procedures and training defined in the existing approved SWPPP would minimize the potential for spills or leaks of hazardous materials or wastes. Agrium's mining contractor, Washington Group, also has a Spill Prevention Plan (SPP) in place to prevent spills and to direct responses if a spill does occur.

Wastes generated by drilling would be handled as described in Section 2.2.2.2, Waste Dump and Backfill Design. Waste produced from the mining process would be placed in the backfilled portions of the Central Rasmussen pit and mined-out areas of the North Rasmussen pits as they become available.

The Proposed Action is unlikely to pose safety hazards to the public related to the proposed route for transporting hazardous materials and wastes. Under the Proposed Action, the proposed storage area for hazardous materials would be the existing shop area at the Central Rasmussen Ridge Mine and the haul route for hazardous materials and wastes would be the same route that is currently used at the Central Rasmussen Ridge Mine. The primary transportation route from Soda Springs to the shop at the existing Central Rasmussen Ridge Mine would be via State Highway 34, Blackfoot River Road, and the existing haul road to the mine site.

4.16.1.2 Alternative 1 – Proposed Action with Impermeable Capping of Backfilled Area

Potential risks associated the hazardous materials or wastes for Alternative 1 would be the same as were analyzed for the Proposed Action. Under Alternative 1, the hazardous materials and wastes, quantities used and stored on site, and storage locations would be the same as were analyzed for the Proposed Action (**Table 2.2-6**). Under Alternative 1, hazardous materials and wastes would continue to be transported along the same route that is currently used for the Central Rasmussen Ridge Mine.

4.16.1.3 Alternative 2 – No Action

The hazardous materials or wastes for Alternative 2 would not pose any risks to the environment or public health and safety. Under Alternative 2, there would be no mining or associated disturbance at North Rasmussen Ridge. This alternative would involve continued mining at the Central Rasmussen Ridge Mine until all ore was recovered. For Alternative 2, the hazardous materials and wastes, quantities used and stored on site, and storage locations would continue to be used at the Central Rasmussen Ridge Mine (**Table 2.2-6**). No significant spills or leaks of fuel have occurred during operation of the existing mine facilities (Agrium 2002).

4.16.2 Irreversible and Irretrievable Commitment of Resources

No long-term effects to health and safety from hazardous materials would result from implementation of any of the alternatives.

4.16.3 Residual Impacts

No residual adverse impacts to health and safety from hazardous materials would result from implementation of any of the alternatives.

4.16.4 Mitigation Summary

Project design features and BMPs (see Chapter 2) are the elements of the Proposed Action designed to reduce environmental impacts from hazardous materials. No specific mitigation measures are proposed to address hazardous materials and wastes, as the handling and storage of those materials are already controlled by a body of laws and regulations. The regulatory framework for hazardous materials and wastes was presented in Section 2.2.3.6.

CHAPTER 5 – CUMULATIVE EFFECTS

CHAPTER 5 - CUMULATIVE EFFECTS

Cumulative effects are the impacts on the environment that result when the incremental impacts of the Proposed Action or alternatives are added to other past, present, and reasonably foreseeable future actions in the Cumulative Effects Area. The reasonably foreseeable future is defined as 15 years (BLM and USFS 2002). Cumulative effects are analyzed for the same resources as were described in **Chapter 4** of this document. Results of these analyses lead to the determination of whether the Proposed Action or alternatives would contribute significantly to impacts associated with other activities in the area.

The geographic Cumulative Effects Area described in this section varies according to the resource discussed, but generally includes the east half of Caribou County and a portion of northern Bear Lake County which encompasses an area of approximately 505,000 acres. Major land uses in the area are timber harvesting, livestock grazing, and mining. The area is also used for dispersed recreation such as hunting, fishing, and other outdoor activities, but the effects of these actions are likely to be of lower magnitude than the three major land uses.

Since the early 1980s, many timber sales have occurred in areas within the Cumulative Effects Area. From 1992 to 2002, the Caribou Unit of the Caribou-Targhee National Forest sold 67.2 million board-feet and harvested approximately 72.5 million board-feet from suitable lands (Padian 2003). Approximately 2,372 acres of timber have been harvested, and 488 acres have been harvested as a result of mining on Rasmussen Ridge. During the period for the analysis of cumulative effects, an additional 1,800 acres may be harvested as a result of mining. After the timber is removed, these areas would be reclaimed with grasses and, where practical, efforts would be made to replace the timber.

The USFS conducts monthly monitoring during the growing season of lands at the Rasmussen Ridge Mine for potential occurrences of weeds. Weeds that are located are reported to the mine, and Agrium retains a contractor to control weeds on Agrium's historic mine properties; the active mine property Agrium treats itself. The USFS has also been treating weeds in other areas and maintains an atlas of weeds and treatments. The increased awareness of and active treatment of weeds are designed to limit the spread of invasive species and, if possible, to eradicate noxious weeds from national forest lands.

The livestock industry has been an integral part of the Cumulative Effects Area since humans settled the area. Allotments have been established and leased on federal lands in the area. After years of overgrazing, recent livestock stocking levels have decreased to bring numbers in line with forage production. Private lands also are grazed within the Cumulative Effects Area. Livestock grazing would continue to be a major land use and may be expected to increase above current rates, after mining areas are reclaimed. Grazing as a general land use can contribute to erosion and sedimentation in waterways in the Cumulative Effects Area.

Mining in the Rasmussen Ridge reserve began in 1991 when an Environmental Assessment was approved for South Rasmussen. Mining continued with approvals of the Central Rasmussen block in 1996, 1997, 1998 and 1999. A total of 488 acres has and will be disturbed by these mines. The Enoch Valley Mine is located west of Rasmussen Ridge and may disturb up to 733

acres of land. The Proposed Action for mining North Rasmussen Ridge includes disturbance of 269 acres between the years 2003 and 2011.

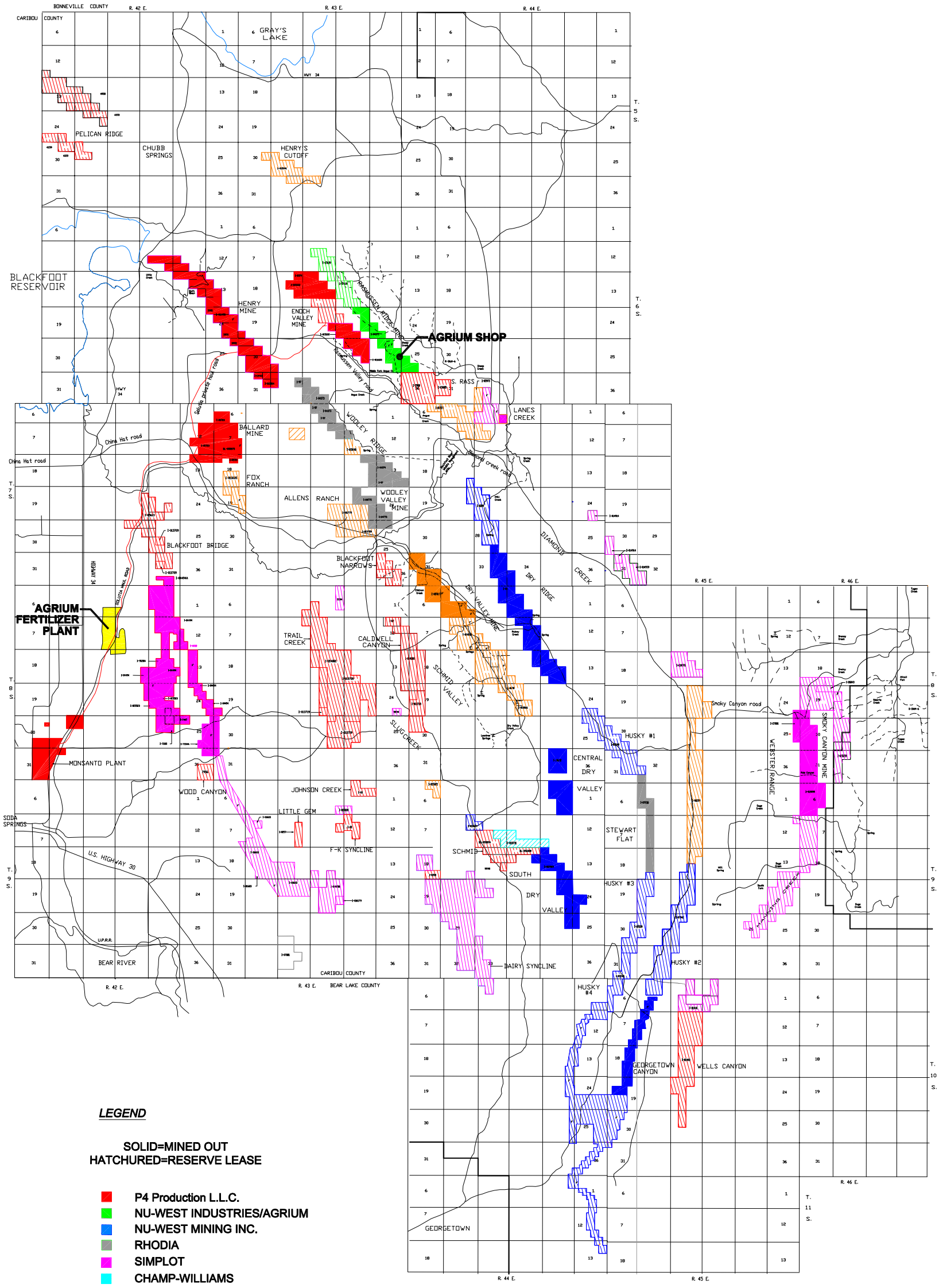
The Caribou Unit of the Caribou-Targhee National Forest comprises a little over 1 million acres in southeast Idaho. The Preferred Alternative for the Draft Revised Forest Plan (USFS 2001) is committed to multiple use on National Forest System lands in the following ways: Access/recreation management emphasizes the recreation opportunity classes of semi-primitive motorized, roaded natural, and rural classes. Ecosystem management indicates a high risk for insect hazard, and a high risk for wildfire in forested areas. The Preferred Future Condition for mature and old-growth forested vegetation is 63 percent conifer and 76 percent aspen, although this preferred future condition is not considered achievable. Livestock grazing management estimates grazing of cattle on 566,800 acres and sheep on 1,000,400 acres. Mining management would follow adaptive directions. Riparian water quality/aquatic habitat management would be based on maintaining a moderate persistence of species. The timber sale program for the first decade estimates a total of 29 million board-feet sold from 7,000 acres and 500 acres in roadless areas, with 9 miles of new road and 9 miles of reconstructed road. Wilderness and roadless area management recommends 47,200 acres for wilderness, available for summer non-motorized and winter-motorized use. Finally, wildlife habitat management is predicted to meet summer habitat effectiveness, hunting season vulnerability, and acres managed for winter range, and the viability analysis indicates a high likelihood of species persistence (USFS 2001).

5.1 MINERALS, TOPOGRAPHY, GEOLOGY AND PALENTOLOGY

A larger Cumulative Effects Area that encompasses the eastern half of Caribou County and the northern half of Bear Lake County was used to evaluate cumulative effects on minerals, topography, geology, geochemistry, and paleontology of the Western Phosphate Field in southeastern Idaho. Implementation of the Proposed Action and other reasonably foreseeable activities would have potential effects related to mineral resource depletion, topographic changes, exposure of potential seleniferous materials and other contaminants of potential concern to weathering processes and subsequent dissolution and mobilization through seepage, geotechnical instability, and discovery, damage, or removal of paleontological resources.

The location and status of known phosphate reserves in the Cumulative Effects Area are shown in **Figure 5.1-1**. If an anticipated annual increase of 1 to 2 percent in annual production of phosphate ore from southeastern Idaho was projected for the next 15 years, the cumulative production of phosphate ore from southeastern Idaho would be 80 to 100 million tons, or an average annual production rate of 6 million tons per year. The impact of the Proposed Action accounts for about 15 percent of the phosphate ore that would be mined over this period. In contrast, economically recoverable phosphate ore reserves in southeastern Idaho have been estimated at one billion tons (BLM and USFS 2002).

The Cumulative Effects Area shown in **Figure 5.1-1** represents an area of 789 square miles, or 504,960 acres. The figure illustrates two classes of phosphate mining: historical and current mining (mined-out) and current reserve leases. Acreages for these classes of phosphate mining are presented in **Table 5.1-1**. The portion of the current leases that represent reasonably foreseeable phosphate mines is not known because ownership of a lease does not guarantee the



LEGEND

SOLID=MINED OUT
HATCHURED=RESERVE LEASE

- P4 Production L.L.C.
- NU-WEST INDUSTRIES/AGRIUM
- NU-WEST MINING INC.
- RHODIA
- SIMPLOT
- CHAMP-WILLIAMS
- ASTARIS
- JOINT FMC - SIMPLOT

NORTH

0 3 6
Scale in Miles

North Rasmussen Ridge Mine EIS Project

FIGURE 5.1-1
PHOSPHATE MINING IN
THE CUMULATIVE EFFECTS AREA

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	1164 MINES.dwg
Scale: 1" = 3 MILES	Drawn By: MTM

Source: R. Petrun 2000

TABLE 5.1-1
TOTAL MINED-OUT AND RESERVE AREAS AND ASSOCIATED ACRES OF VEGETATION, TIMBER MANAGEMENT, DEER AND ELK WINTER RANGE, AND LAND OWNERSHIP WITHIN THE CUMULATIVE EFFECTS AREA

Area	Acres	Percent		
TOTAL	**504,960**	**100**		
Current Leases	38,874	7.7		
Mined-out	13,687	2.7		
Reclaimed	11,976	87.5 of Mined-out		
Total not Reclaimed	1,711	0.34 of TOTAL		
Land Type	**Mined-out (Acres)**	**Reserves (Acres)**	**Area Total**	**Area Percent**
Agriculture	1,340	1,235	90,530	18
Alpine Meadow	1	22	630	0.125
Exposed Rock	550	0	850	0.17
Forest Upland/Broadleaf Forests	2,400	9,955	94,560	18.73
Forest Upland/Needleleaf Forests	1,750	10,850	112,040	22.19
Non-forested Lands (including grassland and shrub)	7,680	11,800	183,060	36.25
Riparian	295	990	17,050	3.38
Urban/Developed	1,960	0	6,240	1.16
Timber Management Units				
Prescription b	575	5,410	25,530	5.01
Prescription c	0	1,570	6,960	1.38
Deer and Elk Winter Range				
Winter Range	1,270	1,255	48,460	9.6
Critical Winter Range	30	60	11,100	2.2
Land Ownership				
BLM	1,215	540	23,800	4.71
U.S. Forest Service	6,800	19,130	249,275	49.37
State of Idaho	1,875	10,190	41,045	8.13
Private	6,080	4,985	196,925	40
USFWS	0	0	3,968	0.79

ore will be mined. The active leases represent three times the amount of mineralized area that has already been mined.

The portion of the mined-out areas that has been reclaimed is unclear, as reclamation is highly variable from mine to mine and information for older mines is sparse. As of October 2000, there

were four active phosphate mines in the Southeast Idaho Phosphate Resource Area: Dry Valley Mine, Smoky Canyon Mine, Enoch Valley Mine, and the Rasmussen Ridge Mine (Montgomery Watson 2000). These mines have published plans to reclaim more than 87.5 percent of the disturbance areas. The areas that will not be reclaimed consist of pit walls, pit lakes, or partially backfilled pit bottoms. Nearly 12,000 disturbed acres have been reclaimed, and the amount of disturbance that will remain unreclaimed is less than 1 percent of the Southeast Idaho Phosphate Resource Area. Acreages for these classes of phosphate mining are presented in **Table 5.1-1**. **Table 5.1-1** also depicts total acres of vegetation, timber management units, deer and elk winter range, and land ownership that are located within mined-out and reserve areas within the Cumulative Effects Area.

Effects on topography result from mining-related surface disturbance. Natural and mining-related slope failures or erosion also affect the land surface and its features. The topography of the Cumulative Effects Area has been relatively unaffected by mining. A large phosphate mine usually affects several hundred acres, and most is reclaimed to the approximate original topography. In contrast, the Cumulative Effects Area contains more than one-half million acres. The Proposed Action and reasonably foreseeable activities within the Cumulative Effects Area would not have a noticeable effect on topography except in pit areas that are not backfilled or in external waste rock dump areas.

Mobilization of selenium and other contaminants of potential concern within the Cumulative Effects Area can be affected by a variety of activities. However, mining has the most significant impact because it disturbs and exposes geologic units that contain elevated concentrations of selenium. Recent research has identified sources, pathways, and control measures that would reduce this impact from reasonably foreseeable phosphate mining. Based on the design measures for the Proposed Action described in this document, dissolution and mobilization of selenium from the Proposed Action and reasonably foreseeable future actions would be greatly reduced when compared with past phosphate mining operations, and minor relative to the Cumulative Effects Area.

Within the Cumulative Effects Area, potential geotechnical instability associated with mining results from failures of highwall and overburden fill or failures associated with other major earth moving. Earthquakes or storms could also increase failures of the highwall or overburden fill in mine areas, activate landslides, or cause failures in road cuts or other surface disturbance areas. The potential effects on geotechnical stability that would be associated with the Proposed Action and other reasonably foreseeable future activities likely would be minor relative to the Cumulative Effects Area.

Within the Cumulative Effects Area, impacts associated with the discovery, damage, destruction, or removal of paleontological resources would result primarily from mining. The effects from mining can be positive as well as negative. Mining can uncover paleontological resources and information that otherwise would not be discovered, thereby increasing scientific knowledge. However, mining generally is very destructive to fossil resources.

