United States Department of the Interior
Bureau of Land Management

Environmental Assessment
DOI-BLM-MT-C010-2009-0010-EA
April, 2011

Bull Mountains Mine No. 1
Federal Coal Lease MTM 97988
Musselshell County, Montana

U.S. Department of the Interior
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United States Department of the Interior

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TAKE PRIDE IN AMERICA

In Reply Refer To:
3420 (MTM-97988)

April 15, 2011

Dear Reader:

Enclosed is a copy of the Finding of No Significant Impact (FONSI) and Decision Record (DR) for the Bull Mountains Mine Number 1 Federal Coal Lease by Application project.

The Environmental Assessment (EA) was prepared pursuant to the National Environmental Policy Act (NEPA), other regulations, and statutes to fully disclose potential impacts of: 1) the proposed action to competitively lease coal; 2) the continued operation and development of an existing underground coal mine; and 3) the impacts from not taking any action.

The EA, FONSI, and DR are also available for viewing and printing on the web at http://www.blm.gov/mt/st/en/fo/billings_field_office.html.

We solicited public comments on the EA via a letter mailed to the appropriate agencies, specific interested parties, and the general public dated March 16, 2010, and by posting the letter on the BLM Billings Field Office website. The EA was available for public review from March 28, 2010, to April 27, 2010, by legal notice published in the *Federal Register* and the Billings newspaper. In addition, there were announcements of the availability of the EA in the Roundup newspaper. A public hearing was held on April 13, 2010, at the BLM State Office, 5001 Southgate Drive, Billings, Montana. Public comments were received through April 27, 2010.

Five parties commented on the EA by letter during the public comment period. We reviewed and analyzed all EA comments. Those requesting clarification or additional analyses were considered and, as appropriate, supplemental information is highlighted and included in the revised EA. Comments that were outside the scope of the analysis or required a response that is not included in the revised EA are addressed in the DR.

The BLM would like to thank everyone who participated in the analysis process. Your input was essential to ensure that all issues were fully considered.

If you have questions or need additional information, please contact Jim Sparks at 406-896-5241, or Craig Drake at 406-896-5349.

Sincerely,

James M. Sparks
Field Manager

Enclosure

Finding of No Significant Impact / Decision Record
Billings Field Office

INTRODUCTION:

Signal Peak Energy, LLC (SPE) filed a Coal Lease-by-Application (LBA), MTM 97988, with the Bureau of Land Management (BLM) on March 20, 2008 according to 43 CFR 3425. The Federal Coal Tract contains the following lands:

Township 6 North, Range 27 East, PMM, Musselshell County, Montana

Sec. 4, lot 1, S1/2NE1/4, SE1/4NW1/4 and S1/2;	479.76 acres
Sec. 8, NE1/4, NE1/4NW1/4, S1/2NW1/4 and S1/2;	600.00 acres
Sec. 10, W1/2NE1/4, SE1/4NE1/4, NW1/4 and S1/2;	600.00 acres
Sec. 14, SW1/4NE1/4, NW1/4 and S1/2;	520.00 acres
Sec. 22, W1/2 and SE1/4.	480.00 acres
Total	2,679.76 acres

The BLM has prepared an environmental assessment (EA No. DOI-BLM-MT-C010-2009-0010-EA) to analyze the potential impacts of incorporating the LBA into the existing Bull Mountains Mine No. 1, Musselshell County, Montana. The EA is available at the Billings Field Office and is incorporated by reference for this Finding of No Significant Impact (FONSI). The LBA would provide a logical extension of SPE's Mammoth coal seam workings within the current Bull Mountains Mine No. 1 and would allow the mine to continue producing coal at the current rate instead of ceasing production as recoverable private coal reserves are exhausted.

PLAN CONFORMANCE AND CONSISTENCY:

The authorized officer shall only consider for lease sale those lands that have been included in a comprehensive land use plan (43 CFR 3425.2). The federal coal lands are located in the Billings Field Office and were analyzed in the Billings Resource Management Plan (RMP) prepared in 1983. The Record of Decision for the RMP was issued in September 1984. The RMP Decision Record states at page 34, " All the Federal coal which is mineable by underground methods is suitable for further consideration for leasing..." in the Bull Mountains coal field. The proposed action has been reviewed and found to be in conformance with the BLM Land Use Plan. A number of changes have occurred since that time including the development of the Bull Mountains Mine No. 1, and the RMP is currently being revised.

FINDING OF NO SIGNIFICANT IMPACT DETERMINATION:

Based upon a review of the EA and the supporting documents, I have determined that the project is not a major federal action and will not significantly affect the quality of the human environment, individually or cumulatively with other actions in the general area. No environmental effects meet the definition of significance in context or intensity as defined in 40 CFR 1508.27 and do not exceed those effects described in the Billings RMP/FEIS. Therefore, an environmental impact statement is not needed. This finding is based on the context and intensity of the project as described in the sections below.

Context: This project is a site-specific action directly involving underground mining of federal coal reserves in a 2,679.76 acre lease tract. There will be no direct surface impact above the coal to be mined as the surface facilities for the mine are already established and in operation. This coal is an element of the life of mine (LOM) plan that has been approved for the mine and does not have international, national, regional or state-wide importance. There would be socioeconomic benefits related to continued mining and coal production at or near current levels that are currently being mined.

Short-term effects to some water resources may occur as a result of mine related subsidence. Fractures in the overburden above the mined coal seam could cause leakage of water into the mine. A monitoring program has already been implemented for the existing mine area and will be applied to the coal lease area. Approved mitigation measures will also be applied to prevent, minimize, or restore any potential effects from subsidence. Settling of the land associated with subsidence would not change the existing character of the local landscape.

Affected interests related to this coal lease may include special use, grazing, and people who use the project area for recreation. Effects would be minor and short-term in nature. No short or long term significant impacts on affected interests are expected in a regional context.

Intensity: The following discussion is organized around the Ten Significance Criteria described in 40 CFR 1508.27 and incorporated into BLM's Critical Elements of the Human Environment list (H-1790-1), and supplemental Instruction Memorandum, Acts, regulations, and Executive Orders. The following have been considered in evaluating intensity for this proposal:

1. **Impacts may be both beneficial and adverse**. Beneficial and adverse effects of the Proposed Action alternative were described in the EA. Mitigating measures to reduce potential short-term impacts to geology, water resources, air quality, soils, vegetation, wildlife, sensitive species, ownership and use of land, and cultural resources were incorporated in the design of the Proposed Action. The project would make a minor contribution to small amounts of airborne particulate matter and release of minor amounts of greenhouse gases (GHGs) at the surface facilities. Benefits of the project would be continuation of gainful employment at the mine and associated suppliers, and contribution to the supply of coal to meet the nation's energy demands. None of the environmental effects discussed in the EA are considered to be significant.

2. **The degree to which the selected alternative will affect public health or safety**. The Proposed Action Alternative is designed to control the limited public traffic that may occur in the project area of the existing surface facilities. Mine

subsidence would be monitored and mitigation measures would be implemented when subsidence would occur in the area of roads or other structures. Precautions for public health and safety would also be implemented during transport of equipment along public roads to and from the project area. Potential risks to public health and safety would be low and would occur over limited, brief periods.

3. **Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farm lands, wetlands, wilderness, wild and scenic rivers, or ecologically critical areas**. Inventories have been completed for historic and cultural resources in the area and no potential impacts to important historic or cultural resources have been identified. These resources are discussed further in Item 8. The following Critical Elements of the Human Environment are not affected because they are not present near the project area: Areas of Critical Environmental Concern, Wilderness Areas, Wild and Scenic Rivers, and Prime or Unique Farmlands. The Proposed Action includes mitigation measures to minimize any effects to small areas of wetlands in the lease areas. Fourteen Critical Elements of the Human Environment and five Non-critical Elements were analyzed in detail in the EA. Best Management Practices (BMPs) and mitigation measures were identified for those elements that could be affected. None of these elements would be significantly impacted because BMPs and mitigation measures would reduce any potential effects to either minor, or no impacts.