The cumulative effects associated with Alternative 1 would be similar to the Proposed Action, with the following exception. A mining operation that produces the mineral materials for the

impermeable backfill cap likely would affect at least 25 additional acres. This addition to the cumulative disturbance described above for the Proposed Action would not have a noticeable effect on topography except in the immediate vicinity of the mine disturbances.

The cumulative effects associated with Alternative 2, No Action, would not be similar to the Proposed Action. The impact of Alternative 2 would not account for any of the phosphate ore mined in the Cumulative Effects Area at North Rasmussen Ridge. Thus, this alternative would represent an estimated 15 percent reduction in the phosphate ore mined through 2011, unless this volume could be produced from another mine within the Cumulative Effects Area.

5.2 AIR RESOURCES

Airborne particulate matter is the most common air pollutant emission associated with the major commercial land use activities in the Cumulative Effects Area. Sources of airborne particulate matter include mining, timber harvesting, prescribed fire, wildfire, fire suppression activities, road use, and grazing. Grazing and timber harvesting can produce fugitive dust, but the quantities are minimal and are expected to remain approximately equal to present conditions. Mining is the major activity that produces dust in the area. The trend in phosphate production in southeast Idaho is an increase of 1 to 2 percent annually (BLM and USFS 2002). Since fugitive dust emissions are directly related to the mining process rate, it can reasonably be expected that fugitive emissions in southeast Idaho may increase 1 to 2 percent annually. However, cumulative effects on air quality from phosphate mining are not expected for the following reasons: all existing mines and all foreseeable mines are required by stipulations in their permits to implement BMPs for air quality that include watering roads and active work areas or applying magnesium chloride (a dust suppressant) to roads and work areas. Adherence to these and other permit conditions, enforced by the State of Idaho, ensures that the mines will be in compliance with NAAQS for fugitive dust. Additionally, there is typically from 2 to 5 miles between mines in southeast Idaho (**Figure 5.1-1**). The separation between mines contributes to the amelioration of effects from any single mine rather than contributing to cumulative effects among several mines. The Proposed Action and Alternative 1 would be extensions of the existing Central Rasmussen Ridge Mine at the same mining rate and would not be expected to increase existing levels of air pollutant emissions.

The cumulative effects of noise would also be equivalent to existing conditions. Noise impacts from mining operations would shift in a northern direction for the proposed mining operations. The noise from these operations would not be cumulative but relocated along the phosphate-mining trend.

5.3 WATER RESOURCES

The North Rasmussen Ridge mining activities span three watersheds, including Reese Canyon Creek, No Name Creek, and the West Fork of Sheep Creek. A drainage divide occurs in the northwestern portion of the project area that separates surface water tributary to the Little Blackfoot River from water tributary to the Blackfoot River. Reese Canyon Creek flows northwest and is tributary to the Little Blackfoot River. No Name Creek flows southeast to Angus Creek, and Sheep Creek also flows southeast, to Lanes Creek; both are tributaries to the

Blackfoot River. The Little Blackfoot River and Blackfoot River both discharge into Blackfoot Reservoir that defines the Cumulative Effects Area.

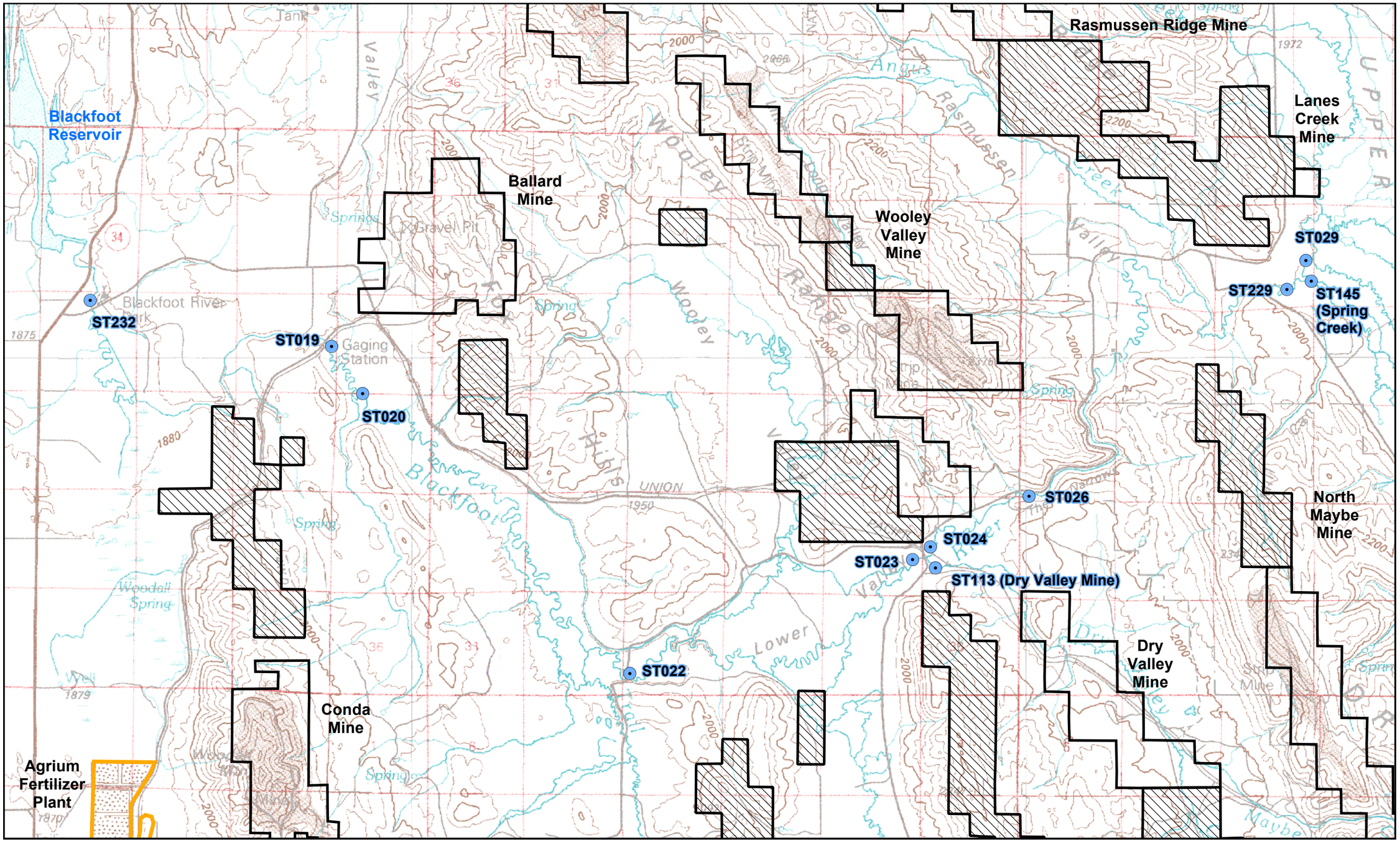
Groundwater used in the Cumulative Effects Area is from water wells for domestic water supplies. Domestic water wells in the Cumulative Effects Area are few in number and are widely distributed. Modeling calculations in the Environmental Consequences chapter indicate the only groundwater contaminant plume may travel three thousand feet over 500 years. In most cases, domestic water wells are miles from the nearest mine. Where a phosphate mine and domestic water well are in closer proximity, intensive monitoring would occur and well water mitigation measures would be taken when necessary. Effects from timber harvesting, grazing, road construction, and recreational uses on groundwater resources are negligible.

Many of the past and current human activities within these watersheds, including mining, livestock grazing, timber harvesting, and road construction, typically increase sediment loads to streams and often result in channel instability. These types of impacts are documented within the watersheds of interest, and Sheep Creek, Angus Creek, Lanes Creek, and the Blackfoot River below the confluence with Lanes Creek are listed as water quality limited water bodies under Section 303(d) of the Clean Water Act. Sediment was the pollutant that exceeded standards in the assessment. Best management practices and other controls implemented in recent years serve to reduce sediment impacts from mining and timber production.

Samples of stream water from 12 stations were collected along the Blackfoot River in the summer of 1999 (Montgomery Watson 2000). **Figure 5.3-1** illustrates nine of the sample locations on the Blackfoot River and three stations on tributary streams. **Table 5.3-1** summarizes the results for selenium and cadmium. Values shown in bold type exceed the corresponding aquatic cold-water criteria, and italicized values are less than the upper tolerance bound (Montgomery Watson 2000).

Figure 5.3-2 displays selenium and cadmium concentrations from May through August 1999 for monitoring stations ST232 and ST113 on the Blackfoot River and Dry Valley Creek, respectively. The figure shows that concentrations of selenium at these two stations exceeded the chronic cold-water standard of 0.005 mg/L in May. In June, only the sample collected from the Dry Valley Creek station (ST113) exceeded the standard, and by July, the selenium concentrations were less than the standard at both stations. Concentrations of cadmium at both locations were less than the hardness-specific standard during all sampling events (Montgomery Watson 2000).

Stream field data also were collected and are presented in **Table 5.3-2.** These data were considered consistent with what was observed in 1998 (Montgomery Watson 2000). Effects from timber harvest, grazing, recreational uses, and road construction on groundwater resources are minimal. Mining has the potential to affect the resource by withdrawal for consumptive use or from infiltration from open pits and seepage through overburden backfill that have the potential to affect groundwater quality. Groundwater modeling indicated that the Proposed Action would have a limited and localized impact on existing groundwater.



Note: Station ST233 is located on West side of Blackfoot Reservoir.

Source: Montgomery Watson 2000

NORTH

0 0.5 1 2 3 4 Miles

Legend

Phosphate Mining Area

- Mined Out
- Reserved
- Agrium Fertilizer Plant
- Stream Monitoring Location

North Rasmussen Ridge Mine EIS Project

FIGURE 5.3-1
STREAM MONITORING LOCATIONS ON THE BLACKFOOT RIVER

ANALYSIS AREA: Caribou County, Idaho

Date: 02.27.03	Arcview File: Agrium_Monitoring_Wells.mxd
Scale: As Noted	Prepared by: MSH

TABLE 5.3-1
CONCENTRATIONS OF SELENIUM AND CADMIUM IN STREAMS

Site ID	Date	Selenium (mg/L)	Selenium Chronic Cold-water Concentration[1]	Cadmium (mg/L)	Cadmium Chronic Cold-water Concentration[2]
May					
ST233	5/26/99	*0.00049*	0.005	*0.0015*	0.0019
ST232	5/24/99	**0.0067**	0.005	*-0.00076*	0.0017
ST019	52499	**0.0082**	0.005	*-0.00073*	0.0015
ST020	5/25/99	**0.0072**	0.005	*-0.00073*	0.0015
ST022	5/25/99	**0.0098**	0.005	*0.0*	0.0015
ST023	5/24/99	**0.079**	0.005	*-0.0015*	0.0015
ST113	5/24/99	**0.049**	0.005	*0.0011*	0.0020
ST024	5/24/99	**0.0074**	0.005	*0.00073*	0.0015
ST026	5/25/99	**0.0090**	0.005	*-0.0012*	0.0015
ST229	5/25/99	**0.019**	0.005	*-0.00073*	0.0015
ST145	5/25/99	**0.046**	0.005	*-0.0015*	0.0016
ST029	5/26/99	0.00044	0.005	*0.00048*	0.0014
June[1]					
ST232	6/23/99	0.0021	0.005	0.00010	0.00018
ST113	6/23/99	**0.0068**	0.005	0.00078	0.0021
July[3]					
ST232	7/21/99	0.0024	0.005	0.0016	0.0018
ST113	7/21/99	0.0027	0.005	0.0012	0.0022
August[3]					
ST232	8/10/99	0.0015	0.005	0.00088	0.0018
ST113	8/10/99	0.00099	0.005	0.0018	0.0022

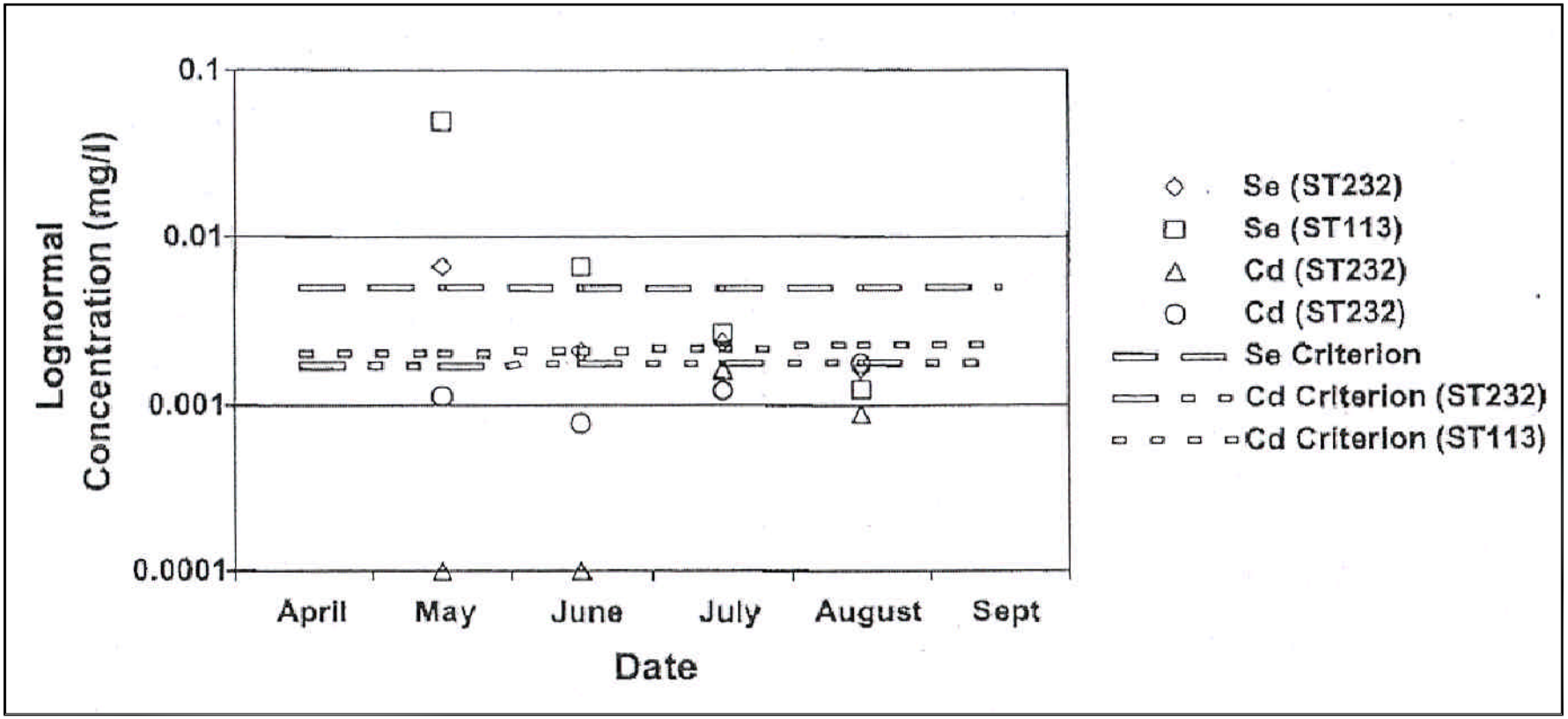
Notes: 1 EPA chronic hardness criterion (EPA 1988)
2 Hardness specific chronic criterion. Hardness values are presented in Ratti and Garten 2000.
3 Upper tolerance bounds (UTB) were not calculated for samples collected in June, July, and August because the sample size was inadequate for statistical tests. The UTB calculations are presented in Ratti and Garten 2000.
Values shown in **bold** exceed the chronic aquatic cold water criterion.
Values shown in *italics* are less than the UTB for the blank samples.
Source: Montgomery Watson 2000.

TABLE 5.3-2
STREAM FIELD DATA

Parameter	Range of Reported Values
pH (units)	7.8 – 8.4
Conductivity (µS/cm)	297 – 506
Temperature (°C)[1]	9.8 – 22.1
Dissolved Oxygen (mg/L)	7.7 – 10.9
Turbidity (NTU)[2]	3.93 – 113
Oxygen-Reduction Potential (mV)[3]	97 - 206

Notes: 1 In general, the coolest temperatures were measured in May and increased every month. The highest value was measured at ST232 in July.
2 Turbidity readings were typically much higher in May than in the other months. Measurements at ST113 were similar every month.
3 Oxygen reduction potential was not measured in June through August.

Source: Montgomery Watson 2000.



Source: Montgomery Watson,2000

North Rasmussen Ridge Mine EIS Project	
FIGURE 5.3-2 STREAM CONCENTRATION TEMPORAL TRENDS	
ANALYSIS AREA: Caribou County, Idaho	
Date: 02.27.03	Drawing File: 1164 Stream.dwg
Scale: NTS	Drawn By: ETC

Water quality data for selenium were gathered from a variety of sites at various mines in the southeast Idaho area (BLM and USFS 2002). Data were collected from ponds, overburden seeps, and springs below overburden storage, and from French drains. (The Proposed Action at North Rasmussen Ridge does not include any of these features, and these data sets represent other existing mines in the area). There were 29 revised data points taken from ponds that had a mean value of 0.080 mg/L of selenium. There were 23 revised data points from overburden seep and springs below overburden that had a mean value of 0.252 mg/L. There were four data points from French drains and they had a mean concentration of selenium of 0.508 mg/L. (The data for these three categories of samples are presented in **Tables 5.3-3, 5.3-4,** and **5.3-5**). Although these data are non-homogeneous with regard to field workers, sampling protocols, months and years of sampling, laboratories, analytical methods, and other factors, the data provide ranges of results that meet the objective of generally describing the variability and approximate maximum values that might be expected to occur in water samples obtained from facilities at phosphate mines in southeast Idaho (BLM and USFS 2002).

5.4 WATERSHED AND SOILS

A Cumulative Effects Area that encompasses the eastern half of Caribou County and the northern half of Bear Lake County was used to evaluate cumulative effects on soils and watersheds of the Western Phosphate Field in southeastern Idaho. Activities affecting watersheds include mining, farming, ranching, livestock grazing, wildfires, fire suppression activities, timber sales, and road building. Past and present mining affects approximately 10.4 percent of the area; agricultural activities affect approximately 18 percent of the area; and forested lands occupy approximately 40.9 percent of the Cumulative Effects Area. All of man's activities affect soils and watershed resources within the Cumulative Effects Area. Potential cumulative effects consist of damage or removal of vegetation, topsoil and subsoil, changes in slope, and exposure of soil and earth materials to weathering processes and subsequent erosion. Another result of all the activities in the watershed is that the watershed slowly loses the ability to capture, store, and safely release the water deposited on it.

Effects on soil slope values result from mining-related surface disturbance. Natural and mining-related slope failures or erosion also affect the land surface and its soil and watershed resources. The soil resources of the Cumulative Effects Area have been relatively unaffected by mining. A large phosphate mine usually affects several hundred acres, most of which are reclaimed to the approximate original topography. In contrast, the Cumulative Effects Area contains more than million acres. The Proposed Action and reasonably foreseeable activities within the Cumulative Effects Area would not have a noticeable effect on soil slopes except in pit areas that are not backfilled or external waste rock dump sites.

Mobilization of selenium and other contaminants of potential concern within the Cumulative Effects Area can be affected by a variety of activities. However, mining has the most significant impact because it disturbs and exposes geologic units that contain elevated concentrations of selenium, leading to the formation of soluble selenium in overlying soil. Recent research has identified sources, pathways, and control measures that would reduce this impact from reasonably foreseeable phosphate mining. Based on the design measures for the Proposed Action described in this document, dissolution and mobilization of selenium from the Proposed Action

and reasonably foreseeable future actions would be greatly reduced when compared with past phosphate mining operations, and minor relative to the Cumulative Effects Area.

TABLE 5.3-3
REVISED DATA FROM PONDS

Site	Location	Description	Sample Date	Selenium (mg/L)
13[1]	South Rasmussen Ridge	Haul Road Pond in Ras. Valley	4/10/00	0.008
32	Enoch Valley	Bat Cave Pond	9/97 – 8/00	0.201
27	Henry	Center Henry	9/19/979	0.248
15[1]	South Rasmussen Ridge	Haul Road Pond in Ras. Valley	4/10/00	0.039
34	Enoch Valley	South Pond	9/97 – 8/00	0.401
26	Henry	Smith Pond	9/19/97	0.402
33	Enoch Valley	West Pond	9/97 – 8/00	0.432
55	Gay	JF Pit Lake	9/23/97	0.468
4	South Rasmussen Ridge	Haul Road Pond on East Ridge	4/10/00	0.05
12[1]	South Rasmussen Ridge	Haul Road Pond in Ras. Valley	4/10/00	0.05
16	South Rasmussen Ridge	Haul Road Pond by Cattleguard	4/10/00	0.05
31	Enoch Valley	Stock Pond	5/97 – 8/00	0.507
14[1]	South Rasmussen Ridge	Haul Road Pond in Ras. Valley	4/10/00	0.504
35	Enoch Valley	Tipple Pond	9/97 – 8/00	0.057
3	South Rasmussen Ridge	Haul Road Pond on East Road	4/10/00	0.057
58	Gay	Z Pit Lake	9/29/97	0.0583
36	Enoch Valley	Haul Road Pond	9/97 – 8/00	0.0592
40	Wooley Valley	Unit III Panel E Pond	9/19/97	0.0746
39	Wooley Valley	Large Haul Road Pond	9/19/97	0.075
6	Rasmussen Valley	Enoch Valley Pond	4/10/00	0.075
A-Pit	Smoky Canyon	A-Pit Pond	5, 9/98	0.0805
8	South Rasmussen Ridge	Haul Road Pond near Coyote Corner	4/10/00	0.095
41	Wooley Valley	Unit III Panel F Pond	9/19/97	0.098
56	Gay	A-12 Pit Lake	9/23/97	0.1
71	Conda	NL4 Pond	9/29/97	0.151
37	Enoch Valley	North Pond	9/18/97	0.185
17	South Rasmussen Ridge	Pond East of Shop/Office-North	4/17/00	0.2
7	South Rasmussen Ridge	Haul Road Pond near Shop/Office	4/17/00	0.22
18	South Rasmussen Ridge	Pond East of Shop/Office – South	4/17/00	0.22

Selenium Count = 29
Data Average = 0.080086207
Standard Deviation = 0.058560956
Maximum = 0.22
Minimum = 0.008
Variance = 0.003429386

Notes: Revised data have been modified to combine results for multiple samples at the same location and to delete results for samples that are near or below 0.05 mg/L.
[1] Reclaimed in 2001.
Source: BLM and USFS 2002.

TABLE 5.3-4
REVISED DATA FROM OVERBURDEN SEEPS AND SPRINGS BELOW OVERBURDEN

Site	Location	Description	Sample Date	Selenium (mg/L)
SE Well 99-1	Enoch Valley	SE Well 99-1	6/6/00	0.005
West Seep	Enoch Valley	West Seep	5/31/00	0.008
10	Champ	Champ Dumps	9/17/97	0.0149
7	Mtn. Fuel	New Spring #2	9/18/97	0.0209
DS003	Dry Valley	S. B-Dump	Ave. 5, 9/98	0.02145
2	S. Rasmussen Ridge	Spr. S. of Shop	4/10/00	0.023
1	N. Maybe	East Mill Dump	9/16/97	0.0336
DS011	Wooley Valley	Unit III Dump	Ave. 5, 9/98	0.37
6	Mtn. Fuel	New Spring #1	9/17/97	0.431
42	Wooley Valley	Unit III Dump	9/19/97	0.65
DS010	Wooley Valley	Unit I Dump	Ave. 5, 9/98	0.0785
North B Dump	Dry Valley	North B Dump	Ave. 5, 9/98	0.114
SE Well 99-2	Enoch Valley	SE Well 99-2	6/6/00	0.013
SE Well 99-3	Enoch Valley	SE Well 99-3	6/6/00	0.14
Hidden Lake	Conda	Hidden Lake	9/11/97	0.15
No Name Creek Spring	S. Rasmussen Ridge	No Name Creek Spring	Ave. 4, 5/99, 4/00	0.1567
1, 16	S. Rasmussen Ridge	Wetlands South of Shop	4, 12/00	0.165
Shop Spring	S. Rasmussen Ridge	Shop Spring	Ave. 4, 5/99	0.24
E Dump	Smoky Canyon	E. Dump Seep	Ave. 99, 7, 10, 12/00, 4/00	0.31
East Spring	Conda	East Spring	9/11/97	0.325
D Dump	Smoky Canyon	D Dump Seek	Ave. 5, 6, 9, 10, 12/00, 4/00	0.716
DS012	Wooley Valley	Unit IV Dump	Ave. 5, 9/98	1.4
46 and DS015	Conda	SW3/West Limb Seep	9/97, 9/98	1.617

Selenium Count = 23
Data Average = 0.25278913
Standard Deviation = 0.427315708
Maximum = 0.1.617
Minimum = 0.005
Variance = 0.182598714

Note: Revised data have been modified to combine results for multiple samples at the same location and to delete results for samples that are near or below 0.05 mg/L.
[1] Sites 1,16 and Shop Spring are at the same location.
Source: BLM and USFS 2002.

TABLE 5.3-5
REVISED DATA FROM FRENCH DRAINS

Site	Location	Description	Sample Date	Selenium (mg/L)
44	Conda	SL# Drain	9/29/97	0.065
FD001	Conda	Conda Mine French Drain	Ave. 5, 9/98	0.154
66 & Pole Creek	Smoky Canyon	Pole Creek Below Pole Canyon Dump	Ave. 1991 – 2001	0.673
SW-2	Maybe Canyon	Maybe Creek below Cross Valley Fill	Ave. 5/97 – 10/98	1.14

Selenium Count = 4
Data Average = 0.508
Standard Deviation = 0.49940431
Maximum = 01.14
Minimum = 0.065
Variance = 0.24940467

Note: Revised data have been modified to combine results for multiple samples at the same location and to delete results for samples that are near or below 0.05 mg/L.
Source: BLM and USFS 2002.

5.5 VEGETATION, RIPARIAN AREAS AND WETLANDS

Mining has disturbed vegetation in the Cumulative Effects Area in the past, including 257 acres associated with the South Rasmussen Ridge Mine and 231 acres associated with the Central Rasmussen Ridge Mine. Total acreages reclaimed are 257 acres at the South Rasmussen Ridge Mine and 196 acres at the Central Rasmussen Ridge Mine. The estimated life of the proposed development of the open pit at the North Rasmussen Ridge under the Proposed Action is 8 years and would disturb an additional 269 acres. A description of vegetation types that would be disturbed under the Proposed Action and Alternative 1 are presented in Chapter 4 of this EIS and include aspen, conifer, and sagebrush. Of the 269 acres proposed for disturbance, 72 would be left as exposed pit highwall and would not be reclaimed. If North Rasmussen is mined, the 35 acres of unreclaimed pit at Central Rasmussen would be filled and revegetated. In October 1989, Monsanto's Enoch Valley Mine began operations at the north end of Rasmussen Valley. During the life of the Enoch Valley Mine (about 15 years), 733 acres would be disturbed. Of this total, 676 acres or 92 percent of the disturbed lands would be reclaimed. The 57 acres that would not be reclaimed at the Enoch Valley Mine also include exposed highwalls in the pits that would result in long-term impacts to grazing and visual resources.

Beginning in the early 1980s, the timber resources have been harvested on 2,372 acres within the Greater Rasmussen Valley-Grays Range area. Since the early 1980s, several timber sales have occurred in the Greater Rasmussen Valley-Sheep Creek area and the timber resources have been removed and reforested on 1,644 acres. The timber sales included 344 acres on the east flank of the Wooley Range (west side of Rasmussen Valley) and about 1,300 acres in the Sheep Creek area, including 800 acres on Rhone-Poulenc's Rasmussen Ridge leasehold. The timber sales have increased access into both areas and as a result have affected security of big game.

Timber resources are also managed within portions of the Caribou-Targhee National Forest located in the Cumulative Effects Area. According to the most recent version of the Caribou-Targhee National Forest Plan revision (USFS 2001), Alternative 7 (agency's Preferred

Alternative) 30 to 40 percent of timber resources will be maintained in a mature/old growth structure. Forest types managed include conifer sites (particularly mixed conifer), aspen/conifer, and aspen communities. Silviculture methods focus on harvest of saw timber and wood fiber resources from mixed conifer, aspen/conifer, and aspen sites to restore ecological processes. Specific management actions include prescribed fire, wildfire for resource benefit, timber harvesting, and forest thinning. Some areas that do not represent timber resources may also be managed to restore ecosystem function.

Timber management prescriptions for recreation within the Cumulative Effects Area include prescriptions b and c. Both prescriptions allow for cross-country, road, and trail travel by pedestrians, horse/pack stock, motorized off road vehicles and mountain bikes during the snow-free season. Prescription b does not allow for cross country travel of motorized vehicles but allows for road and trail travel. Prescription b establishes an open motorized route density of 2.0 miles/square mile. Prescription c allows for both cross country, road, and trail travel of motorized vehicles. Prescription c does not establish an open motorized route density. Both prescriptions b and c allow for winter non-motorized and snowmobile travel.

Timber management within the Cumulative Effects Area has the goal of using all techniques available to achieve ecosystem management and multiple use goals, with emphasis on restoration of ecological function, structure, composition (Proposed Future Condition) and providing products and services to the public. Prescription 5.1 (b, c, d) - Timber Management, emphasizes scheduled wood-fiber production and use and other compatible commodity outputs, with consideration for long-term forest resilience. There are specific guidelines for minimum stocking rates, slash treatments, created openings, logging systems, and general practices. Fire/fuels management prescriptions on the Cumulative Effects Area include guidelines for forest vegetation management, semi-primitive recreation, rangeland, visual quality maintenance, elk and deer winter range, concentrated development areas, and phosphate mine areas. All of these prescriptions default to forest-wide guidance except for Semi-Primitive Recreation (minimal fire suppression), Forest Vegetation Management (suppress wildfires; prescribed fire may be used to meet various goals), and Concentrated Development Areas (Wildfire aggressively suppressed; mechanical treatments preferred). Phosphate land are classified as being a Concentrated Development Area.

Cumulative effects of timber management include changes in species composition, habitat loss, habitat fragmentation from road construction, and increased soil erosion. Future timber management will result in similar effects within the Cumulative Effects Area in the future. Mining within the Cumulative Effects Area may also affect timber resources. Areas designated for timber management are or may be affected by phosphate mining activities within the Cumulative Effects Area are shown on **Figure 5.5-1**. Timber resources within the Cumulative Effects Area are limited. However, the Proposed Action would contribute to the cumulative effects on timber resources. Thinning of over-mature stands in the Cumulative Effects Area would likely take place in the future to prevent beetle infestation and reduce fuel loads.

Disturbance to wetlands and waters of the U.S. would not occur as part of the Proposed Action. However, indirect effects from erosion and alteration of the shallow groundwater system may affect some springs/seeps and flow rates in surface drainages. If phosphate mining in the

Cumulative Effects Area increases by 1 to 2 percent over the next 15 years, then additional wetland areas could be affected. However, current regulations that require compensatory mitigation would reduce or eliminate potential effects to wetlands and waters of the U.S.

Noxious weeds have been introduced in the Cumulative Effects Area from ground disturbances associated with mining, grazing, timber harvest and road construction. Species that have been observed include spotted knapweed, diffuse knapweed, musk thistle, Canada thistle, yellow toadflax, and dyer's woad. Mining-related disturbance has the potential for further encroachment by noxious weeds in the area.

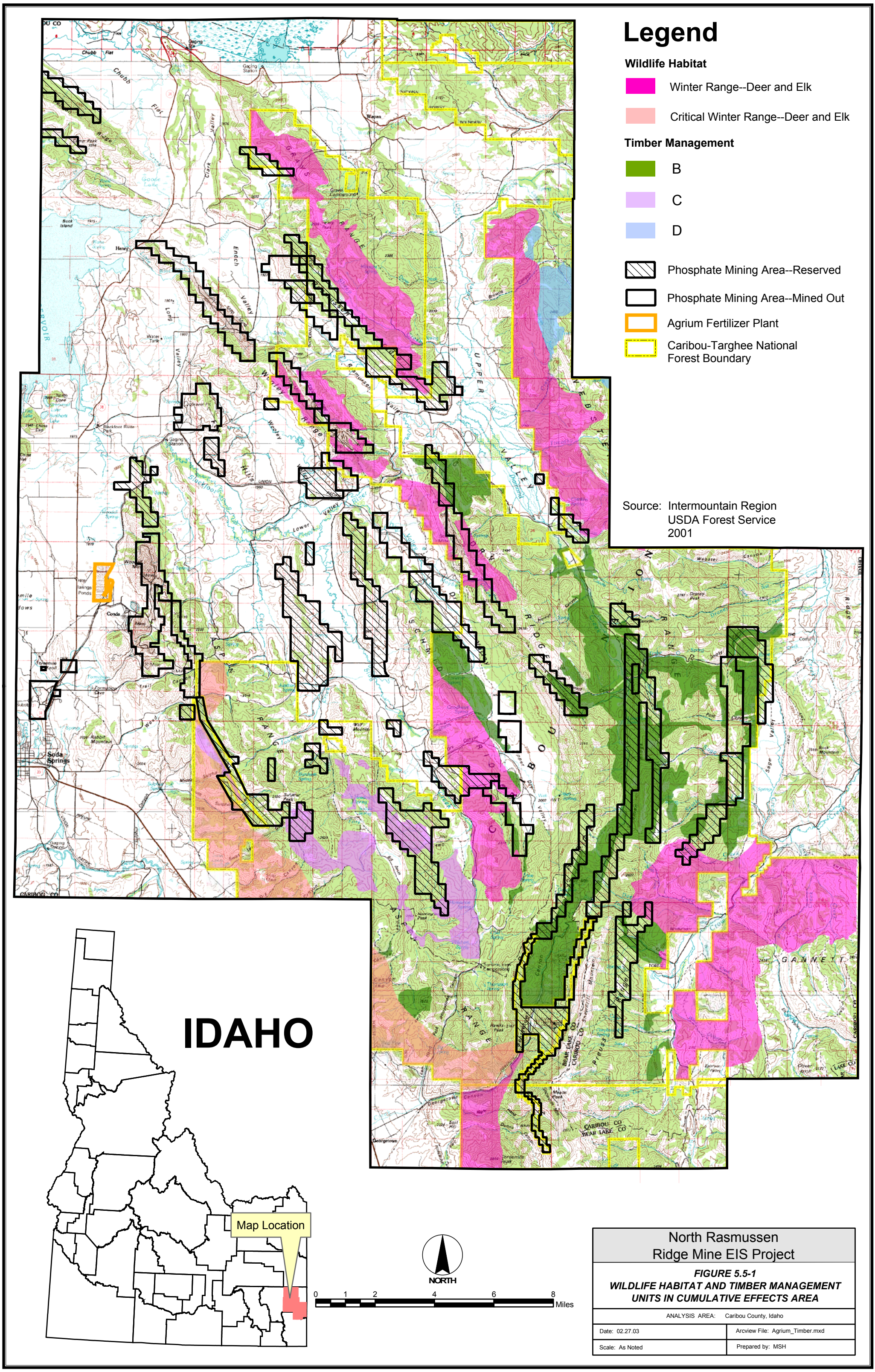
A number of plant communities located within the cumulative effects area have been affected or may be affected by mining. **Figure 5.5-2** illustrates those vegetation communities that existed within mined-out areas and vegetation communities located within current reserve leases.