4. **The degree to which the effects on the quality of the human environment are likely to be highly controversial**. This decision for leasing coal reserves and its effects are not unique. Coal leasing decisions have been made in this region for many years. There is no scientific controversy over the nature of the impacts. There is some scientific uncertainty regarding the long-term effects of subsidence and how these effects can be managed. Proposed mitigation and reclamation procedures should be successful in reducing impacts. The potential intensity of these effects on the quality of the human environment is minimal.

5. **The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks**. The coal lease area is not unique or unusual. The BLM has experience implementing similar actions in similar areas. The environmental effects to the human environment are fully analyzed in the EA. There are no anticipated effects on the human environment that are considered to be highly uncertain or involve unique or unknown risks.

6. **The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.** This decision is not precedent setting. The actions considered in the selected alternative were considered by the interdisciplinary team within the context of past, present, and reasonably foreseeable future actions. Significant

cumulative effects are not anticipated. A complete analysis of the direct, indirect, and cumulative effects of all alternatives is described in Chapter 4 of the EA.

7. **Whether the action is related to other actions with individually insignificant but cumulatively significant impacts – which include connected actions regardless of land ownership.** The interdisciplinary team evaluated the possible actions in context of past, present and reasonably foreseeable actions. Present and future mining activities in the area were considered and significant cumulative effects are not anticipated. A complete disclosure of the effects of the project is contained in Chapter 4 of the EA.

8. **The degree to which the action may adversely affect districts, sites, highways, structures, or other objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources.** Inventories have been completed for historic and cultural resources in the area and no potential impacts to districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or potential loss or destruction of significant scientific, cultural, or historic resources have been identified. No cultural or historic sites would be directly affected by the Proposed Action. Subsidence over mined areas could result in localized cracking, sloughing or rock toppling, particularly in areas of steep slopes. No significant or potentially eligible cultural resources have been identified in settings that may be affected by subsidence.

9. **The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973, or the degree to which the action may adversely affect: 1) a proposed to be listed endangered or threatened species or its habitat, or 2) a species on BLM's sensitive species list.** No adverse impacts to endangered, threatened, or sensitive species or their habitat have been identified. Nevertheless, mitigating measures to reduce impacts to all wildlife species have been incorporated into the design of the Proposed Action as described in the EA.

10. **Whether the action threatens a violation of a federal, state, local, or tribal law, regulation or policy imposed for the protection of the environment, where non-federal requirements are consistent with federal requirements.** The project does not violate any known federal, state, local or tribal law or requirement imposed for the protection of the environment. State, local, and tribal interests were given the opportunity to participate in the environmental analysis process. Furthermore, letters were sent to area Native American tribes concerning consulting party status, and there was no response from any of the tribes. Follow up phone calls were initiated with the tribes, and it was concluded and documented that there was no interest in this project by those tribes. In addition, the project is consistent with applicable land management plans, policies, and programs.

DECISION:

This FONSI is based on the information contained in the EA and my consideration of criteria for significance (40 CFR 1508.27). It is my determination that: 1) the implementation of the Proposed Action would not have significant environmental impacts; 2) the Proposed Action is in conformance with the Billings Resource Management Plan; and 3) the Proposed Action does not constitute a major federal action having significant effect on the human environment. Therefore, an EIS is not required.

It is in the public interest to offer the Federal Coal Tract described in the introduction to this FONSI for competitive sale so that these reserves are available to compete for sale in the open coal market to meet the national coal demand.

Under this decision, the Proposed Action for the Federal Coal Tract has been selected from the Bull Mountains Mine No.1 EA. Under the Proposed Action, the Federal Coal Tract will be offered for lease at a competitive sealed-bid sale. The tract includes 2,679.76 acres, more or less, and the BLM estimates that the tract contains approximately 61.4 million tons of mineable Federal coal resources in Musselshell County, Montana.

If the highest bid received at the sale meets or exceeds the Fair Market Value (FMV) as determined by BLM and if all other leasing requirements are met, a lease will be issued to the successful qualified high bidder. The competitive lease sale will be held as described in Federal regulations found at 43 CFR Subpart 3422, Lease Sales. In the event that the highest bid submitted at the competitive lease sale of the Federal Coal Tract does not meet or exceed the FMV as determined by BLM, the BLM may, but is not obligated to, re-offer the coal tract for leasing at a later date.

Under the Proposed Action, it is assumed that the applicant would be the successful bidder on the Federal Coal Tract and that the Federal coal would be mined to the extent as provided for in the LOM underground mining plan for the adjacent Bull Mountains Mine No.1.

This decision incorporates by reference the standard coal lease stipulations which address compliance with the basic requirements of the environmental statutes and additional BLM special stipulations (Appendix A).

Alternatives Considered: The EA addressed two alternatives, the No Action and the Proposed Action Alternative. Under the No Action Alternative, current and future mining activities approved by the Montana Department of Environmental Quality (MDEQ) will continue on private lands and appropriate mitigation measures will be implemented to reduce or eliminate effects of mining on the environment. Under the Proposed Action Alternative, the subject federal coal would be mined according to the LOM plan and these same mitigation measures would be applied to the lease areas.

Rationale for Decision: This action would make additional federal coal reserves available for competitive leasing, provide an opportunity to extend the life of the mine, and be consistent with BLM management goals and prescriptions for the area. This decision balances recovery of the coal resource with protection of other resources and their uses consistent with the applicable laws, regulations, BLM policy and Resource Management Plan goals and objectives, standards and guidelines, and multiple-use decisions. The coal lease application was submitted under the Mineral Leasing Act of 1920, Federal Coal Leasing Amendments Act of 1976, and the implementing regulations found at 43 CFR 3425.

The decision to allow the proposed action does not result in any undue or unnecessary environmental degradation and is in conformance with the 1984 Billings Resource Management Plan. It has been made in consideration of the impacts to the affected resources. The lease stipulations applied to the proposed action will meet or exceed the standard for Public Land Health.

A summary of these mitigation measures contained in the MDEQ Mining and Reclamation Permit, Bull Mountains Mine No 1 SMP 93017discussed in the EA are described below:

Topography and Physiography

- A monitoring plan has been implemented to determine the nature of subsidence and the potential effects to other resources listed below.

Geology, Mineral Resources, and Paleontology

- As subsidence data is collected, observed surface effects to topography would be repaired on a case by case basis by mechanical or other measures as deemed appropriate by MDEQ;

Air and Atmospheric Values

- Mining operations at the surface facilities would continue to comply with the Air Quality Permit requirements as the federal coal is mined;

Water Resources

- Depending on the resource, impacts and mitigation alternatives available, SPE would rehabilitate water resources as appropriate. This might include drilling new wells, piping water from wells or springs to specific locations, development of new springs, repair of stream channels, repair of ponds, or establishment of other water management structures. SPE would evaluate these measures on a site-specific basis in consultation with MDEQ;

Soils

- Subsidence over mined areas may alter surface drainage and accelerate erosive or unstable soils in limited areas. Mitigation of surface effects to soils would be evaluated on a site-specific basis and remedial measures would be implemented in consultation with MDEQ;

Vegetation

- Areas of subsidence disturbance would be evaluated on a site-specific basis and, if the extent of disturbance warranted, a specific repair plan would be developed and implemented in consultation with MDEQ;

Wildlife

- Subsidence may result in local changes to water resources or distribution of vegetation resources. This may affect habitat available to wildlife, however, mitigation measures for water resources and vegetation would reduce or eliminate effects on wildlife;

Threatened, Endangered, and Sensitive Species

- Subsidence may result in local changes to water resources or distribution of vegetation resources. This may affect habitat available to sensitive species, however, mitigation measures for water resources and vegetation would reduce or eliminate effects on sensitive species;

Ownership and Use of Land

- SPE would repair damage to existing buildings and structures resulting from subsidence;
- SPE would repair damage to existing infrastructure over mined areas such as roads, fences, communications facilities and utilities;
- Where there would be known or reasonably anticipated damage to infrastructure, SPE would submit a protection and mitigation plan to MDEQ for approval prior to mining under that area;
- SPE would publish the mining schedule at least six months prior to mining under an individual's land, to provide adequate warning to minimize the potential risk to humans and livestock; and

Cultural Resources

- If any cultural resources are located during subsidence repair, work would stop and the MDEQ and BLM would be notified.