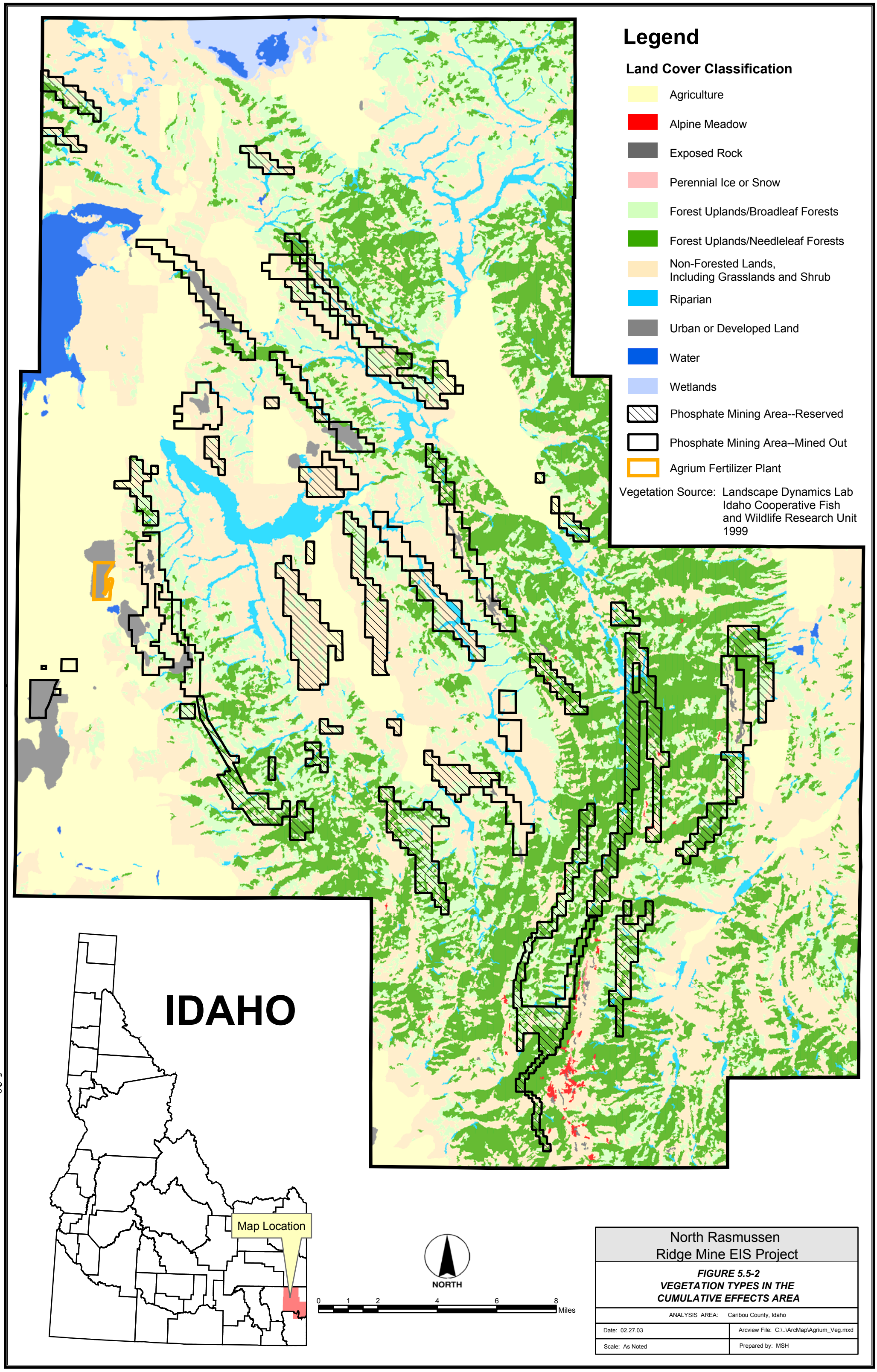
5.6 TERRESTRIAL WILDLIFE

Dominant wildlife habitat types within the Cumulative Effects Area include aspen and conifer forests as well as sagebrush communities. Riparian and wetland communities also represent potentially important wildlife habitat, although they occupy a very small portion of the Cumulative Effects Area. The most common types of impacts to wildlife habitat in the area include disturbances associated with phosphate mining, timber harvest, and livestock grazing. Other impacts include noise, increased human activity, and wildlife mortalities.

Elk and deer winter range are managed within portions of the Caribou-Targhee National Forest located within the Cumulative Effects Area. Areas designated as elk and deer winter range under the most recent Caribou-Targhee National Forest Plan revision (USFS 2001) - Alternative 7 (agency's Preferred Alternative) are shown in **Figure 5.5-1**. Winter range represents areas that contribute to the long-term viability of elk and deer population. Under this management prescription, a number of actions are taken to protect winter habitat while allowing for multiple land uses. Specific management actions include the following:

- Vegetation management to improve habitat to contain a good mixture of grasses, forbs, and shrubs and maintain good vegetative cover.
- Timber harvesting resulting in changes in structure and composition of the plant community.
- Manage or restrict recreational access to elk and deer winter range.
- Manage livestock grazing to ensure that forage conditions are compatible with goals for the big game winter range.
- Minimize human disturbance to wintering big game animals.
- Phosphate mining in the Cumulative Effects Area is located within and adjacent to elk and deer winter range. A number of other actions also have and will likely continue to affect big game winter range. These actions include the following:
- Fire suppression, resulting in changes in structure and composition of the plant community.
- Recreation uses including use of off-road vehicles.
- Invasion of native and non-native species, resulting in changes in livestock forage production.


Legend
Wildlife Habitat
Winter Range--Deer and Elk
Critical Winter Range--Deer and Elk
Timber Management
B
C
D
Phosphate Mining Area--Reserved
Phosphate Mining Area--Mined Out
Agrium Fertilizer Plant
Caribou-Targhee National Forest Boundary
Source: Intermountain Region USDA Forest Service 2001
IDAHO
Map Location
NORTH
0 1 2 4 6 8 Miles
North Rasmussen Ridge Mine EIS Project
FIGURE 5.5-1
WILDLIFE HABITAT AND TIMBER MANAGEMENT UNITS IN CUMULATIVE EFFECTS AREA
ANALYSIS AREA: Caribou County, Idaho
Date: 02.27.03
Arcview File: Agrium_Timber.mxd
Scale: As Noted
Prepared by: MSH


Legend
Land Cover Classification
Agriculture
Alpine Meadow
Exposed Rock
Perennial Ice or Snow
Forest Uplands/Broadleaf Forests
Forest Uplands/Needleleaf Forests
Non-Forested Lands, Including Grasslands and Shrub
Riparian
Urban or Developed Land
Water
Wetlands
Phosphate Mining Area--Reserved
Phosphate Mining Area--Mined Out
Agrium Fertilizer Plant
Vegetation Source: Landscape Dynamics Lab Idaho Cooperative Fish and Wildlife Research Unit 1999
IDAHO
Map Location
NORTH
0 1 2 4 6 8 Miles
North Rasmussen Ridge Mine EIS Project
FIGURE 5.5-2
VEGETATION TYPES IN THE CUMULATIVE EFFECTS AREA
ANALYSIS AREA: Caribou County, Idaho
Date: 02.27.03
Arcview File: C:\..\ArcMap\Agrium_Veg.mxd
Scale: As Noted
Prepared by: MSH

- Historical and current livestock grazing.
- Subdevelopment of lands adjacent to the forest, resulting in a loss of winter range.

These actions would be expected to continue within the Cumulative Effects Area under the Proposed Action.

Reclaimed areas would represent a long-term change in wildlife habitat from aspen, conifer, mixed aspen/conifer, and sagebrush communities to habitat dominated by perennial grasses. This conversion would increase the forage productivity of perennial grasses within the Cumulative Effects Area. However, the conversion of habitat would represent a loss of habitat for forest-dependent wildlife as well as wildlife that depends on contiguous stands of forest. Forest-dependent wildlife species far outnumber other species within and adjacent to the project area.

The Proposed Action may cause increased risks of exposure to selenium, even for wide-ranging wildlife species. This risk would arise because of potential cumulative effects from selenium contamination of the environment from phosphate mines within the adjacent watersheds of the area.

Other nearby phosphate mines have increased concentrations of selenium and other metals in groundwater and surface water in the area watersheds, including the Blackfoot River (Montgomery Watson 2000). Concentrations of metals in some creeks may be capable of causing detrimental effects to wildlife that use the creeks as a source of drinking water. A concentration of 0.5 milligrams selenium per liter of water was measured in samples from one of the creeks that may be affected by the Smoky Canyon Mine (BLM 2001). This concentration is considered toxic to cattle (Gough et al 1979), and may be equally toxic to similar-sized terrestrial wildlife such as mule deer, elk, and moose. Concentrations of selenium were measured at 0.436 mg/L in overburden seeps (95 percent upper confidence limit of the mean), 0.716 mg/L in springs below the overburden (mean), and 1.303 mg/L in French drains installed at the Smoky Canyon Mine (95 percent upper confidence limit of the mean) (BLM and USFS 2002). All of these concentrations are near or greater than the toxicity threshold (0.5 milligrams of selenium per liter) for drinking water sources for cattle (Gough et al 1979). Increasing concentrations of selenium in surface water and groundwater seeps and springs may lead to reduced reproductive success in the terrestrial wildlife of the region. The toxicity effects could, in turn, cause changes in food web structure and ecosystem functioning and decreased monetary revenues from big game and waterfowl hunting.

Wildlife are negatively affected by livestock grazing because of the competition for forage, changes in the structure or composition of native plant communities, and habitat removal or conversion caused by overgrazing on both upland and riparian habitats. Grazing is also a factor in the decline or loss of aspen stands by accelerating succession to stands of conifers and reducing fuels that support low intensity wildfires. Aspen habitat provides cover, forage, and nesting opportunities to a variety of both game and nongame species. Grazing may reduce understory vegetation in both forest and shrub habitats. Proper rotation and stocking rates can minimize these negative effects.

Major recreational uses in the area include hunting, fishing, off highway vehicles and snowmobile use, and hiking and camping. Accessible (all-season road) areas receive year-round recreational use. Human disturbance during periods of the year when wildlife are otherwise stressed by a lack of forage or harsh weather can further stress wildlife and may increase mortality. Specifically, wintering big game may be subject to increased harassment by recreationists, particularly if available hiding and escape cover is reduced by other activities. Recreation use in the area can be expected to reflect local changes in population and interest in outdoor activities. Losses of forage or changes in habitat structure caused by road construction, encroachment of noxious weeds, or livestock grazing may also affect game and nongame species that inhabit the area. New road construction tends to increase recreational and other use of formerly remote areas, placing further pressure on wildlife.

In 1996, timber sales of 3,585,000 board-feet occurred in Caribou County (USFS 2003). Over the past 30 years, the Soda Springs Ranger District has sold over 74 million board-feet at a rate of about 2 million board-feet per year (Van deWeg 2003). These timbered lands are used to some extent by many species of game and nongame wildlife. After timber is removed, these areas are either reseeded and reforested or allowed to revegetate naturally. Effects of this habitat conversion are described above.

5.7 FISHERIES AND AQUATIC RESOURCES

The Proposed Action may contribute to increases in sedimentation which can cause loss of habitat or additional stress on reproduction by fish species. Sedimentation can change the composition of streambeds from gravel to fine sediments that are not suitable for the insect prey of fish or the incubation of fish eggs. Sedimentation can also contribute to turbidity that can lessen the suitability of the waterway to fish by increasing the difficulty of finding food.

The Proposed Action may cause increased exposure risks to aquatic life, even for wide-ranging fish species, because of the cumulative effects from selenium contamination of the environment from past mining that have affected the project and adjacent watersheds in the area. Other nearby phosphate mines have caused increases in selenium and other metal concentrations in groundwater and surface water in the area watersheds, including the Blackfoot River, as described above. Reproductive effects may be observed if contributions of selenium to the Blackfoot Reservoir from multiple phosphate mines in the area lead to concentrations in fish eggs that exceed the recommended toxicity threshold in egg tissue of 10 milligrams selenium per kilogram fish egg tissue.

In a study on cutthroat trout fed varying selenium-enhanced diets ranging from 1.4 to 10 ppm seleno-methionine, no clinical signs of selenium toxicity were observed nor were differences in reproductive performance (such as fecundity and egg hatchability) although in all dietary groups, egg fertility and hatchability were lower than that observed in eggs from wild cutthroat trout (Hardy and Moller 2002).

Increasing concentrations of selenium in surface water and groundwater seeps and springs may lead to reduced reproductive success in the fisheries populations of the region that are known to be of high quality from a recreational perspective. The state water quality standard for selenium

has been exceeded in the region's watersheds as a result of surface water runoff from phosphate mining, and hazards to aquatic biota and wildlife have been predicted (Lemly 1999). The toxicity effects of selenium and other mining-related metals could reduce fisheries populations via direct effects on fish or indirectly through effects on prey populations and cause changes in the structure of the food web and ecosystem functioning that result in decreased monetary revenues from fishing licenses and associated spending (equipment, lodging, and meals). Proposed BMPs and other permit requirements for North Rasmussen Ridge would limit cumulative effects of the mining operations.

5.8 THREATENED, ENDANGERED, AND SPECIAL STATUS SPECIES

The most common type of impacts to TES species within the Cumulative Effects Area is loss of habitat associated with phosphate mining, timber harvest, and livestock grazing. Other trends within the Cumulative Effects Area include additional rural residential development, commercial development, road building by state and local governments, and recreational use of state and federal lands. These activities are expected to continue and increase in the future for the Cumulative Effects Area and the southeast Idaho region. The impact of these activities and the future trend would be the increasing displacement and disappearance of species from the region that require large tracts of relatively undisturbed forest. Other impacts to wildlife that might cause mortalities or large-scale avoidance of the region's high-activity areas include increased noise and dust, increased human activity, and degradation of water quality.

Reclaimed areas would represent a long-term change in wildlife habitat from aspen, conifer, mixed aspen/conifer, and sagebrush communities to habitat dominated by perennial grasses. Habitat conversion would represent a long-tem loss of foraging habitat for forest-dependent wildlife such as flammulated owl, northern goshawk, and three-toed woodpecker. The conversion would also represent a long-term loss of habitat for wildlife dependent upon contiguous stands of forest such as gray wolf and wolverine. Canada lynx linkage habitat also exists within the Cumulative Effects Area. As additional areas are developed, this habitat may be fragmented. This fragmentation may prohibit or deter the natural repopulation and movement of Canada lynx into and through the area.

The Proposed Action may cause increased risks of exposure, even for wide-ranging TES wildlife species, because of the cumulative effects regarding selenium contamination of the environment from the Proposed Action and other mines within the same and adjacent watersheds in the area.

5.9 GRAZING MANAGEMENT

Approximately 1,221 acres would be affected by mining operations in the Rasmussen Ridge lease area that are potentially usable for grazing. The available forage would also be reduced by the 269 acres of proposed disturbance under the Proposed Action. Unit 1A of the Rasmussen Valley Cattle Allotment cannot be used for grazing due to the mining activity. This unit supported 23 percent of the grazing use on this allotment. Over time, reclamation of disturbed areas would replace lost grazing resources. The private lands within the Greater Rasmussen Valley-Sheep Creek Area (primarily the Rasmussen Valley) have been grazed since the late

1800s and would continue into the foreseeable future. All state and federal lands that are not affected by active mine operations with grazing leases would continue to be used to graze livestock.

Vegetation growing in soils or growth media that contains elevated levels of selenium can lead to bioaccumulation of selenium in plant tissues. Subsequent consumption of vegetation that contains elevated levels of selenium by livestock can result in selenium poisoning. The maximum tolerance level for selenium is estimated to be 2 milligrams selenium per kilogram of food for large mammals such as cattle, sheep, horses, and pigs (NRC 1980). Levels greater than the maximum tolerance level can cause chronic selenium toxicity. BMPs have been established in recent years that make significant reductions in selenium accumulation in surface soils and waters. These BMPs include selective placement of seleniferous waste rock, backfilling with non-seleniferous materials, covering waste rock with 2 to 3 feet of growth media, enhancing runoff to minimize infiltration, and avoiding the formation of ponds or lakes. Previous analyses of vegetation samples collected from reclaimed waste rock dumps indicate that total selenium levels ranged from less than 0.5 to 3.00 mg/kg. All samples of vegetation contained less than 5.0 milligrams selenium per kilogram of dry weight vegetation (TRC 1999; Greystone 2002). The initial results of these studies indicate that, to date, vegetation has not accumulated selenium to concentrations that exceed standards established by the BLM and USFS.

5.10 RECREATION

The cumulative impact of phosphate mining in the Cumulative Effects Area would be significant if the supply of recreational opportunities is exceeded by the demand. Supply could exceed demand if the supply were reduced from existing levels by the removal of land associated with mining operations, or if demand were increased from any influx of population from employment opportunities at the mine. Forest land near Rasmussen Ridge provides mostly dispersed recreation. It is a small area relative to lands available for dispersed recreation in the Cumulative Effects Area, which contains the Soda Springs Ranger District. Overall demand for recreational use is not expected to exceed supply in the Soda Springs Ranger District and in the Caribou National Forest during project operations. Additional population growth in Caribou County independent of the Proposed Action is possible as a result of various in-migration factors and could result in additional demand for recreational opportunities.

5.11 VISUAL RESOURCES

The Cumulative Effects Area is within a region of generally north- to northwest-trending mountain ranges and valleys. The most common land forms are foothills, which are cut at intervals by small creeks and drainages. Although scenic variety exists in the densities, arrangements, and colors of vegetation, no visually distinct landscapes are found in the Cumulative Effects Area. The area is generally undeveloped other than for mining; visual modifications to the area have been in the form of timber cuts, roads, mining operations, range improvements, power lines, and pipelines. Cumulative effects to visual resources from other planned or foreseeable development activities near the project area would result from historical, existing, and future mining in the Rasmussen Ridge area. Often, phosphate mining impacts are not considered substantial if the disturbance areas are not readily visible to the general public.

5.12 LAND USE, ACCESS AND TRANSPORTATION

Previous, current, and future reasonable foreseeable mining-related operations in the Cumulative Effects Area include the South, Central, and North Rasmussen Ridge Mines, Enoch Valley Mine, the Dry Valley Mine, South Rasmussen, Simplot Manning and Deer Creek, and the Smoky Canyon Mine. Past mining operations have removed more than 1221 acres from rangeland use at the Rasmussen Ridge Mines, 450 acres at the Enoch Valley Mine, more than 1,000 acres at Smoky Canyon, and 350 acres at the Dry Valley Mine. Of these disturbances, more than 125 acres at the Central and South Rasmussen Ridge Mines and more than 310 acres at the Enoch Valley Mine, and at least 120 acres at the Dry Valley Mine have been reclaimed to date (USFS 1998). Under the Proposed Action, an estimated 269 additional acres would be disturbed in the short term, and 197 acres would be reclaimed.

Over the long term, most of the disturbances associated with mining in the area would be reclaimed and returned to rangeland uses. As described above, grazing in the area may be affected by the introduction of noxious weeds or selenium-enriched soil resulting from mining-related ground disturbances.

Land ownership in the area is described in **Table 5.1-1** and illustrated in **Figure 5.12-1**. The private lands within the area would continue to be used primarily as rangeland into the future. All state and federal lands with grazing leases that are not affected by active mine operations would continue to be used for livestock grazing. State and federal land ownership is depicted in **Figure 5.12-1**. After reclamation is completed, cumulative effects to land use, access, or transportation resources would be insignificant relative to the overall availability of rangeland and recreational resources accessible to the public.

5.13 CULTURAL RESOURCES

The existing Rasmussen Ridge Mine and other mines in similar settings have not resulted in adverse effects to cultural resources. These mines have been developed in comparatively high and rugged terrain with few reliable sources of water. These locations have been unattractive for sustained historic or prehistoric occupation, are marginal for ranching, and do not hold precious metal deposits that could have attracted early mining. Historic and prehistoric sites in the region, including emigrant trails, occur along the river valleys and in lower, more open terrain with access to reliable sources of water. Continued development of the Rasmussen Ridge Mine would not result in significant cumulative effects to cultural resources.

5.14 SOCIAL AND ECONOMIC CONDITIONS

Implementation of the Proposed Action or Alternative 1 would not contribute adverse cumulative effects on public utilities and services beyond existing levels. Since no major effects to population, housing, or employment are predicted, there would be no incremental increases in service requirements as a direct result of the project. If the No Action Alternative is selected and mine closure occurs, a loss of county revenues would result, and the county’s ability to fund selected public services and utilities may be jeopardized.

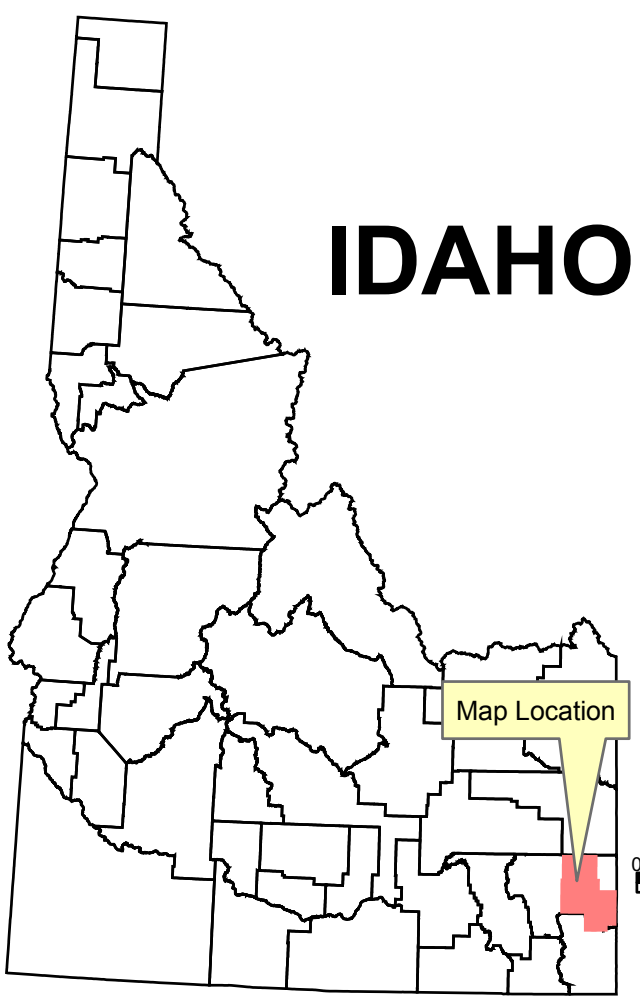
Continued development of phosphate mining within southeastern Idaho would result in increased revenue as a result of tax collections. Continuation of area mining would extend the anticipated life span of existing operations, prolong revenue collections to Caribou and Bear Lake counties. Payment of taxes on purchases of goods and services also would be prolonged.

Legend

Surface Ownership

- Bureau of Land Management
- Forest Service
- State of Idaho
- U.S. Fish & Wildlife Service
- Open Water/River
- Private
- Phosphate Mining Area--Reserved
- Phosphate Mining Area--Mined Out
- Agrium Fertilizer Plant

Source: Intermountain Region
USDA Forest Service
2001



NORTH

0 1 2 4 6 8 Miles

North Rasmussen Ridge Mine EIS Project	
FIGURE 5.12-1 LAND OWNERSHIP IN CUMULATIVE EFFECTS AREA	
ANALYSIS AREA: Caribou County, Idaho	
Date: 02.27.03	Arcview File: Agrium_Surface_Owner.mxd
Scale: As Noted	Prepared by: MSH

CHAPTER 6 - CONSULTATION AND COORDINATION

CHAPTER 6 - CONSULTATION AND COORDINATION

6.1 PUBLIC PARTICIPATION SUMMARY

Public participation for the North Rasmussen Ridge Mine EIS is required by NEPA at four specific project steps: the scoping period, review of the Draft EIS, review of the Final EIS, and receipt of the Record of Decision from the BLM. The public participation process for the North Rasmussen Ridge Mine EIS is comprised of five components, as described in the following sections.

6.1.1 Public Scoping Period and Meetings

The public was provided a 47-day scoping period at the beginning of the EIS process to identify potential issues and concerns associated with the Proposed Action. Publication of a Notice of Intent (NOI) in the Federal Register initiated the public scoping period on May 18, 2001. The NOI summarized the Proposed Action and a determination by the agencies that an EIS would be necessary for analysis of Agrium's proposal. Legal notices of the Proposed Action and public scoping period were published in the Caribou County Sun newspaper on May 30, 2001, and in the Idaho State Journal newspaper on June 5, 2001. Public notice for the Forest Service started with publishing of the public notice in the Idaho State Journal and lasting 30 days.

A scoping letter was mailed to 120 agencies, groups, and individuals announcing the scoping period and describing the Proposed Action. Issues that had been identified by the agencies were also included in the mailing.

Formal public scoping meetings were held in Soda Springs, Idaho and Pocatello, Idaho on June 4 and 5, 2001, respectively. Site maps, photographs, a Power Point presentation describing the proposal, the scoping letter, and public comment forms were made available at these meetings.

The public scoping period ended on July 5, 2001. During that period the agencies received three written responses, and six comment forms from individuals and organizations. Two additional letters were received after the end of the scoping period and were also considered as part of the scoping record. Information obtained by the agencies during public scoping was combined with issues identified by the agencies themselves and this formed the scope of the EIS.

6.1.2 EIS Mailing List

A mailing list of interested persons was assembled from mailing lists maintained at the BLM Pocatello Resource Area Office and the USFS Caribou-Targhee National Forest Office. This list was supplemented by addresses of scoping participants. All parties and agencies on the mailing list were sent a letter requesting that they complete and return a preprinted form including any comments and their level of interest in receiving a copy of the Draft and Final EIS. The mailing list was adjusted accordingly. A copy of the mailing list is presented in Section 6.4.

6.1.3 Distribution of the Draft EIS

A 60-day Draft EIS review period was initiated by publication of the Notice of Availability for the Draft EIS in the Federal Register. Public review meetings were held in Soda Springs, and Pocatello, Idaho during the public comment period to obtain comments on the Draft EIS and to answer questions that the public had regarding the project or the EIS process.

The Draft EIS was distributed as follows:

- A Notice of Availability was published in the Federal Register specifying dates for the comment period and the date, time, and location of the public comment meetings.
- A news release was provided by the agencies at the beginning of the 60-day comment period on the Draft EIS. The news release was submitted to the same news organizations as for the initial public scoping announcement.
- The Draft EIS was distributed to interested parties identified in the updated EIS mailing list, as described above.

6.1.4 Final EIS Distribution

The Final EIS distribution will be completed after consideration is given to comments received on the Draft EIS. A 30-day Final EIS review period will be initiated by publication of the Notice of Availability for the Final EIS in the Federal Register. The Final EIS will be released as follows:

- Notice of Availability will be published in the Federal Register.
- Copies of the Final EIS will be sent to addresses on the updated mailing list.
- A news release will be issued to the same newspapers used for previous project announcements.

6.1.5 Record of Decision

Subsequent to the 30-day review period for the Final EIS, the USFS and IDL will make recommendations to the BLM and BLM will prepare a Record of Decision. The BLM Record of Decision will be distributed to people and organizations identified on the updated project mailing list. A Notice of Availability will be published in the Federal Register. A news release will be made to the same newspapers used for previous project announcements.

6.2 CONSULTATION WITH OTHER AGENCIES, ORGANIZATIONS AND ELECTED OFFICIALS

The following local, state, and federal agencies were consulted during preparation of the DEIS:

- U.S. Army Corps of Engineers
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- Idaho Department of Environmental Quality
- Idaho Department of Fish and Game
- Idaho Department of Water Resources – Eastern Region
- Idaho Conservation Data Center
- Caribou County Board of Commissioners
- Soda Springs City Council and Rotary Club
- Staff representatives of elected officials

The BLM, USFS and IDL coordinated with various agencies and organizations during the preparation of the DEIS and in reviewing the information in the document. Specific meetings held during this process were as follows:

1) January 15, 2003 - Met Sho-Ban Tribes for briefing of Supplemental Mine and Reclamation Plan.

2) December 18, 2002 - Met IDL in Idaho Falls to review Supplemental Mine and Reclamation Plan.

3) December 17, 2002 - Met IDEQ in Pocatello with ID Team to review comments on the Preliminary Draft EIS.

4) November 8, 2002 – Met IDEQ at the mine site for a tour with questions and answers.

5) October 28, 2002 – Met at the IDEQ office in Pocatello to discuss IDEQ's comments on the groundwater modeling and use of attenuation in the fate and transport model prior to their preparing their comment letter on the DEIS.

6) October 10, 2002 – Met with Mr. Marv Hoyt of the Greater Yellowstone Coalition and Mr. John Robison and Mr. Justin Hayes of the Idaho Conservation League. Mine and Greystone personnel conducted a site visit with questions and anwers.

7) February 21, 2002 – Met at the Soda Springs City Council office along with Soda Springs Rotary Club to review the project description and to take questions and answers.

8) February 13, 2002 – Met at the IDEQ office in Pocatello to review the Supplemental Mining and Reclamation Plan that triggered the preparation of the EIS.

9) January 29, 2002 – Met with representatives of Senator Crapo, Senator Craig and State Representative Simpson. Representatives were John Atkins, Francois Cleveland and Kitty Kuntz, respectively.

10) November 19, 2001 – Met in Idaho Falls with managers and staff from BLM, USFS, IDL, and Greystone to assess progress on the project.

11) August 8, 2001 – Met with Mr. Marv Hoyt of the Greater Yellowstone Coalition at the mine site for a tour with questions and answers.

12) There were 2 field trips in 2000 for the ID Team. An October 2, 2000 field trip included USFS, IDEQ, Idaho Fish and Game, and BLM. An October 17, 2000 field trip included USFS and BLM participants.

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CHAPTER 7 - REFERENCES, GLOSSARY, AND INDEX

CHAPTER 7 – REFERENCES, GLOSSARY, AND INDEX

7.1 REFERENCES

Agrium. 2001. North Rasmussen Ridge Supplemental Mine and Reclamation Plan for Agrium's Federal Phosphate Leases 1-04375 and 1-07619 and Agrium State Lease 9313, November 19, 2001, Soda Springs, Idaho.

Agrium. 2002. North Rasmussen Ridge Mine Storm Water Pollution Prevention Plan. Agrium CPO, revised January 2002. Soda Springs, Idaho.

Berglund, J. 1996. Montana Department of Transportation. Montana Wetland Field Evaluation Form and Instructions. July 1, 1996, Appendix A, revised 9/23/97.

Call and Nicholas Consultants. 2000. In Agrium Conda Phosphate Operations, 2001. Slope Stability Study. North Rasmussen Ridge Supplemental Mine and Reclamation Plan. Soda Springs. 1D.

Canada Lynx Conservation Assessment and Strategy. 2000. U.S. Forest Service, Bureau of Land Management, and U.S. Fish and Wildlife Service.

Code of Federal Regulations, 40 CFR Part 50, National Primary and Secondary Ambient Air Quality Standards.

Code of Federal Regulations, 40 CFR Part 112, Spill Prevention Control and Countermeasures Plans.

Collins, B. 1981. A Report on the Biological Values of the Rasmussen Ridge Area Caribou County, Idaho. Idaho Department of Fish and Game, U.S. Geological Survey.

Colorado State University (CSU). 2001. Diagnosing Selenium Toxicity. Colorado State University Cooperative Extension. Fact Sheet no. 6.109.

Crawford, D.L., H.M. Knotek-Smith, G. Moller, and R. Henson. Microbial involvement in the reductive immobilization of selenium in infiltration waters from waste shale at an Idaho mine. Environmental Biotechnology Institute, Univ. of Idaho. Abstract. SETAC 23rd Annual Meeting Abstract Book.

Druss, M. 1983. Rasmussen Ridge CB-82-128. Cultural survey of parts of Sections 15, 22, 26, 27 T65, R43E. Prepared for Monsanto, Soda Springs ID, by Basin & Range Research, Logan, UT.

Desborough, G., E. DeWitt, J. Jones, A. Meier, and G. Meeker. 1999. Preliminary Mineralological and Chemical Studies Related to the Potential Mobility of Selenium and Associated Elements in Phosphoria Formation Strata, Southeastern Idaho. USGS Open-File Report 99-129. U.S. Geological Survey, Denver, CO. Prepared in Collaboration with BLM, USFS, Agrium U.S. Inc., FMC Corporation, J.R. Simplot Company, Rhodia Inc., and Solutia, Inc. 20 pp.

Digital Atalas of Idaho. 2003. Idaho's Natural History On-Line. http://imnh.isu.edu/digitalatlas/

Driscoll, F. 1995. Ground Water and Wells, Equation 9.6. Published by U.S. Filter and Johnson Screens.

Edwards, T.K. 1977. Hydrogeology of the Proposed Phosphate Mining Area in the Diamond Creek Drainage, Caribou County, Idaho, M.S. Thesis, University of Idaho, 111 pp.

Eisler, R. 1985. Selenium Hazards to Fish, Wildlife, and Invertebrates: A Synopotic Review. United States Fish and Wildlife Service, Patuxent Wildlife Research Center, Laurel, Maryland. Contaminant Hazard Reviews Report 5.

Executive Order 1867. Regarding Establishment of Coeur d'Alene and Fort Hall Reservations, (October 1, 1866).

Fort Bridger Treaty of 1863: Treaty between the United State of America and the Eastern Bands of Shoshonee Indians. Concluded July 2, 1863; Ratification advised, with amendment, March 7, 1864; Amendment assented to August 31, 1865; Proclaimed June 7, 1869. United States Statutes at Large. 40th Congress, 1867-1869. Vol. 15 pp. 673-678.

Fort Bridger Treaty of 1868: Articles of a Treaty with the Shoshonee (Eastern Band) and Bannack Indians, made the third Day of July 1868, at Fort Bridger, Utah Terriotry. United States Statutes at Large. 43rd Congress, 1873-1875. Vol. 18, part 3, pp. 685-688.