Compliance/Monitoring: BLM conducts quarterly compliance inspections and production verification actions throughout the life of the lease. The inspections will be designed to insure that the operator complies with the lease stipulations. In addition, the MDEQ monitors all surface disturbing and mining activities in the lease area to insure compliance with the mine permit and the reclamation plan.

Public Involvement: Public comments were solicited via a letter mailed to the appropriate agencies, specific interested parties, and the general public dated March 16, 2010, and by posting this letter on the BLM Billings Field Office website. The EA was made available for public review from March 28, 2010 to April 27, 2010 by legal notice published in the Federal Register and Billings Newspaper. In addition there were announcements of the availability of the EA in the Roundup Newspaper. A public hearing was held on April 13, 2010 at the BLM State Office, 5001 Southgate Drive, Billings, Montana. Public comments were received through April 27, 2010.

Five parties commented on the EA by letter during the public comment period. All EA comments were reviewed and analyzed. Comments requesting clarification or additional analyses were considered and, as appropriate, supplemental information is highlighted and included in the revised EA. Those comments that were outside of the scope of this analysis or require a response that is not included in the revised EA are provided as follows:

- Global warming has not been described as part of the environmental setting but is an observed trend in climate patterns. Furthermore, effects on global warming at the contribution level of this mine cannot be quantified. Climate tipping points are a theoretical possibility, not a verifiable reality; thus, climate tipping points have not been identified. There is speculation that tipping points may exist and may result in sudden and irreversible climate change. However, no studies have identified any thresholds or quantifiable tipping points that could be addressed in this EA. No agency has identified this as a regulatory issue and assumed responsibility for establishing standards.

- Many of the proposed impact mitigation measures take the form of adaptive management and would be evaluated as they are implemented. These types of measures are implemented until one is found to be effective. The effectiveness of proposed mitigation measures have been included in the Final EA where past experience is known.

- Air quality assessments for the existing operating mine were completed during permit updates and are summarized in the EA. Ongoing operations of the mine will comply with the terms and conditions of the permits issued.

- As stated in the EA, the only listed species with the potential to occur in Musselshell and Yellowstone Counties are the Whooping Crane and the black-footed ferret. The project area analyzed in this EA does not contain habitat for either of these species, nor have they been documented in any of the wildlife monitoring surveys. The Bureau of Land Management is not required to formally consult with the USFWS or the NMFS where a listed species is not known to occur or have its habitat potentially impacted;.

- The legal status of the Powder River Basin related to a coal production region is beyond the scope of the EA. In any event, the petition to reconsider the decertification of the Powder River Basin as a coal production region has been recently considered and rejected by the Director of the Bureau of Land Management. The detailed findings considering the decertification are a public record and can be provided upon request;

- The EA has adequately demonstrated that the foreseeable effects of the Bull Mountain Mine No. 1 expansion would not significantly affect the quality of the human environment and that there was no need to prepare a detailed EIS;

- Analysis of additional alternatives related to renewable energy sources pertain to national policy and are beyond the scope of this document;

- A protective financial bonding lease stipulation is not necessary since the regulations implementing the provisions of the Surface Mining Control and Reclamation Act (SMCRA) at chapter VII of 30 CFR, subchapter J sets forth requirements for performance bonds and public liability insurance for both surface mining and underground mining activities. Furthermore, the regulations at 30 CFR 740.4c (Responsibilities) state that the following responsibilities of OSM may be delegated to a State regulatory authority under a cooperative agreement: 4) Approval and release of performance bonds, liability insurance and, as applicable, Federal lessee protection bonds required for surface coal mining and reclamation operations on Federal lands. The State of Montana has an approved Cooperative Agreement as described in the regulations at 30 CFR 926.30. This agreement allows for State control and regulation of coal mining and reclamation operations on Federal lands. The MDEQ has the responsibility to administer this Agreement. Therefore financial bonding for water replacement, erosion control, and damage to surface improvements will be handled by the State of Montana's Department of Environmental Quality; and.

- SPE is working with MDEQ, landowners, and other agencies to monitor and determine potential impacts of subsidence. SPE will consider establishment of an Advisory Committee to address subsidence issues.

Appeals Procedures:
This decision may be appealed to the Interior Board of Land Appeals, Office of the Secretary, in accordance with the regulations contained in 43 CFR, Part 4 and the enclosed Form 1842.1. If an appeal is taken, your notice of appeal must be filed in this office (at the above address) within 30 days from receipt of this decision. The appellant has the burden of showing that the decision appealed from is in error.

If you wish to file a petition for a stay (suspension) of the effectiveness of this decision during the time your appeal is being reviewed by the Board, pursuant to Part 4, Subpart B, §4.21 of Title 43, Code of Federal Regulations, the petition for a stay must accompany your notice of appeal. A petition for a stay is required to show sufficient justification based on the standards listed below. Copies of the notice of appeal and petition for a stay **must** be submitted to each party named in this decision and to the Interior Board of Land Appeals and to the appropriate Office of the Solicitor (see 43 CFR 4.413) at the same time the original documents are filed with this office. If you request a stay, you have the burden of proof to demonstrate that a stay should be granted.

Standards for Obtaining a Stay

Except as otherwise provided by law or other pertinent regulation, a petition for a stay of a decision pending appeal shall show sufficient justification based on the following standards:

1. The relative harm to the parties if the stay is granted or denied,

2. The likelihood of the appellant's success on the merits,

3. The likelihood of immediate and irreparable harm if the stay is not granted, and

4. Whether the public interest favors granting the stay.

Should you have any questions regarding this decision, please feel free to contact…Jim Sparks, Billings Field Office Manager at (406) 896-5241.

Recommendation: I recommend that following a competitive coal lease sale, Federal Coal Tract MTM 97988 and its associated 2679.76 acres, more or less, be leased to the successful qualified high bidder provided it is determined that the highest bid meets or exceeds the Fair Market Value of the tract as determined by BLM and that all other leasing requirements are met. The competitive lease sale requirements will be held in accordance with the requirements at 43 CFR 3422. **It is further recommended to not offer the Federal Coal Tract on a deferred bonus basis, but to require payment of the balance of the bonus bid prior to award of the lease.** The lease will be subject to the standard and special stipulations found in Appendix A of this decision.

James M. Sparks,
James M. Sparks, Billings Field Office Manager, Billings, Montana
Date Signed: 4/15/11

ATTACHMENTS: DOI-BLM-MT-C010-2009-0010-EA

Approval: I agree with the recommendation of the Billings Field Office Manager and approve the FONSI and the decision of the BLM to offer for lease sale the coal contained in the Federal Coal Lease Application MTM 97988.

Theresa M. Hanley,
Theresa M, Hanley, Deputy State Director, Division of Resources,
Billings, Montana
Date Signed: 4/15/11

Bull Mountains Mine No. 1
Federal Coal Lease MTM 97988
Musselshell County, Montana
EA No. DOI-BLM-MT-C010-2009-0010-EA

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1.0 PURPOSE AND NEED

1.1 Introduction

This Environmental Assessment (EA) has been prepared to analyze and disclose the environmental consequences of the Bull Mountains Coal Lease by Application as proposed by Signal Peak Energy, LLC (SPE), operator of the Bull Mountains Mine No. 1 underground coal mine. The EA is a site-specific analysis of potential impacts that could result with the implementation of a proposed action or alternative to the proposed action. The EA assists the Bureau of Land Management (BLM) in project planning and ensuring compliance with the National Environmental Policy Act (NEPA), and in making a determination as to whether any "significant" impacts could result from the analyzed actions. "Significance" is defined by NEPA and is found in regulation 40 CFR 1508.27. An EA provides evidence for determining whether to prepare an Environmental Impact Statement (EIS) or a statement of "Finding of No Significant Impact" (FONSI). If the decision maker determines that this project has "significant" impacts following the analysis in the EA, then an EIS would be prepared for the project. If not, a Decision Record (DR) may be signed for the EA approving the selected action, the proposed action or another alternative. A DR, including a FONSI statement, documents the reasons why implementation of the selected action would not result in "significant" environmental impacts (effects) beyond those already addressed in the Lease by Application for subject coal to be leased.