Freeze, R. and J. Cherry. 1979. Ground Water, Equation 8.41 & 8.42, Published by Prentice Hall.

Garten, E.O., R. Vasterling and J.T. Ratti. 2002. Impact of Selenium on Birds in Phosphate Mining Region of Southeast Idaho. University of Idaho Department of Fish and Wildlife Resources. Abstract at SETAC 23rd Annual Meeting Abstract Book.

Garrand Corporation. 1974. Geologic Mapping compiled on Lanes Creek Quadrangle. Phosphate Study. Caribou National Forest.

Gelhar, L.W., C. Welty, and K.R. Rehfeldt. 1993. A Critical Review of Data on Field Scale Dispersion in Aquifers. Water Resources Research, Vol. 28, No. 7, pp 1955-1974.

Geraghty and Miller. 1990. Data Review in Support of Dewatering Operations for Enoch Valley Mine Northeast of Soda Springs, Idaho. Consultant Report Prepared for Monsanto.

Gough, L.P., H.T. Shacklette, and A.A. Case. 1979. Selenium. Pages 40-44 *in* Element Concentrations Toxic to Plants, Animals, and Man. U.S. Geological Survey Bulletin 1466. U.S. Government Printing Office, Washington, D.C. 80 pp.

Grace Chamber of Commerce. 2001a. Healthcare in Area. From the Internet. http://www.graceidaho.com/html/healthcare.html/. Accessed on 10/26/01.

Grace Chamber of Commerce. 2001b. Grace Area Services. From the Internet. http://www.graceidaho.com/html/services.html. Accessed on 10/26/01.

Grauch R., R. Tysdal, J. Johnson, J. Herring, and G. Desborough. 2001. Stratigraphic Section and Selected Semi Quantitative Chemistry, Meade Peak Phosphatic Shale Member of Permian Phosphoria Formation, Central Part of Rasmussen Ridge, Caribou County, Idaho United States Geological Survey Open File Report 99-20E.

Greystone Environmental Consultants. 2002. Soil and Vegetation Analysis Results – North Dump. Agrium Conda Phosphate Operations. Greenwood Village, CO 13 pp.

Greystone Environmental Consultants. 2003a. Biological Assessment of Federally Listed Threatened and Endangered Species for the Proposed Agrium North Rasmussen Ridge Mine. Prepared for the BLM - Pocatello Field Office, Idaho.

Greystone Environmental Consultants. 2003b. Biological Evaluation of Federally Identified Threatened, Andangered, Proposed, or Sensitive Species for the Proposed Agrium North Rasmussen Ridge Mine. Prepared for the Caribou-Targhee National Forest, Soda Springs Ranger Division, Idaho.

Gulbrandsen, R. 1960. Petrology of the Meade Peak Phosphatic Shale Member of the Phosphoria Formation at Coal Canyon Wyoming: United States Geological Survey Bulletin 1111-C p. 71-146.

Hamann, B. 2001. Personal communication [*Nov 13* facsimile to Patrick Golden, Greystone, Greenwood Village, Colorado. *RE*: Sensitive Species List for the Caribou-Targhee National Forest]. Wildlife Biologist, U.S. Forest Service, Caribou-Targhee National Forest, Idaho Falls, ID. 4 pages.

Hardy, R.W. and G. Moller. 2002. Growth and reproduction of cutthroat trout (Oncorhynchus clarki) fed varying amounts of seleno-methionine over a life-cycle. University of Idaho. Abstract at SETAC 23rd Annual Meeting Abstract Book.

Hem, J. 1989. Study and Interpretation of the Chemical Characteristics of Natural Waters, United States Geological Survey Paper 2254.

Herring, J.R., G.A. Desborough, S.A. Wilson, R.G. Tysdal, R.I. Grauch, and M.E. Gunter. 1999. Chemical Composition of Weathered and Unweathered Strata of the Meade Peak Phosphatic Shale Member of the Permian Phosphoria Formation. Measured Sections A and B, Central part of Rasmussen Ridge, Caribou County, Idaho. USGS Open-File Report 99-147A. Prepared in Collaboration with BLM, USFS, Agrium U.S. Inc., FMC Corporation, J.R. Simplot Company, Rhodia Inc., and Solutia, Inc. U.S. Geological Survey, Denver, CO. 23 pp.

Idaho Bureau of Labor Statistics. 2001. Local Area Unemployment Statistics. From the Internet. http://data.bls.gov/labjava/outside.jsp?survey=la. Accessed on 10/26/01.

Idaho Cooperative Fish and Wildlife Research Unit. 2002. Vegetation Data by Landscape Dynamics Lab. Internet. http://www.wildlife.uidaho.edu/data/id g2veg.zip.

Idaho Department of Commerce. 2001a. Official State Travel Planner; Bear Lake-Caribou Scenic Highway. From the Internet. http://www.visitid.org/Database/db_pdf/BearLake_Caribou.pdf. Accessed 10/25/01.

Idaho Department of Commerce. 2001b. Official State Travel Planner; Pioneer Historic Byway. From the Internet. http://www.visitid.org/Database/db_pdf/Pioneer.pdf. Accessed 10/25/01.

Idaho Department of Commerce. 2001c. County Profiles of Idaho: Caribou County. From the Internet. http://www.idoc.state.id.us/idcomm/cntypro.html. Accessed on 10/26/01.

Idaho Department of Commerce. 2001d. Community Profiles: Soda Springs. From the Internet. http://www.idoc.state.id.us/idcomm/action.lasso. Accessed on 10/26/01.

Idaho Department of Education. 2001. Idaho School District Profiles 1999 – 2000. From the Internet. http://www.sde.state.id.us/Finance/profiles99-00/default.htm#Region%205%20 (14%20Districts). Accessed on 10/26/01.

Idaho Department of Environmental Quality. 2001. Blackfoot River. Waterbody Assessment and Total Maximum Daily Load (TMDL). Prepared by IDEQ. April 2001. Pocatello, Idaho.

Idaho Department of Fish and Game (IDFG). 1999. White-tailed Deer, Mule Deer, and Elk Management Plan: Status and Objectives of Idaho's White-tailed Deer, Mule Deer, and Elk Resources. Idaho Department of Fish and Game, Boise, Idaho.

Idaho Department of Fish and Game. 2000. Elk Historical Populations – Diamond Creek Zone Southeastern Idaho. One sheet with tables, maps, and graphs. Received from Carl Anderson, Idaho Department of Fish and Game, Pocatello, Idaho.

Idaho Department of Fish and Game. 2001. General Season Harvest Data. From the Internet. http://www2.state.id.us/fishgame/hunt/programsinfo/genharv.htm. Accessed 10/25/01.

Idaho Department of Labor. 2001. Idaho Employment: Southeast Idaho. April, 2001.

Idaho Housing and Financing Association. 2001. State of Idaho 5-Year Strategic Plan for Housing and Community Development. From the Internet. http://www.ihfa.org/pdf/2000 _Idaho_Strategic_Plan.pdf. Accessed on 10/26/01.

Idaho Department of Water Resources 2002. Water Rights for Wells and Springs.

JBR Environmental Consultants, Inc. 1997. Studies on the Macroinvertebrates of Three Creeks Situated Northeast of Soda Springs, Caribou County, Idaho. Samples Collected on October 8, 1997.

Keysor, A. 2002. North Rasmussen Ridge Mine Draft EIS Comments. Zone Wildlife Biologist. Montpelier RD and Soda Springs RD. December 16.

Knudsen, A., C.M.E. Gunter, and J.R. Herring, 2000. Preliminary Mineralogic Characterization of Weathered and Less-weathered Strata of the Meade Peak Phosphatic Shale Member of the Permian Phosphoria Formation: Measures Sections A and B, Central Part of Rasmussen Ridge, Caribou County, Idaho. Western Phosphate Project. USGS Open-File Report 00-116. Prepared in Collaboration with BLM, USFS, Agrium U.S. Inc., FMC Corporation, J.R. Simplot Company, Rhodia Inc., and Solutia, Inc. U.S. Geological Survey, Denver, CO. 74 pp.

Kuck, L. 1984. Cooperative Wildlife-Phosphate Study, Final Report. Summary and Management Recommendations. Idaho Department of Fish and Game.

Laymon, S.A. 2000. Supporting Information for the Listing of the Western Yellow-Billed Cuckoo.

Lemly, A.D. 1993. Guidelines for Evaluating Selenium Data form Aquatic Monitoring and Assessment Studies. Environmental Monitoring and Assessment 28: 83-100.

Lemly, A.D. 1996. Evaluation of the Hazard Quotient Method for Risk Assessment of Selenium. Ecotoxicology and Environmental Safety 35: 156-162.

Lemly, A.D. 1997. A Teratogenic Deformity Index for Evaluating Impacts of Selenium on Fish Populations. Ecotoxicology and Environmental Safety 37: 259-266.

Lemly, A.D. 1999. Preliminary assessment of selenium hazards on Caribou National Forest, Idaho. U.S. Forest Service, Southern Research Station, Coldwater Fisheries Research Unit, Department of Fisheries and Wildlife, Virginia Tech University, Blacksburg, VA. Prepared for U.S. Forest Service, Caribou National Forest, Pocatello, ID. February

Lemly, A.D. and G.J. Smith. 1987. Aquatic Cycling of Selenium: Implications for Fish and Wildlife. U.S. Fish and Wildlife Service Leaflet #12.

Lowham, H.W. 1988. Streamflows in Wyoming. U. S. Geological Survey Water Resources Investigations Report 88-4045.

Lyon, L.J. 1983. Road Density Models Describing Habitat Effectiveness for Elk. Journal of Forestry. 81(9):592-595.

Mackowiak, C.L., M.C. Amacher and J.R. Herring. 2002. Selenium Uptake and vegetation from the Southeast Idaho phosphate mines region. USDA FS, Rocky Mountain Research Station and US Geological Survey. Abstract at SETAC 23rd Annual Meeting Abstract Book.

Mansfield, G. 1927. Geography, Geology, and Mineral Resources of part of Southeastern Idaho. United States Geological Survey Professional Paper 152. United States Government Printing Office, Washington, D.C. 453 pages.

Mariah Associates, Inc. 1992. Aquatic Monitoring Program for Rhone-Poulenc's Wooley Valley Operation, Caribou County, Idaho: Final Report.

Maxim Technologies, Inc. 2000. Baseline Data Collection, Cultural Resources, North Rasmussen Ridge Mine, Caribou County, Idaho. Prepared for Agrium-CPO, Rasmussen Ridge Mine, Soda Springs, Idaho. Helena, Montana.

Maxim Technologies, Inc. 2001a. Baseline Data Collection Water Resources Investigation, North Rasmussen Ridge Mine, Caribou County, Idaho. Prepared for Agrium U. S. Inc. April 2001. Helena, Montana.

Maxim Technologies, Inc. 2001b. Personal communication between R. Grauch of the USGS and L. Kirk of Maxim, Bozeman, Montana.

Maxim Technologies, Inc. 2001c. Soil Baseline Study for North Rasmussen Ridge Mine Expansion Project, Caribou County, Idaho, prepared for Agrium-CPO, March 2001, Helena, Montana.

Maxim Technologies, Inc. 2001d. Baseline Data Collection Vegetation and Wildlife Resources. North Rasmussen Ridge Mine, Caribou County, Idaho. Prepared for Agrium-CPO, August 2001, Helena, Montana.

Maxim Technologies, Inc. 2001e. Addendum to Baseline Studies Report. Preliminary Wetlands Delineation, North Rasmussen Ridge Mine, Caribou County, ID. Prepared for Agrium - CPO November 2001. Helena, Montana

Maxim Technologies, Inc. 2001f. Baseline Data Collection Aquatic Resources. North Rasmussen Ridge Mine, Caribou County, Idaho. Prepared for Agrium-CPO, Helena, Montana.

Maxim Technologies, Inc. 2002a. Final Environmental Geochemistry Study. North Rasmussen Ridge Mine. Prepared for Agrium - CPO. Bozeman, Montana.

Maxim Technologies, Inc. 2002b. Baseline Data Collection Water Resources Investigation Revised August 2002, North Rasmussen Ridge Mine, Caribou County, Idaho. Prepared for Agrium - CPO, August 2002. Helena, Montana.

Maxim Technologies, Inc. 2002c. Technical Memorandum from Bill Craig and Cam Stringer (Maxim) to Rob Squires and Chuck Jessel (Agrium) Regarding Rasmussen Ridge Spring/Seep Survey - June/July 2002, dated July 19, 2002. 1 pp plus attachments.

Maxim Technologies, Inc. 2002d. Groundwater Baseline Investigation, North Rasmussen Ridge Mine, prepared fro Agrium - CPO, January 2002, 34 pp plus appendices. Helena, Montana.

Maxim Technologies, Inc. 2002e. Final Watershed Analysis, North Rasmussen Ridge Mine Expansion Project, Caribou County, Idaho, prepared for Agrium-CPO, January 2002, Helena, Montana.

Maxim Technologies, Inc. 2002f. Memo from Cam Stringer (Maxim) to Rob Squires (Agrium) Regarding Additional Hydrogeologic Information, March 25, 2002.

McDonald, Michael G., and A. W. Harbaugh. 1988. A Modular Three-Dimensional Finite-Difference Ground-Water Flow Model – Chapter Al, U.S. Geological Survey

Mignogno, D. 2003. Phosphate Mine Expansion on Rasmussen Ridge in Caribou County. Species List SP#1-4-03-SP-0087. File # 111.0200. Eastern Idaho Sub-office.

Miller, H. 1991. Chapter 12 Lithic Resources *in* Prehistoric Hunters of the High Plains. Second ed. G.C. Frison, Ed. Academic Press, San Diego, CA. 530 pp.

Mohammad, O.J. 1976. Evaluation of the Present and Potential Impacts of Open Pit Phosphate Mining on Ground Water Resource Systems in the Southeastern Idaho Phosphate Field: University of Idaho, Ph.D. Dissertation.

Moller, G. 1997. Selenium Control Technologies for Overburden Leachate in Southeastern Idaho Phosphate Fields. Interim Data Report #1 to the J.R. Simplot Corporation, Research and Development. From the Center for Hazardous Waste Remediation Research, University of Idaho, Moscow, Idaho. November 12, 1997.

Montgomery Watson. 2000. 1999 Interim Investigation Data Report. Southeast Idaho Phosphate Resource Area Selenium Project. Idaho Mining Assoc. Selenium Committee.

Morin, K. and Hutt, N. 1994. Observed Preferential Depletion of Neutralization Potential Over Sulfide Minerals in Kinetic Tests: Site Specific Criteria for Safe NP/AP Ratios, In Proceedings of the International Land Reclamation and Mine Drainage Conference, and Third International Conference on the Abatement of Acidic Drainage, Pittsburgh, PA, April 24-29, v. 1, p 148-156.

Munkers, J. 2000. Abiotic and Biotic Processes in the Release and Control of Selenium in the Western Phosphate Resource Area, M.S. Thesis, University of Idaho.

National Park Service. 2003. National Wild and Scenic Rivers System and Nationwide Rivers Inventory. http://www.nps.gov. Accessed January 10, 2003.

National Research Council (NRC). 1980. Mineral Tolerance of Domestic Animals. National Academy of Sciences, Washington, DC.

NRCS. 2002a. Idaho Monthly Precipitation Averages (1961 - 1990) published for all SNOTEL sites available from http://idsnow.id.nrcs.usda.gov/snow/siteinfo/61-90averages/idprcavg.txt.

NRCS. 2002b. SNOTEL tabulated historical data for Somsen Ranch station: <http://idsnow.id.nrcs>.usda.gov/ snow/prec/idtables/somsen_ranch.

Padian, B. 2003. Unpublished timber harvest statistics. Caribou-Targhee National Forest, Soda Springs Ranger District. Soda Springs, Idaho.

Parkhurst, D.L. and C.J. Appelo. 2000. Users Guide to PHREEQC (Version 2) – A Computer Program for Speciation, Batch-Reaction, One-Dimensional Transport, and Inverse Geochemical Calculations.

Petrun, R. 1999. Field Guide to the Southeast Idaho Phosphate District, *in* Guidebook to the Geology of Eastern Idaho, Hughes, S. and Thackray, G., eds., P. 269-279.

Petrun, R. 2000. Figure 1: Southeastern Idaho Phosphate. Rev 2: Map.

Piper D. 1999. Trace Element and Major-Element Oxides in the Phosphoria Formation at Enoch Valley Idaho - Permian Sources and Current Reactivities. USGS open file report 99-163.

Polk, A.S. 1991. A Cultural Resources Survey of an Extension of the Rasmussen Ridge Phosphate Mine, Caribou County, Idaho. Sagebrush Archaeological Consultants, Ogden, Utah. Prepared for Rhone-Poulenc, Montpelier, Idaho.

Polk, M.R. 1993. A Cultural Resources Survey of a Proposed Haul Road and Phosphate Mine Parcels on Wooley and Rasmussen Ridges, Caribou County, Idaho. Sagebrush Archaeological Consultants, Ogden, Utah. Prepared for Rhone-Poulenc, Montpelier, Idaho.

Ralston, D., T. Brooks, M. Cannon, T. Corbet Jr., H. Singh, G. Winter and C. Wai. 1980. Interactions of Mining and Water Resource Systems in the Southeastern Idaho Phosphate Field. Research Technical Completion Report Project C-7651. Idaho Water Research Institute Moscow, Idaho.

Rapp, G. 1972. Selenium: Element and Geochemistry, The Encyclopedia of Geochemistry and Environmental Sciences, ed. Rhodes W. Fairbridge, p. 1079.

Ratti, John 2002. Personal communication [Feb 13 with Chris Rutledge, Greystone, Greenwood Village, Colorado. RE: Status of Egg Survivorship Study for Southeast Idaho Phosphate Resource Area], Biologist, Montomery Watson, Idaho.

Raviv and Patricio Associates. 1990. Hydrogeologic Evaluation and Dewatering Feasibility for the Dry Valley Mine Site. Prepared for FMC Corporation, Soda Springs, Idaho.

Robinette, M.J. 1977. Ground Water Flow Systems in Lower Dry Valley, Caribou County, Idaho: University of Idaho, M.S. thesis.

Rose, A., H. Hawkes, and J. Webb. 1979. Geochemistry in Mineral Exploration, Published by Academic Press, Orlando, Florida.

Rosenfeld, I. and O.A. Beath. 1954. Effect of selenium on reproduction in rats. Proc. Soc. Exp. Biol. Med. 87:295-297.

Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, CO.

Sample, B.E., D.M. Opresko, and G.W. Suter, II. 1996. Toxicological benchmarks for wildlife: 1996 revision. ES/ER/TM-86/R3. Prepared for Office of Environemental Management, U.S. Department of Energy by Lockheed Martin Energy Systems, Inc., East Tennessee Technology Park, Oak Ridge National Laboratory. June.

Sauer, J.R., J.E. Hines, and J. Fallon. 2001. The North American Breeding Bird Survey, Results and Analysis 1966 - 2000. Version 2001.2, USGS Patuxent Wildlife Research Center, Laurel, Maryland. http://www.mbr-pwrc.usgs.gov/bbs/.

Schoumacher, R. 1999. TRC Mariah Associates Inc. Selenium Values in Topsoil in Central Rasmussen (Letter to Rob Squires on September 29, 1999).

Schroeder, P.R., Aziz, N.M., Lloyd, C.M., and Zappi, P.A. 1994a. *The Hydrologic Evaluation of Landfill Performance (HELP) Model: User's Guide for Version 3*, EPA/600/R-94/168A; US EPA Office of Research and Development, Washington, D.C.

Shacklette, H.T. and J.G. Borengen. 1984. Element Concentrations in Soils and other Surficial Materials of the Coterminus United States. USDI Geological Professional Paper No. 1270. Washington D.C.

Skorupa, J. 1998. Selenium. P.L. Martin and D.E. Larsen, editors. *In*: Guidelines for Interpretation of the Biological Effects of Selected Constituents in Biota, Water, and Sediment. Information Report No. 3. National Irrigation Water Quality Program. United States Department of the Interior, Bureau of Land Management. Denver, Colorado.

Soil and Water Conservation Society (SWCS). 1993. Revised Universal Soil Loss Equation (RUSLE). Version 1.02. Soil and Water Conservation Society. Ankeny, Iowa.

Thomas, J.W., H. Black Jr., R.J. Sherzinger, and R.J. Pederson. 1979. Deer and Elk. Pp. 104-127 *In*: Wildlife habitats in managed forests – the Blue Mountains of Oregon and Washington, J.W. Thomas, Ed. United States Department of Agriculture Handbook No. 553.

TRC Mariah Associates, Inc. 1999. Selenium Values in Topsoil in Central Rasmussen, September 29, 1999, prepared for Agrium Conda Phosphate Mines, Caribou County, Idaho.

TRC Mariah Associates, Inc. 2000. Draft Jurisdictional Wetlands and Other Waters of the U.S., Rasmussen Ridge Mine, prepared for Agrium Conda Phosphate Mines, January 2000, Caribou County, Idaho.

U.S. Census Bureau. 2001a. Profiles of General Demographic Characteristics. From the Internet. http://www.census.gov/prod/cen2000/index.html. Accessed on 10/26/01.

U.S. Census Bureau. 2001b. Labor Statistics. From the Internet. http://www.labor.state.id.us/lmi/pubs/idempnews/archived/iepoccurapr.pdf. Accessed on 10/26/01.

U.S. Census Bureau. 2001c. Quick Facts. From the Internet. http://quickfacts.census.gov/qfd/states/16/16029.html. Accessed on 10/26/01.

U.S. Department of Agriculture, Forest Service. 1985. Draft Environmental Impact Statement for the Caribou National Forest - Proposed Land and Resource Management Plan. United States Department of Agriculture, Forest Service.

U.S. Department of Agriculture, Forest Service. 1997. Fall 1997 Interim Surface Water Survey Report. Caribou National Forest, Idaho.

U.S. Department of Agriculture, Forest Service 1998. Environmental Assessment for the Dump and Growth Media Area Extension at the Central Rasmussen Ridge Mine (CRRM) for USFS Special Use Permit, Idaho Falls, Idaho.

U.S. Department of Agriculture, Forest Service. 2001. Draft Environmental Impact Statement for the Caribou National Forest, Draft Revised Forest Plan. Prepared May 2001, Idaho Falls, Idaho.

U. S. Department of Agriculture Forest Service in cooperation with Soil Conservation Service (SCS). 1990. Soil Survey of the Caribou National Forest, Idaho Falls, Idaho.

U. S. Department of Agriculture, Soil Conservation Service. 1994. Utah Guide for Soil Survey Manuscripts. Supplement to National Soil Survey Handbook. Salt Lake City, Utah.

U.S. Department of Agriculture, Soil Conservation Service (SCS). 1999. National Soils Handbook. Handbook Number 430. U.S. Government Printing Office. Washington D.C.

U.S. Department of Interior, Bureau of Land Management. 1987. Draft Pocatello Resource Management Plan and Environmental Impact Statement, Idaho Falls District. Bannock, Bear Lake, Bingham, Bonneville, Caribou, Franklin, and Bureau of Land Management, Idaho Falls District.

U.S. Department of Interior, Bureau of Land Management, and U.S. Department of Agriculture, Forest Service. 1990. Environmental Assessment, Rhone-Poulenc Basic Chemicals Company, South Rasmussen Ridge Mine and Reclamation Plan and New Ore Haulroad Construction Plan For Federal Phosphate Leases Id-04375 and Id-07619, August 1990, Idaho Falls, Idaho.

U.S. Department of Interior, Bureau of Land Management, and U.S. Department of Agriculture, Forest Service. 1997b. Environmental Assessment, Rhone-Poulenc Basic Chemicals Central Rasmussen Ridge Mine and Reclamation Plan Federal Phosphate Leases I-04375 and USFS Special Use Permit, May 22, 1997, Idaho Falls, Idaho.

U.S. Department of Interior, Bureau of Land Management and U.S. Department of Agriculture, Forest Service. 2002. Final Supplemental Environmental Impact Statement, Smoky Canyon Mine, Panels B & C. Pocatello Field Office, Pocatello, Idaho.

U.S. Department of Interior, Bureau of Land Management, U.S. Department of Agriculture, Forest Service, and U.S. Army Corps of Engineers. 2000. Final Environmental Impact Statement, Dry Valley Mine – South Extension Project, FMC Corporation, June 2000, Caribou County, Idaho.

U.S. Department of Interior, Geological Survey (USGS). 2001a. Diagnostic Services Case Report, case # 16322, 001-020; March 22, 2001. National Wildlife Health Center, U.S. Geological Survey, Madison, Wisconsin.

U.S. Department of Interior, Geological Survey (USGS). 2001b. Diagnostic Services Case Report, case # 16947, 001-003; March 23, 2001. National Wildlife Health Center, U.S. Geological Survey, Madison, Wisconsin.

U.S. Department of Interior, Geological Survey (USGS). 2002. Water data website: http://waterdata.usgs.gov/nwis/peak?site_no=13062700&agency_cd=USGS&format=html (plus no=13063500 and no=13063000).

U.S. Environmental Protection Agency. 2002. AIR*Data*. From the Internet. www.epa.gov/air/data/, Accessed January 2002.

U.S. Department of Interior, Fish and Wildlife Service (USFWS). 2001. Endangered and Threatened Wildlife and Plants; 12-month Finding for a Petition to List Yellow-billed Cuckoo (*Coccyzus americanus*) in the Western Continental U.S. 66 Federal Register 38611, July 25, 2001.

VandeWeg, D. 2003. Personal communication, F.S. ID Team Leader with D. Solomon of Greystone. January 22, 2003.

Western Regional Climate Center (WRCC). 2002. Temperature and Precipitation Data. From the Internet. www.wrcc.dri.edu/cgi-bin/cliPRECtM.pl?idcond, Accessed January 2002.

Whetstone Associates, Inc. 2002. Water Resources Technical Report. Compilation of Data, Modeling and Analysis for North Rasmussen Ridge Mine in Support of the Environmental Impact Statement. La Veta, CO.

Wiemeyer, S.N. and D.J. Hoffman. 1996. Reproduction in eastern screech-owls fed selenium. Journal of Wildlife Management 60:332-341.

Williams, R. D. and E. Schuman (eds.), 1987. Reclaiming mine soils and overburden in the western United States; Analytical parameters and procedures. Ankeny, Iowa: Soil Conservation Society of America.

Yochelson, E., 1968, Biostratigraphy of the Phosphoria, Park City and Shedhorn Formations. United States Geological Survey Professional Paper 313-D, p. 571-660

Zheng C. 1990. MT3D: A Modular Three-Dimensional Multispecies Transport Model for Simulation of Advection, Dispersion and Chemical Reaction of Contaminants in Groundwater Systems; Report to the USEPA Robert Kerr Environmental Research Laboratory, Ada, Oklahoma.

Zheng C., Wang, P.P. 1999. MT3DMS: A Modular Three-Dimensional Multispecies Transport Model for Simulation of Advection, Dispersion and Chemical Reaction of Contaminants in Groundwater Systems; Documentation and Users Guide; USCOE Contract Report SERDP-99-1, December 1999.

7.2 GLOSSARY

Acid Rock Drainage - Drainage with a pH of 2.0 to 4.5 from mines and mine wastes that is the result of oxidation of sulfides exposed during mining.

Acre-feet - The volume of liquid or solid required to cover one acre to a depth of one foot, or 43,560 cubic feet; measure for volumes of water, reservoir rock, etc.

Allotment - A unit of land suitable and available for livestock grazing that is managed as one grazing unit.

Alluvium - Unconsolidated or poorly consolidated gravel sands and clays, deposited by streams and rivers on riverbeds, floodplains, and alluvial fans.

Ambient - The environment as it exists at the point of measurement and against which changes or impacts are measured.

Animal Month - For a cow/calf operations, it is the amount of forage consumed by a 1,000 pound cow and calf (less than 6 months of age) over a one month period. It is approximately 1,050 pounds of forage.

Animal Unit Months (AUMs) - For the BLM allotments, it is the amount of forage consumed by a 1,000 pound cow over a one month period, approximately 800 pounds of forage. An animal unit month is then multiplied by 1.32 for a cow/calf operation such as the Mahala Creek allotment, and is equivalent to an animal month for purposes of this document.

Anomaly - A geological feature, especially in the subsurface, distinguished by geological, geophysical, or geochemical means, which is different from the general surroundings.

Anticline – A fold in rock, where the interior of the fold is comprised of rocks that are older in age than the rocks on the exterior of the fold.

Aquatic Resources - Biological resources (plants, animals, and other life forms) present in or dependent on streams, lakes, and other surface water.

Aquifer - A body of rock that is sufficiently permeable to conduct groundwater and to yield economically significant quantities of water to wells and springs.

Aspect - The direction toward which a slope faces with respect to the compass or the sun.

Assemblage - A group of rocks grouped together by age or similar origin.

Attenuation - The process of becoming thinner, or diminished, in dimension, concentration or density.

Background - The viewing area of a distance zone that lies beyond the foreground-middleground. Usually from a minimum of 3 to 5 miles to a maximum of about 15 miles from a travel route, use area, or other observer position. Atmospheric conditions in some areas may limit the maximum to about 8 miles or increase it beyond 15 miles.

Baseline Study - A study conducted to gather data prior to mining for the purpose of outlining conditions existing on an undisturbed site. Impacts are evaluated against the baseline data and reclamation success is measured against baseline data.

Bioaccumulation - A process by which chemicals are taken up by organisms from water or sediment directly or through consumption of food containing the chemicals.

Biodiversity - The diversity of species, ecosystems, and natural processes in an area.

Broadcast seeding - Distribution of seed by a fan spreader or by hand spreading.

Cation Exchange Capacity (CEC) – The number of sites on a solid surface where reversible cation adsorption and desorption can occur.

CFR - Code of Federal Regulations, the compilation of federal regulations adopted by federal agencies through a rule-making process.

Characteristic Landscape - The established landscape within an area being viewed. The term does not necessarily mean a naturalistic character, but may refer to features of the cultural landscape, such as a farming community, an urban landscape, or other landscape that has an identifiable character.

Chert - A hard, dense microcrystalline sedimentary rock, consisting chiefly of interlocking crystals of quartz less than about 30 micrometers in diameter; it may contain amorphous silica (opal). It has conchoidal fracture, and it may be white or variously colored. Chert occurs primarily as nodular or concretionary segregations, or nodules in limestone or dolomite, and less commonly as layered deposits, or bedded chert.

Colluvium - General term applied to loose and incoherent deposits, usually at the foot of a slope of cliff and brought there chiefly by gravity; such as talus and cliff debris.

Column Test - A leaching laboratory test where water or other leaching solution is percolated through a vertical column of earth material and the resulting leachate is collected and analyzed for dissolved parameters.

Community Types (vegetation) - A group of plants living in a specific region under relatively similar conditions.

Contrast - The effect of a striking difference in the form, line, color, or texture of the landscape features within the area being viewed.

Critical (Crucial) Habitat - Habitat that is present in minimum amounts and is a determining factor for population maintenance and growth.

Cultural Resources - The archaeological and historical remains of human occupation or use. Includes any manufactured objects, such as tools or buildings. May also include objects, sites, or geological/geographical locations significant to Native Americans.

Cumulative Effects -As defined by 40 CFR 1508.7, cumulative effects are the impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.

dBA - The sound pressure levels in decibels measured with a frequency weighing network corresponding to the A-scale on a standard sound level meter. The A-scale tends to suppress lower frequencies, e.g., below 1,000 Hz.

Debitage - Chipped stone flaking debris resulting from stone tool making.

Decibel (dB) - A unit used in expressing ratios of electric or acoustic power. The relative loudness of sound.

Direct Effects - As defined by 40 CFR 1508.9, these are effects which are caused by the action and occur at the same time and place as the action. Synonymous with direct impacts.

Discharge - The volume of water flowing past a point per unit time, commonly expressed as cubic feet per second (cfs), gallons per minute (gpm), or million gallons per day (mgd).

Disturbed Area - Area where natural vegetation and soils have been removed or disrupted.

Drainage - Natural channel through which water flows some time of the year. Natural and artificial means for effecting discharge of water as by a system of surface and subsurface passages.

Drawdown - The lowering of the water level in a well as a result of withdrawal.

Earthquake - Sudden movement of the earth’s crust resulting from faulting, volcanism, or other mechanisms.

Endangered Species - Any species in danger of extinction throughout all or a significant portion of its range. Plant or animal species identified by the Secretary of the Interior as endangered in accordance with the 1973 Endangered Species Act.

Ephemeral Stream - A stream or portion of a stream that flows briefly in direct response to precipitation in the immediate vicinity, and whose channel is at all times above the water table.

Erosion - The wearing away of soil and rock by weathering, mass wasting, and the action of streams, glaciers, waves, wind, and underground water.

Evapotranspiration - The portion of precipitation returned to the air through evaporation and plant transpiration.

Exploration - The search for economic deposits of minerals, ore, and other materials through practices of geology, geochemistry, geophysics, drilling, and/or mapping.

Fate And Transport - Description of the movement of a contaminant through a groundwater system which may include the effects of dilution, dispersion, attenuation, and various chemical reactions.

Fault - Surface of rock rupture along which has been differential movement.

Fisheries - Streams and lakes used for fishing.

Floodplain - That portion of a river valley, adjacent to the channel, which is built of sediments deposited during the present regimen of the stream and is covered with water when the river overflows its banks at flood stages.

Footprint - The actual surface area physically disturbed by mining operations and ancillary facilities.

Forage - Vegetation used for food by wildlife, particularly big game wildlife and domestic livestock.

Forb - Any herbaceous plant other than a grass.

Foreground-Middleground - The area visible from a travel route, use area, or other observer position to a distance of 3 to 5 miles. The outer boundary of this zone is defined as the point where the texture and form of individual plants are no longer apparent in the landscape, and vegetation is apparent only in pattern or outline.

Fugitive Dust - Dust particles suspended randomly in the air from road travel, excavation, and rock loading operations.

Game Species - Animals commonly hunted for food or sport.

Geochemistry - The study of the distribution and amounts of the chemical elements in minerals, ores, rocks, soils, water, and the atmosphere, and their circulation in nature, on the basis of the properties of their atoms and ions.

Geotechnical - A branch of engineering concerned with the engineering design aspects of slope stability, settlement, earth pressures, bearing capacity, seepage control, and erosion.

Grade - A slope stated in terms of feet per mile or as feet per feet (percent); the content of precious metals per volume of rock (ounces per ton).

Ground Cover - The amount of ground surface covered by vegetation.

Ground Water - All subsurface water, especially that as distinct from surface water portion in the zone of saturation.

Ground Water Table - The surface between the zone of saturation and the zone of aeration; that surface of a body of unconfined ground water at which the pressure is equal to that of the atmosphere.