This EA analyzes the environmental effects of leasing five tracts of federal coal reserves under private and federal owned land east of the existing Bull Mountains Mine No. 1 permit area. The Bull Mountains Mine No. 1 is in the Bull Mountains of south central Montana in Musselshell County between the Musselshell and Yellowstone Rivers, approximately 30 miles north of Billings and 20 miles southeast of Roundup, Montana. On March 19, 2008, SPE filed an application to lease approximately 2,679.9 acres of federal coal (MTM 97988) in sections 4, 8, 10, 14, and 22, Township 6 North, Range 27 East, Musselshell County under the Lease by Application regulations (43 CFR 3425.1) and the Energy Policy and Conservation Act of 2005. These tracts are shown in **Figure 1.1-1** and are referred to in this document as the coal lease area. The legal description for each tract is provided in **Chapter 2** of this EA.

1.2 Background

The coal lease area is east of the existing Mine Permit area and within the existing Bull Mountains Mine No. 1 Life of Mine (LOM) area. The coal lease area would be mined as part of the existing mine plan proposed by SPE (described in Chapter 2 of this EA). The coal would be accessed and recovered by underground continuous miner development and longwall panels. Previous assessments that have included portions or all of the LOM area include:

- Record of Decision (ROD), Billings Resource Area Final Environmental Impact Statement and Resource Management Plan (RMP) (BLM 1984)
- Bull Mountains Exchange Final EIS (BLM 1990)
- Proposed Development of the Bull Mountains Mine No. 1 FEIS (MDSL 1992)
- Bull Mountains Permit Revision 00178 EA (MDEQ 2006)
- Bull Mountains Mine No. 1 State Mine Permit (SPE 2009)

The Billings RMP (BLM 1984) included a discussion of two coal beds (Mammoth-Rehder and McCleary) in the Bull Mountains. The Bull Mountains Mine No. 1 area is within the south central portion of the Mammoth-Rehder coal field discussed in the RMP. The RMP briefly discussed the areas of this coal field suitable for further consideration for surface mining and noted that all federal coal that is mineable by underground methods is suitable for further consideration for leasing or exchange pending more detailed studies. The RMP specifically states that underground mining will be encouraged in the Bull Mountains at the expense of other mining methods. No detailed studies were completed for the RMP.

The Bull Mountains Exchange Final EIS (BLM 1990) addressed the exchange of selected federal coal lands in the Bull Mountains Mine No. 1 LOM area for high value recreation and wildlife offered lands in Montana. This EIS considered various underground mining methods with associated mine surface facilities.

The Final Environmental Impact Statement (FEIS) for the Bull Mountains Mine No. 1 (MDSL 1992) was prepared as part of the approval process for State Mine Permit (SMP) No. 93017. The FEIS covered the mine permit area, all proposed surface facilities at the mine, the Huntley load-out facilities near Billings, Montana, and the railroad spur to Broadview, Montana. The LOM area was analyzed as a foreseeable development, and detailed studies were included in the analysis as presented in the FEIS.

Bull Mountains Mine No. 1 Mine Permit Application was submitted to Montana Department of Environmental Quality (MDEQ) in 1990 and approved with a mine permit being issued in 1993. This document has been revised to reflect current facilities and operations approved for the mine over the past 15 years. This is a living document and will continue to be updated to reflect future changes in facilities and operations for the mine.

The Bull Mountains Permit Revision 00178 EA (MDEQ 2006) was prepared as part of the application process to add 2,172 acres to the south end of the permit area and revise the mine plan (Revision No. 00178). This EA contains a description of the acreage to be added to the permit area and a discussion of proposed modifications to the longwall mining methods and design to reduce the surface effects of the longwall mining.

This EA evaluates the effects of leasing the federal coal within the five tracts in the LOM area. This EA also includes recently collected information specific to the coal lease area and would be used to determine the social, economic, and environmental resource effects of leasing the coal.

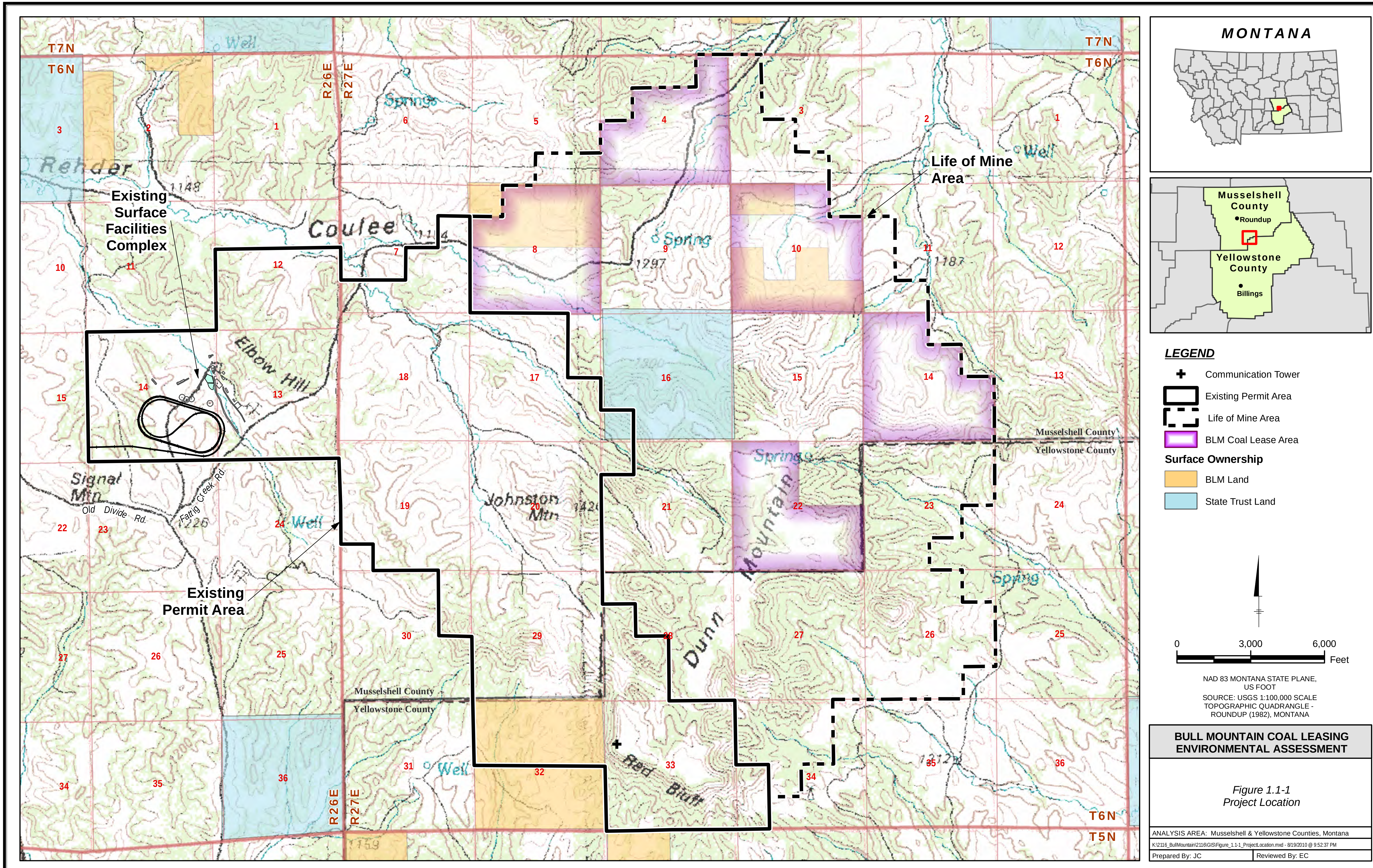

Figure 1.1-1
Project Location

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1.3 Need for the Proposed Action

The purpose of the Proposed Action is to develop the coal reserves contained within the Bull Mountains LOM area, as provided for under the Mineral Leasing Act of 1920. The Proposed Action is needed to continue economically viable development of the coal resources and to allow the lessee to exercise their right to develop the leases mentioned above. The BLM is required to evaluate the Lease by Application (Proposed Action) submitted by SPE and issue decisions related to the coal lease area. This EA provides the analysis upon which the BLM can base such decisions.