Habitat - The place or type of site where a plant or animal naturally or normally lives and grows. Includes all biotic, climatic, and soils conditions, or other environmental influences affecting living conditions.

Haul Road - All roads utilized for transport of an extracted mineral, waste, overburden, or other earthen materials.

Head Month – See Animal Month

Heavy Metals - A group of elements that may be acquired by organisms in trace amounts that are toxic in higher concentrations. Includes copper (Cu), lead (Pb), mercury (Hg), molybdenum (Mo), nickel (Ni), cobalt (Co), chromium (Cr), iron (Fe), silver (Ag), etc.

HELP3 Model - A computer model written by Paul Schroeder et al. at the U.S. Army Corps of Engineers Waterways Experiment Station and distributed by the USEPA that estimates water balance (water inputs and outputs) of landfills.

Host Rock - A body of rock serving as a host for mineral deposits.

Hydraulic Conductivity (K) - A coefficient of proportionality describing the rate at which water can move through a permeable medium.

Hydraulic Gradient - For groundwater, the rate of change of total head per unit of distance of flow at a given point and in a given direction.

Hydrograph - A graph that shows some property of groundwater or surface water as a function of time.

Hydrology - A science that deals with the properties, distribution, and circulation of surface and subsurface water.

Hydrophytic Vegetation - Plants that grow in and are adapted to an aquatic or very wet environment.

Hydrostatic Head - The height of a vertical column of water, the weight of which, if of unit cross-section, is equal to the hydrostatic pressure at a point.

Hydrostratigraphic Unit - A formation, part of a formation, or group of formations in which there are similar hydrologic characteristics allowing for grouping into aquifers or confining layers.

Igneous - Rock or mineral that solidified from molten or partly molten magma, processes relating to or resulting from the information of such rocks.

Impoundment - The accumulation of any form of water in a reservoir or other storage area, generally resulting from a man-made embankment.

Indirect Effects - As defined by 40 CFR 1508.8, these are effects which are caused by the action but occur later in time or are removed in distance from the action, but are still reasonably foreseeable. Synonymous with indirect impacts.

Infiltration - The movement of water or some other liquid into the soil or rock through pores or other openings.

Infrastructure - The basic framework or underlying foundation of a community including road networks, electric and gas distribution, water and sanitation services, and facilities.

Intermittent Stream - 1) A stream that flows only at certain times of the year, as when it receives water from springs or from a surface source; and 2) a stream that does not flow continuously, as when water losses from evaporation or seepage exceed the available stream flow.

Irretrievable - Applies to the loss of production, harvest, or use of natural resources. For example, some or all of the timber production from an area is lost irretrievably while an area is serving as a winter sports site. The production lost is irretrievable, but the action is not irreversible. If the use changes, it is possible to resume timber production.

Irreversible - Applies primarily to the use of nonrenewable resources, such as minerals or cultural resources, or to those factors that are renewable only over long time spans, such as soil productivity and aspen regeneration. Irreversible also includes loss of future options.

Isopleth - A line, on a map or chart, drawn through points of equal size or abundance.

Jurisdictional Wetland - A wetland area identified and delineated by specific technical criteria, field indicators, and other information for purposes of public agency jurisdiction. The public agencies which administer jurisdictional wetlands are the US Army Corps of Engineers, US Environmental Protection Agency, US Fish and Wildlife Service, and USDA-Soil Conservation Service.

K-Hydraulic Conductivity - A coefficient of proportionality describing the rate at which water can move through a permeable medium.

K-Soil Erosion Factor - A ranking of susceptibility of soils to erosion by water. Factors below 0.25 = low susceptibility, 0.25 to 0.4 = moderately susceptible, and 0.4 and above = highly susceptible.

Land Use - Land uses determined for a given area that establish the types of activities allowed (e.g., mining, agriculture, timber production, residences, industry) and the size of buildings and structures permitted.

Landform - Any physical, recognizable form or feature of the Earth's surface, having a characteristic shape and produced by natural causes. Includes major features such as plains, plateaus, and mountains, and minor features, such as hills, valleys, slopes, canyons, arroyos, and alluvial fans.

Landscape Character - The arrangement of a particular landscape as formed by the variety and intensity of the landscape features as defined as the four basic elements (form, line, color, and texture). These factors give the area a distinctive quality that distinguishes it from its immediate surroundings.

Lifts - Construction of waste rock dumps in a series of layers.

Limestone - A sedimentary rock consisting chiefly of the mineral calcite (calcium carbonate, CaCO3), with or without magnesium carbonate. Common impurities include chert and clay. It is the consolidated equivalent of limy mud, calcareous sand, and/or shell fragments.

Lithology - The description of rocks in terms of the physical character of a rock, mineral composition, grain size, color and other physical characteristics.

Long-Term Effects - Long-term effects are effects that would remain following completion of the project. As an example, the loss of vegetation from the development of an open pit would be a long-term effect if the pit were not reclaimed and vegetation not re-established at the end of the project. Other long-term effects, as defined in the Cumulative Effects Analysis (CEA), are coarse and durable angle of repose waste rock dump slopes and haul roads.

Maximum Credible Earthquake - The largest conceivable earthquake that could occur in an area.

Maximum Modification - A visual quality objective that allows activities that alter the vegetation and landform to dominate the original characteristic landscape with some limitations.

Mesic - Moist habitats associated with springs, seeps and riparian areas.

Milling - The general process of separating the economic constituents (metals) from the undesired or un-economic constituents of ore material (tailings).

Mineralization - The process by which a valuable mineral or minerals are introduced into a rock.

Mitigate, Mitigation - To cause to become less severe or harmful to reduce impacts. Actions to avoid, minimize, rectify, reduce or eliminate, and compensate for impacts to environmental resources.

Modification - A visual quality objective in which man's activity may dominate the characteristic landscape, but should appear as a natural occurrence when viewed as background.

Monitor - To systematically and repeatedly watch, observe or measure environmental conditions in order to track changes.

National Register of Historic Places - A list, maintained by the National Park Service, of areas which have been designated as being of historical significance.

Native Species - Plants that originated in the area in which they are found, i.e., they naturally occur in that area.

NEPA - The National Environmental Policy Act of 1969. It is the national charter for protection of the environment. NEPA establishes policy, sets goals, and provides means for carrying out the policy. Regulations at 40 CFR 1500-1508 implement the act.

Net Proceeds Tax - This is a form of income tax assessed as a property tax intended to assess the value of the minerals which are being extracted.

Noxious Weeds - An alien, introduced or exotic species that is adventive, aggressive, or overly-competitive with more desirable species.

Nutrients - Essential chemicals needed by plants or animals for growth and health. If other physical and chemical conditions are optimal, excessive amounts of nutrients can lead to degradation of water quality by promoting excessive growth, accumulation and subsequent decay of plants, especially algae. Some nutrients can be toxic to animals in high concentrations.

One-hundred year, twenty four-hour storm event (100-year, 24-hour) - the maximum precipitation predicted to occur within any 24-hour period over a period of 100 years.

Ordinary high water mark (OHWM) - line on the shore of a water body or stream established by the fluctuation of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas

Ore - A deposit of rock from which a valuable mineral or minerals can be economically extracted.

Overburden - Material (sub-economic, non-ore) which overlies a deposit of valuable material.

Pit Backfill - Placing waste rock in a mined-out pit.

Partial Retention - A visual quality objective in man's activities may be evident, but must remain subordinate to the characteristic landscape.

Perched Water - Unconfined groundwater separated from the underlying main body of groundwater by unsaturated rock.

Perennial Stream - A stream or reach of a stream that flows throughout the year.

Periphyton - Organisms, both plant and animal, attached or clinging to stems and leaves of rooted plants or other surfaces projecting above the bottom of a water body.

Permeable - The property or capacity of a porous rock, sediment, or soil to transmit a liquid.

pH - The negative $\log_{10}$ of the hydrogen ion activity in solution; a measure of acidity or basicity of a solution. pH 1 is highly acidic and pH 14 is strongly basic.

PM_{10} - Particulate matter less than 10 microns in aerodynamic diameter.

Plan of Operations - As required by 43 CFR 3809, the operator submits a Plan of Operations (POO) to the BLM that includes: the name and address of the operator, location of the proposed area of operations, information sufficient to describe the type of operations proposed, and measures to be taken to meet the requirements for environmental protection.

Peak Flow - The greatest flow attained during melting of winter snowpack or during a large precipitation event.

Preservation - A visual quality objective that provides for ecological change only.

Probable Maximum Precipitation (PMP) - The greatest depth of precipitation for a given duration that is physically possible over a given storm area at a particular location at a certain time of year.

Productivity - In reference to vegetation, productivity is the measure of live and dead accumulated plant materials.

Project Alternatives - Alternatives to the proposed Project developed through the NEPA process.

Protohistoric - Time period when native culture is in contact with outside culture before written record.

Public Scoping – See Scoping.

Q-saturated - Saturated flow rate: The volume of water flowing through a saturated aquifer past a specific point in a given period of time.

Raptor - A bird of prey (e.g., eagles, hawks, falcons, and owls).

Recontouring - Restoration of the natural topographic contours by reclamation measures, particularly in reference to roads.

Record of Decision (ROD) - A decision document for an Environmental Impact Statement or Supplemental EIS that publicly and officially discloses the responsible official's decision regarding the actions proposed in the Environmental Impact Statement and their implementation.

Q-Saturated - Saturated flow rate; The volume of water flowing through a saturated aquifer past a specific point in a given period of time.

Reserves - Identified resources of mineral-bearing rock from which the mineral can be extracted profitably with existing technology and under present economic conditions.

Resources (geologic) - Reserves plus all other mineral deposits that may eventually become available - either known deposits that are not recoverable at present, or unknown deposits, that may be inferred to exist but have not yet been discovered.

Retention - A visual quality objective which, generally means man's activities should not be evident to the casual forest visitor.

Riparian - Situated on or pertaining to the bank of a river, stream, or other body of water. Riparian is normally used to refer to plants of all types that grow along streams, rivers, or at spring and seep sites.

Runoff - That part of precipitation that appears in surface streams; Precipitation that is not retained on the site where it falls and is not absorbed by the soil.

Run-of-Mine Overburden - Sub-economic rock mined from the ore body which is placed in surface dumps or as pit backfill.

Scoping - Procedures by which agencies determine the extent of analysis necessary for a proposed action, (i.e., the range of actions, alternatives, and impacts to be addressed; identification of significant issues related to a proposed action; and the depth of environmental analysis, data, and task assignments needed). (40 CFR 1501.7)

Sediment Load - The amount of sediment (sand, silt, and fine particles) carried by a stream or river.

Sediment - Material suspended in or settling to the bottom of a liquid. Sediment input comes from natural sources, such as soil erosion, rock weathering, agricultural practices, or construction activities.

Seismicity - The likelihood of an area being subject to earthquakes; the phenomenon of earth movements.

Shale - A fine-grained detrital sedimentary rock formed by the compaction of clay, silt or mud. It has a finely laminated structure which gives it a fissility along which the rock splits readily, especially on weathered surfaces. It may be red, brown, black or gray.

Short-Term Effects - Short term effects are defined under the Independence Range Cumulative Effects Analysis (CEA) process as those effects that would not last longer than the life of the project. As an example, the loss of vegetation from the construction of a drill road would be a short-term effect because the road would be reclaimed and vegetation re-established following completion of the project. Other short-term effects, as defined in the CEA, are revegetated areas such as waste rock dump slopes, facility areas and pit backfills.

Significant - As used in NEPA determination of significance requires consideration of both context and intensity. Context means that the significance of an action must be analyzed in several contexts such as society as a whole, and the affected region, interests, and locality. Intensity refers to the severity of impacts (40 CFR 1508.27).

Sodium Adsorption Ration (SAR) - The ratio of dissolved sodium to calcium+magnesium in water; it provides a prediction of cation exchange reaction potential.

Soil - Loose, unconsolidated surface material including the A and E horizon (topsoil) and B horizon (subsoil).

Specific Yield - See Storativity.

Storage Coefficient (S) - Volume of water that an aquifer absorbs or releases from storage per unit surface area of aquifer per unit decline in the component of hydraulic head normal to the surface; S is dimensionless.

Storativity - The volume of water an aquifer releases from, or takes into storage per unit surface area of the aquifer per unit change in head. In an unconfirmed aquifer, the storativity is equivalent to the specific yield.

Syncline - A folded rock sequence where the interior of the fold is younger than the rock on the exterior.

Ten-Year 24-hour Storm Event - The maximum precipitation predicted to occur within any 24-hour period with a return interval of 10 years.

Threatened Species - Any species of plant or animal which is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Total Dissolved Solids (TDS) - Total amount of dissolved material, organic or inorganic, contained in a sample of water.

Total Suspended Particulates (TSP) - Particulates less than 100 microns in diameter suspended in a liquid sample.

Total Suspended Solids (TSS) - Amount of undissolved particles suspended in liquid.

Transmissivity (T) - The rate at which water will flow through a vertical strip of aquifer of one unit width and extending through the full saturated thickness, under a hydraulic gradient of 1.0.

Visual Quality Objective (VQO) - A desired level of excellence based on physical and sociological characteristics of an area. Refers to degree of acceptable alteration of the characteristic landscape.

Visual Resource - The composite of basic terrain, geologic features, water features, vegetation patterns, and land use effects that typify a land unit and influence the visual appeal the unit may have for viewers.

Waste Dump - Location and/or destination of waste, spoil, or overburden material removed during the mining operation to expose the orebody, but not including the marketable mineral, subsoil and topsoil.

Waste Rock - Non-ore rock that is extracted to gain access to ore. It contains no ore metals or ore metals at levels below the economic cutoff value, and must be removed to recover the ore.

Waters of the United States - A jurisdictional term from Section 404 of the Clean Water Act referring to waterbodies such as lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation, or destruction of which could affect interstate or foreign commerce.

Watershed - The geographic region from which water drains into a particular stream, river or body of water. A watershed includes hills, lowlands, and the body of water into which the land drains. Watershed boundaries are defined by the ridges or divides separating watersheds.

Wind Erodability Group (WEG) - A ranking of how susceptible soils are to erosion by wind. 1 and 2 = extremely severe, 3 and 4 = highly to moderately erodible, 4L = erodible, 5 and 6 = slightly erodible, 7 and 8 = very slightly erodible or not subject to erosion.

Wetlands - Areas that are inundated by surface or groundwater with a frequency sufficient to support and under normal circumstances does or would support a prevalence of vegetation or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.

Wilderness - Land designated by Congress as a component of the National Wilderness Preservation System.

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APPENDIX A

APPENDIX A

Laws and Regulations for Mining on Public Lands

- 43 CFR 3500, Solid Minerals Exploration and Mining Operations (administered by BLM and USFS); Federal Land Policy and Management Act of 1976; and Mineral Leasing Act of 1920 – These laws, in combination with other agency plans (i.e., Caribou National Forest Land and Resource Management Plan and BLM Pocatello Resource Management Plan) require the agencies to analyze proposed mining operations to ensure that exploration and mining plans are consistent with and responsive to requirements of the lease, license, or permit.

- 43 CFR 3510, Phosphate Leasing (administered by BLM) – Lists procedures for qualified applicants to obtain rights to develop deposits of phosphate on federal land that is available for leasing.

- 43 CFR 3590, Solid Minerals (Other Than Coal) Exploration and Mining Operations (administered by BLM) – Requires submittal of a mine and reclamation plan for BLM review. Provides for orderly development of mineral deposits without waste or damage to deposits, and promotes maximum recovery using operating practices that will avoid, minimize, or correct damage to the environment.

- 43 CFR 3592 (administered by BLM) – Establishes requirements for permit applications for mining on land leased from the federal government. These requirements include submittal of exploration and mining plans which detail the proposed exploration, prospecting, testing, development, or mining operations to be conducted by the applicant and/or leasee. BLM reviews the proposed mining activity with USFS specialists and receives input from USFS regarding disturbance and reclamation of portions of the proposed mining action that would occur on land administered by USFS.

- 43 CFR 3594.1(a) – Requires mining operations be conducted in a manner that yields maximum recovery of mineral deposits while recognizing the need to protect other environmental resources.

- 36 CFR 251 Subpart b – Stipulates that entities that propose to occupy National Forest System land for specified purposes must obtain a Special Use Permit from USFS.

- Sections 404 and 401 of the Clean Water Act (CWA), administered by USCOE, regulate activities that would fill or dredge wetlands and other waters of the U.S. Section 401 of the CWA requires any applicant for a federal license or permit that may result in discharge of a pollutant to waters of the US to obtain a certification from the state of Idaho (IDEQ) that the proposed discharge will comply with applicable effluent limitations and water quality standards. These two permits are applied for in a Joint Application for Permit. Information in the Joint Application for Permit is also submitted to the Idaho Department of Water Resources (IDWR) to obtain a Stream Alteration Permit.

- NEPA of 1969 – Requires that federal agencies use a multidisciplinary approach to evaluate potential impacts of the proposed detailed mine plan on the human environment. The agencies are required to compile an EIS to disclose to the public what the decisionmaker considered in reaching the decision.

- Non-Federal Actions – Mining and reclamation plans requiring protection of nonmineral resources and reclamation of land affected by exploration and/or mining must be authorized by IDL pursuant to the Idaho Administration Procedures Act (IDAPA).

- The Bevill Amendment excludes phosphate waste from being considered hazardous waste. As specified in 40 CFR §261.4(6)&(7), "The following solid wastes are not considered hazardous wastes: Solid waste from the extraction, beneficiation, and processing of ores and minerals (including coal, phosphate rock, and overburden from the mining of uranium ore)."