The underlying need for the Proposed Action is for SPE to develop these federal coal reserves by continuing underground mining operations. The Proposed Action would extend the existing permitted mine plan to the full extent of the LOM area. These coal lease tracts are located within the LOM area and are within the mining sequence for developing large blocks of state and private coal reserves. Based on the current projected annual coal production, SPE estimates that underground mining would reach the first coal lease tract in Section 8 within approximately three years. If the federal coal reserves are not leased, the Life of Mine Plan could not be implemented in its entirety. Mining would cease upon reaching the federal coal lease area and the state and private coal reserves to the south and east would not be accessible by the longwall mine plan that has been proposed (described in Chapter 2 of this EA). It may appear that a portion of these state and private reserves could be reached by reorientation of the mine plan; however, the accessible coal would not be economically mineable by longwall methods. The need for this leasing action would be to acquire the federal coal to ensure implementation of the Life of Mine Plan and economically recover federal, state, and private coal reserves through a logical mining unit.

A primary goal of the National Energy Policy is to add energy supplies from diverse sources, including domestic oil, gas, and coal, as well as hydropower and nuclear power. BLM recognizes that the continued extraction of coal is essential to meet the nation's future energy needs. As a result, private development of federal coal reserves is integral to the BLM coal leasing program under the authority of the Mineral Leasing Act, as well as FLPMA and FCLAA. The coal leasing program, managed by BLM, encourages the development of domestic coal reserves and reduction of the U.S. dependence on foreign sources of energy. As a result of the leasing and subsequent mining and sale of federal coal resources from the Bull Mountains Mine, the public receives lease bonus payments, lease royalty payments, and a reliable supply of low sulfur coal for power generation.

1.4 Purpose(s) of the Proposed Action

The purpose of this assessment is for the BLM to respond to SPE's Lease by Application to acquire the coal reserves in five coal lease tracts in order to implement the Life of Mine Plan for the Bull Mountains Mine No. 1. The lease area contains an estimated 61.4 million tons of in-place coal reserves in the Mammoth coal seam. The BLM, charged with administration of the mineral estate under these private and federal lands, is required, by law, to consider leasing federally-owned minerals for economic recovery. The BLM considers leasing the coal reserves and prescribes mitigation or stipulations for the protection of non-mineral resources.

The BLM is the lead agency responsible for leasing federal coal under the Mineral Leasing Act of 1920 as amended by the Federal Coal Leasing Act Amendment (FCLAA) of 1976, and is also responsible for the preparation of this EA to evaluate the potential environmental effects of issuing the coal lease.

1.5 Conformance with Land Use Plan(s)

The FCLAA requires that lands considered for leasing be included in a comprehensive land use plan and that leases be compatible with that plan. The Bull Mountains LOM area is within the Powder River Coal Region and includes public lands administered by the BLM Billings Field Office. These lands are covered by the RMP prepared in 1983 (BLM 1983). The ROD for that plan was issued in September 1984. A number of changes have occurred since that time including the development of the Bull Mountains Mine No. 1, and the RMP is currently being revised. Under the existing RMP, coal reserves were assessed for suitability for leasing for surface mining. The assessment process entails identifying the presence of known coal deposits, consulting surface owners, applying unsuitability criteria for surface mining (but not for underground mining), and applying multiple-use management concepts. Known coal deposits have been identified in the Mammoth-Rehder seam in this area. The current surface ownership of the coal lease area is both private and federal (**Figure 1.1-1**). There is an exemption under Surface Mining Control and Reclamation Act (SMCRA) from application of unsuitability criteria for coal to be mined by underground methods. Subsidence caused by underground coal mining is not included in the definition of surface coal mining operations under Section 701(28) of the SMCRA. All federal coal which is mineable by underground methods is suitable for further consideration for leasing or exchange pending further studies. The RMP ROD (BLM 1984) specifically states that underground mining would be encouraged in the Bull Mountains area. Furthermore, legislative and administrative guidance to encourage longwall mining over surface mining provides directives why SMCRA Section 522(b) and 43 CFR Subpart 3461 (designating areas unsuitable for surface coal mining) do not apply to the subsidence effects of underground mining.

1.6 Relationship to Statutes, Regulations, or other Plans

The coal lease application would be processed in accordance with the regulations found at 43 CFR 3425 for Lease by Application, and evaluated under the following federal authorities:

- Mineral Leasing Act, 1920 (MLA), as amended;
- National Environmental Policy Act, 1969 (NEPA);
- Federal Coal Leasing Act Amendment, 1976 (FCLAA);
- Surface Mining Control and Reclamation Act, 1977 (SMCRA);
- Energy Policy and Conservation Act, 2005 (EPCA).

The Office of Surface Mining Reclamation and Enforcement (OSMRE) is a cooperating agency for this EA. When a federal coal lease is issued, OSMRE is responsible for the administration of programs that regulate the surface effects of underground coal mining operations under SMCRA.

Pursuant to Section 503 of SMCRA, MDEQ developed Montana's permanent regulatory program authorizing MDEQ to regulate surface coal mining operations and the surface effects of underground coal mining on private, state, and federal lands in the State of Montana. MDEQ is also a cooperating agency for this EA and is responsible for issuing a permit to allow mining to occur on the leased areas.

1.7 Identification of Issues

Identification of issues began during the preparation of the Bull Mountains Mine No. 1 FEIS (MDSL 1992) and has continued to the present during several modifications to the mine permit. Under federal regulations governing BLM leasing of federal minerals (43 CFR 3420.4), the BLM is required to consult with qualifying surface owners in the preparation of a land use plan or analysis only for "mining by other than underground methods." Consultation with surface owners is not required for underground mines. Nevertheless, the public, including surface owners, have been provided the opportunity, through the scoping process, to express their concerns over potential environmental effects of leasing the coal. Special meetings have been held with several landowners in the area to discuss their concerns.

BLM released an announcement to interested parties on November 19, 2008 upon receipt of the coal Lease by Application and an invitation to comment on the application was provided. A public scoping period was held from November 24, 2008 through December 23, 2008. An open house was held in the Roundup, Montana Community Center on December 10, 2008 to answer questions about the project and receive public comment. Nine written comments were received during the scoping period. Issues identified for analysis in the EA include:

- Effects on employment, local economy, and tax base, including the adverse effects of not leasing the coal.
- Effects on steep slopes from subsidence in mined areas.
- Effects to aquifers and springs from subsidence in the mined areas.
- Effects to local surface drainages and water users from subsidence in the mined areas.
- Effects to structures in areas of surface subsidence and compensation for structural damage.
- Effects to historic and archaeological resources from subsidence in the mined areas.

Most of these issues are related to the potential direct or indirect effects of subsidence in the mined areas. These issues, as well as others identified by the Interdisciplinary Team preparing this analysis, are presented in this EA.

1.8 Summary

This chapter has presented the purpose and need of the Proposed Action, as well as the relevant issues, i.e., those elements of the human environment that could be affected by the implementation of the Proposed Action. In order to meet the purpose and need of the Proposed Action in a way that resolves the issues, the BLM has analyzed the Proposed Action and the No Action Alternative. These alternatives are described in **Chapter 2**. The affected environment of the coal lease area is described in **Chapter 3**. Potential environmental impacts resulting from the implementation of an action is analyzed in **Chapter 4** for each of the identified issues. Consultation and Coordination for the EA is included in **Chapter 5** and References and Acronyms are presented in **Chapter 6**.

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2.0 DESCRIPTION OF NO ACTION AND PROPOSED ACTION

This chapter describes the existing facilities and operations at the Bull Mountains Mine No. 1, the No Action Alternative and the Proposed Action for the coal lease, and a comparison of the potential effects related to these alternatives. The existing conditions include all of the operating mining facilities within the permit area as approved by the federal, state, and local regulatory agencies. The continued operation of these existing permitted facilities during mining of the proposed coal lease is an essential part of the Proposed Action. The Proposed Action is to lease five tracts of federal coal in the current LOM area, east of the current mine permit area as shown on **Figure 1.1-1**. The No Action Alternative would result in not leasing the federal coal and would result in no future mining in the LOM area under the currently proposed mine plan.

2.1 Existing Condition

There has been a long history of coal mining in the Bull Mountains and specifically, at the Bull Mountains Mine No. 1 site. PM Coal Company opened a small underground mine at the current location of the Bull Mountains Mine No. 1 surface facilities in 1932 that operated until 1973. In 1973, PM Coal Company opened the PM Surface Mine which produced 15,000 to 25,000 tons of coal per year from the Mammoth and Rehder coal seams. Also in the 1970s, Consolidation Coal Company and the Montana Bureau of Mines and Geology (MBMG) completed various investigations gathering information about coal quantity and quality of the Mammoth coal seam and regional hydrology in the current Bull Mountains LOM area. In the early 1980s, Louisiana Land and Exploration (LLE) gathered additional coal and environmental data in the current Bull Mountains LOM area for a permit application that was never completed. In the late 1980s, Meridian Minerals Company (Meridian) acquired the rights to mine coal in the area and also purchased the PM Mine. In 1989 and 1990, Meridian permitted and mined a surface test pit adjacent to the current Bull Mountains Mine No. 1 surface facilities and extracted approximately 180,000 tons of coal for test burn purposes. Meridian submitted a permit application to MDEQ for the existing Bull Mountains Mine No. 1 in 1990 and was issued State Mine Permit (SMP) No. 93017 in 1993. Since that time, the permit has been transferred to several ownership entities and was acquired by SPE in 2008.

The Bull Mountains Mine No. 1 is an operating underground operation using continuous and longwall mining methods as approved by MDEQ under SMP No. 93017 (SPE 2009). Continuous mining methods are used for development of production mains and longwall panels. Longwall equipment is currently extracting the coal in panels between the development entries. This combination of mining methods is the most efficient in the underground coal mining industry, and results in the highest coal recovery with the lowest costs while providing a safe working environment for mine personnel. Surface facilities associated with the Bull Mountains Mine No. 1 provide mine servicing, coal handling, coal cleaning and storage, coal transport by railroad, soil and sub-soil storage, coal processing and waste disposal, and water and air pollution control. Layout of the mine plan and surface facilities is shown in **Figure 2.1-1**. All surface facilities and the mining plan have been permitted in accordance with applicable MDEQ regulations and guidelines.

The following sections briefly summarize the existing operations. It is intended to provide a basic understanding of how the mine currently operates.

2.1.1 Mine Plan

The continuous mining method is used for main entry development, longwall panel development, and sump or other underground facility development. Longwall equipment is also currently mining the coal in panels. This is the most efficient mining method currently utilized in the underground coal mining industry. It results in the highest coal recovery with the lowest costs, while providing a safe working place for mine personnel.

The existing highwall at the PM Surface Mine (located in Section 13, Township 6 North, Range 26 East) was used to develop five portals for access to the underground mine. Main entry development followed portal development. Initially, the mains advanced toward the northeast corner of Section 13, Township 6 North, Range 26 East. Expansion of the five portal entries to multiple mainline underground entries provides travel ways for personnel, materials and ventilating air. Mainline development includes roof support installations that protect these areas over the LOM.

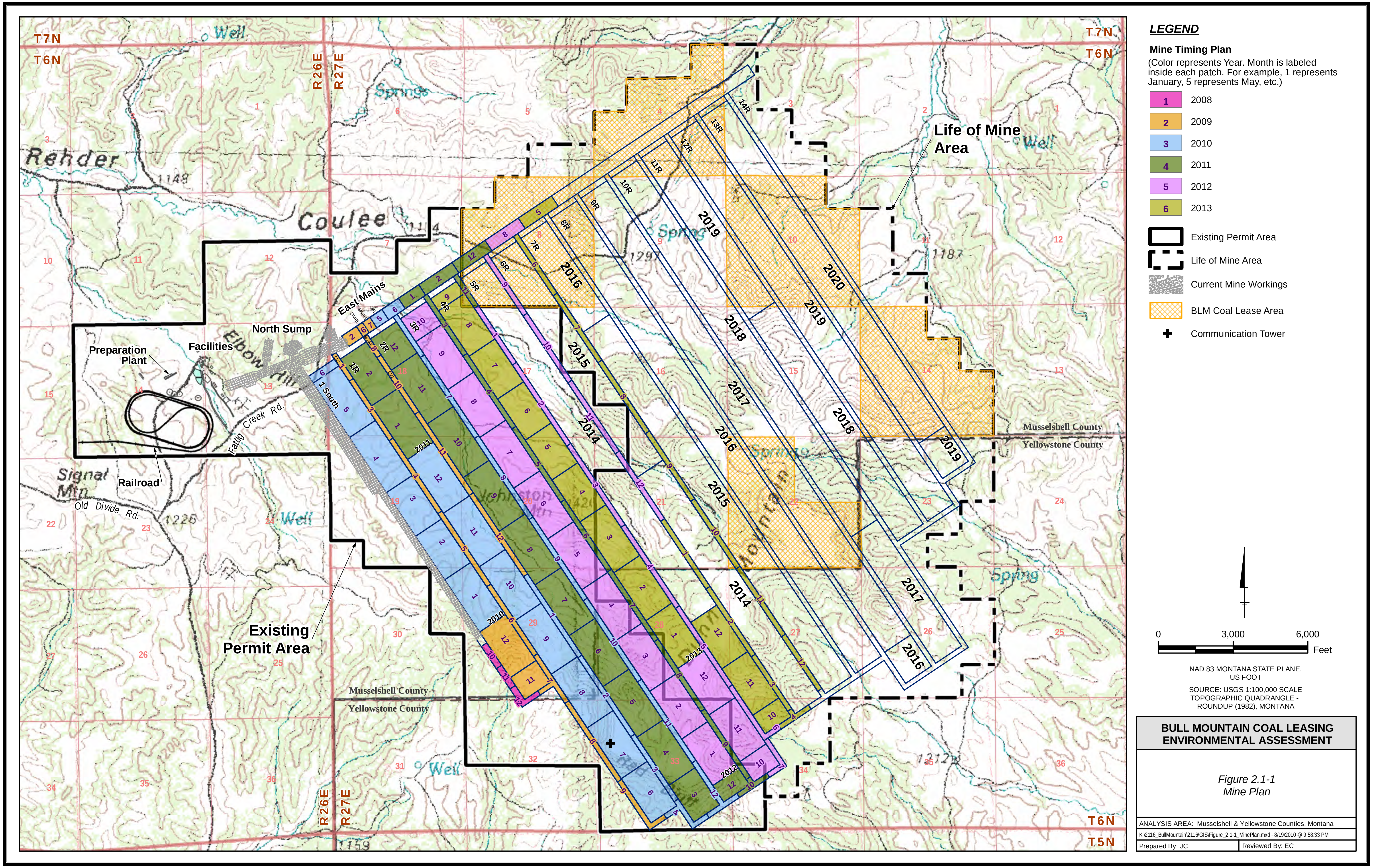
Mainlines are for multiple entries on centers ranging from 60 of 160 feet with connecting cross-cuts. The entry configuration is normally 18 to 20 feet wide and an average of about 9 feet in height, with a 1 foot coal roof (where applicable). Mining height normally does not exceed 10 feet in development entries to assure stable rib conditions. Thick coal found on the eastern portion of the property may provide top coal and bottom coal boundaries on the roof and floor. The multiple entry system includes return entries, intake entries, and an isolated belt entry located between the intakes and returns.

After development of the mainline entries and longwall panel headgate and tailgate, longwall equipment was installed for maximum production. The longwall is designed to mine the full seam up to 13 feet. The panel development widths are approximately 1,250 feet. Longwall panels would extend to near the outcrop, but would not mine under overburden of less than 200 feet in thickness.

SPE is permitted to mine about 12 million tons of raw coal per year with four crews working seven days per week. The 2,000-ton-per-hour coal processing facility provides clean coal recovery to approximately 85 percent. The coal processing facility will produce about 10 million tons of clean coal annually. The estimated mineable tons in the current permit area are 34 million tons of raw coal or 29 million tons of clean coal. The estimated production in the LOM area is 167 million tons of raw coal or about 144 million tons of clean coal. **Figure 2.1-1** shows the LOM underground mining plan and the sequence of mining by years.

2.1.1.1 Continuous Mining Operations

A continuous mining section employs a production machine (continuous miner), a haulage system (shuttle cars) and a roof support system (roof bolting machine). The major components of the continuous miner are the rotating cutting drum, gathering head and conveyor. The machine is electro-hydraulic powered and cat track propelled. The cutting drum is equipped with carbide tip cutting tools (bits). Operation of the machine at the working face involves driving the rotating cutting drum into the coal bed and raking downward, thereby cutting coal from the coal face. Mined coal is transferred via the gathering head to the conveyor. The conveyor transports cut


LEGEND
Mine Timing Plan
(Color represents Year. Month is labeled inside each patch. For example, 1 represents January, 5 represents May, etc.)
1 2008
2 2009
3 2010
4 2011
5 2012
6 2013
Existing Permit Area
Life of Mine Area
Current Mine Workings
BLM Coal Lease Area
Communication Tower
0 3,000 6,000 Feet
NAD 83 MONTANA STATE PLANE, US FOOT
SOURCE: USGS 1:100,000 SCALE TOPOGRAPHIC QUADRANGLE - ROUNDUP (1982), MONTANA
BULL MOUNTAIN COAL LEASING ENVIRONMENTAL ASSESSMENT
Figure 2.1-1
Mine Plan
ANALYSIS AREA: Musselshell & Yellowstone Counties, Montana
K:\2116_BullMountain\2116\GIS\Figure_2.1-1_MinePlan.mxd - 8/19/2010 @ 9:58:33 PM
Prepared By: JC
Reviewed By: EC
T7N
T6N
T5N
R26E
R27E
Life of Mine Area
Existing Permit Area
Preparation Plant
Facilities
North Sump
East Mains
Railroad
Rehder Coulee
Elbow Hill
Fattig Creek Rd.
Signal Mtn
Old Divide Rd.
Johnston Mtn
Musselshell County
Yellowstone County
Spring
Well
1 South
1R
2R
3R
4R
5R
6R
7R
8R
9R
10R
11R
12R
13R
14R
2014
2015
2016
2017
2018
2019
2020

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coal from the head (cutting drum) of the continuous miner to the tail of the machine which features a conveyor discharge section that is articulating. A continuous miner operates in a cyclic manner to provide coal for the haulage system. Elements of the mining cycle depend on mining conditions but generally include sump, shear, floor cut and raise-the-head. Each cycle advances the mining operation about 3 feet. Typical operations allow for 20 feet of total advancement, and then the mined area is roof supported in order to assure that the miner operator never works directly under an unsupported roof. Advancement can be much greater than 20 feet when using remote control continuous miners. Multiple entries are developed concurrently to allow for continuous mining (while roof bolts are installed in some entries, mining occurs in other entries). Multiple entries also provide working room for personnel and equipment (at least two entries are required to establish intake and return ventilation).

Shuttle cars are used as the primary face haulage vehicles. They transport mined coal from the tail of the continuous miner to a conveyor belt transfer point, known as a feeder breaker. Conveyor belts transfer the coal from the feeder breaker to outside the mine portal. The typical shuttle car has a payload of 10 to 15 tons and may be electric or diesel powered two-wheel or four-wheel drive, with a conveyor or push ram discharge design. The function of the shuttle cars is to receive a load of mined coal, tram to an unloading unit, discharge the loaded coal and return to the continuous miner for reloading. Each continuous miner typically requires two or three shuttle cars to allow for continued loading of one shuttle car while the others are in the tram/dump cycle.

Completion of the mining cycle is followed by roof support installation to ensure that a safe working environment is maintained. The most common roof support is installation of roof bolts which are an effective control for the immediate roof material.

2.1.1.2 Longwall Mining Operations

Longwall mining accomplishes the same objectives of production, haulage and roof support systems as continuous mining. However, longwall mining uses an electro-hydraulic powered shearer to mine the coal, and the major components of this machine are the drums and the tram system. The drums are located at each end of the machine, are limited to up-down movement, and are equipped with carbide cutting tools or bits. Operation of the shearer involves driving the rotating cutting drums into the coal seam and tramming along the face conveyor. The mined coal falls from the drums to the floor-supported face conveyor (**Figure 2.1-2**).

The longwall face conveyor transports mined coal from any location along the coal face to a belt conveyor transfer dump, known as the headgate. The end of the conveyor opposite the headgate is known as the tailgate. The major components of the face conveyor are the track, pan, chain, and drives. The track is the structure used by the shearer to advance back and forth along the face. The pan is a steel member which is designed to guide and house the conveyor chain and support the shearer. The pan has sections with normal lengths of five feet joined together to form a single, continuous unit from headgate to tailgate and sits on the floor of the coal seam. The chain is the conveyor instrument and is made up of steel chain and flight bars. The drives, located at each end of the conveyor, consist of sprockets coupled to electric motors which are used to power the conveyor chain.

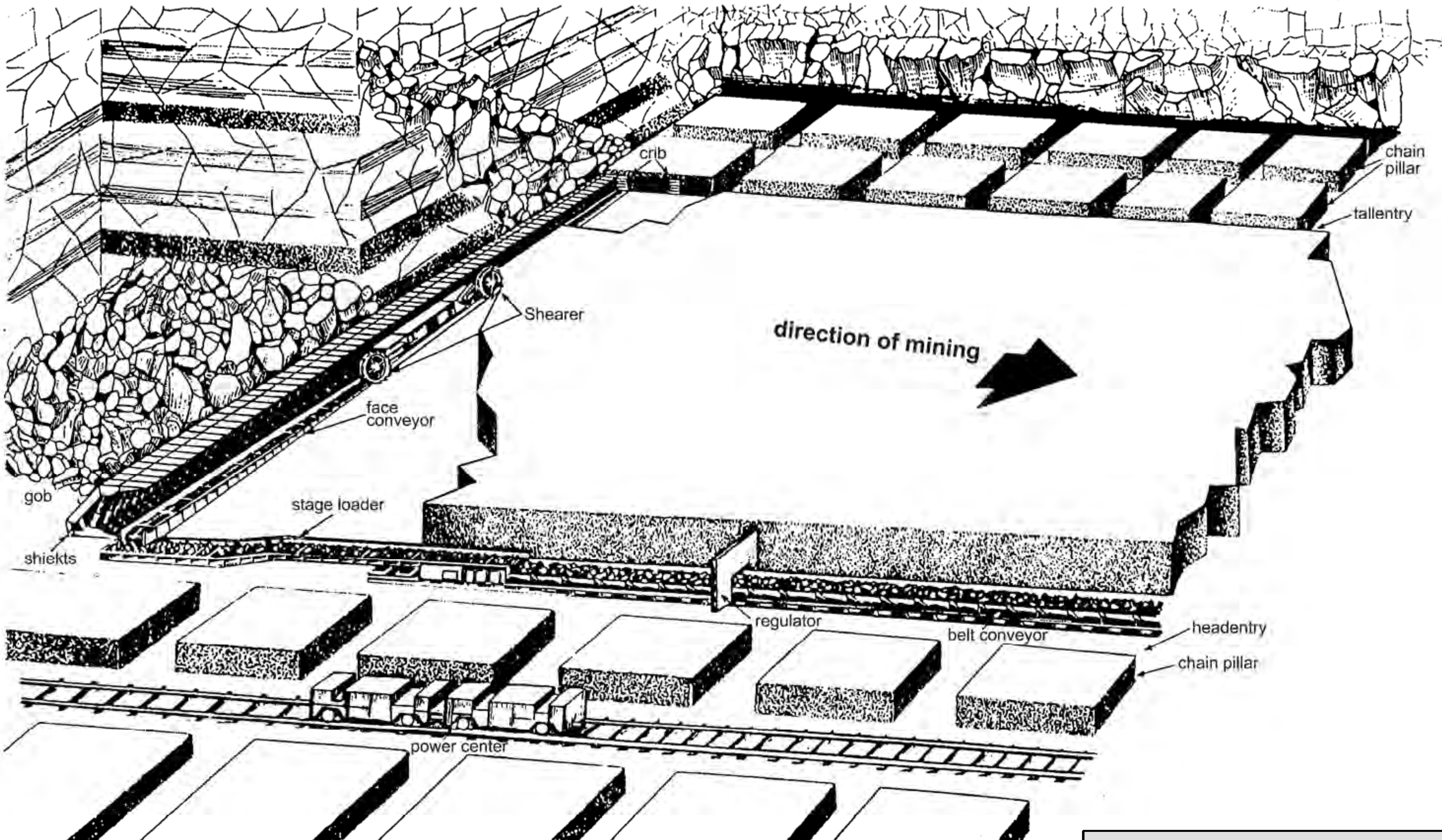
The longwall roof support is accomplished by using hydraulic roof supports, referred to as shields. The major components of the shields are the canopy, hydraulic cylinder, hydraulic controls, and base. The canopy is a thick steel plate, structurally reinforced, which is pushed against the roof. The hydraulic cylinders are used to push the canopy against the roof and to support the weight of the roof. The shields typically have a design load capacity of 500 tons or more per shield. The hydraulic cylinder diameter is approximately 12 inches and the hydraulic fluid pressure on the cylinders is approximately 5,000 pounds per square inch. The canopy is designed long enough to allow the face conveyor and shearer to be located under it. The base length of the shield is relatively short, allowing the face conveyer to sit on the floor ahead of the base and under the canopy.

Installation of longwall equipment was accomplished by using continuous mining equipment to develop a set of parallel entries. The distance between the entries is equal to the longwall face length. The continuous miner is used to establish a mineable block of coal; the longwall equipment is used to extract the block of coal between development entries.

2.1.1.3 Subsidence

Each of the longwall panels at the Bull Mountains Mine No. 1 consists of a large block of coal, approximately 1,250 feet wide by approximately 15,000 to 23,300 feet long (**Figure 2.1-1**). The panels would be completely extracted. Once the coal has been removed and the shields have advanced, the opening (mined-out area or "gob") would be unsupported, allowing overlying rock strata to collapse into the void. As subsequent rock strata above the mine caves in, the disturbance eventually propagates to the surface in the form of subsidence, or surface depression. The gob caves in behind the longwall system as it advances along the length of the panel. Collapse of the roof over the longwall panel would cause the surface overlying the panel to subside by an amount somewhat less than the thickness of the coal seam. Subsidence in the Bull Mountains has been predicted to be about 70 percent of the extraction thickness. The Mammoth Coal ranges in thickness from 8 to 13 feet in the permit area. Maximum subsidence is expected to be 9.1 feet (SPE 2009).

The mine plan incorporates large longwall panels that result in relatively uniform surface subsidence over larger areas as shown on **Figure 2.1-3**. From an environmental regulatory perspective, the surface effects of this mining method are uniform. In addition, the pillars supporting the gateroad openings have been designed to slowly fail as the longwall panel progresses. Failure of the gateroad pillars would result in partial subsidence over the gateroads. In longwall mining, surface subsidence typically occurs as a series of troughs over the longwall panels. But because the gateroads are designed to yield under the stress of the mined-out panels, the expected result is less extreme transitions between each trough. The expected outcome is that the surface subsidence would be uniform and less surface cracking would occur. However, uniform means that there would be few sudden transitions, not that surface effects would be identical at all locations. Subsidence would occur as a progressive wave behind mining resulting in a deflection plane that is not vertical, distributing shear laterally. Changes in surface slope are expected to be less than three degrees over the mined area. A slight slope into the subsided area would remain over the final mine boundary.



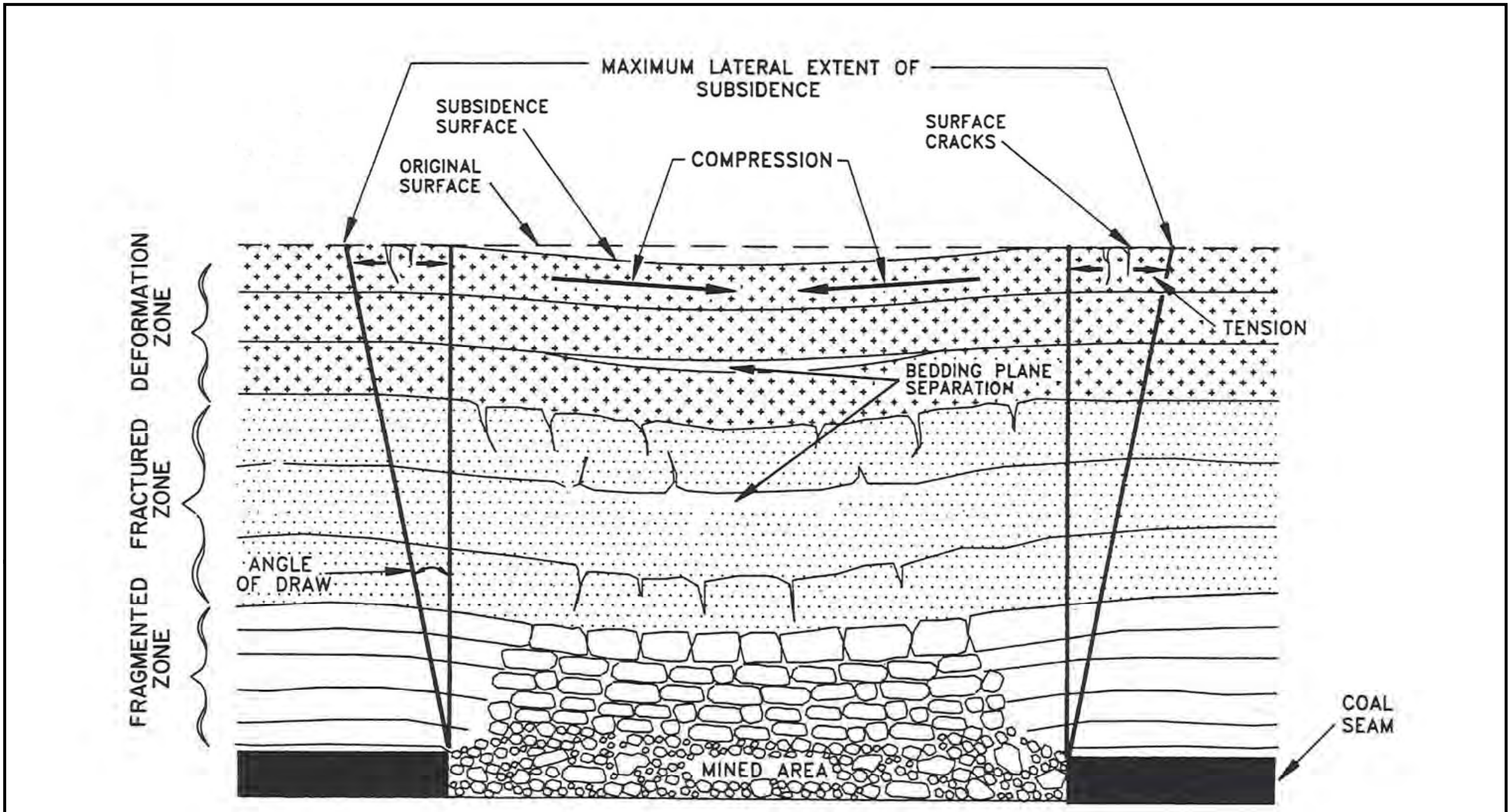
BULL MOUNTAIN COAL LEASING
ENVIRONMENTAL ASSESSMENT

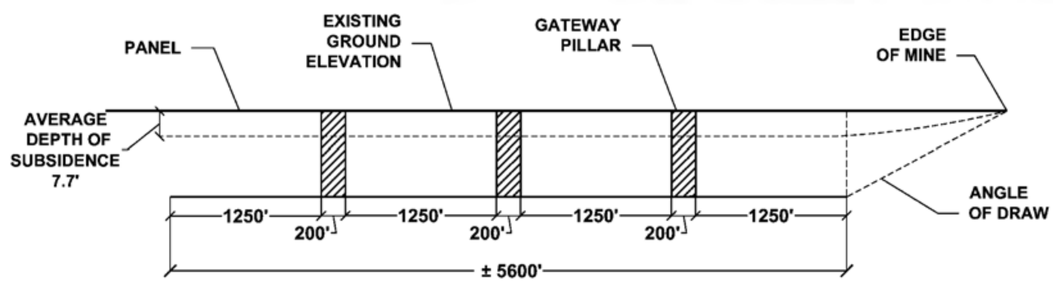
FIGURE 2.1-2
Typical Longwall
Retreating Panel Layout

ANALYSIS AREA: Musselshell & Yellowstone Counties, Montana

K:\2116_BullMountain\2116\GIS\Figure_2.1-2_LongwallRetreating_11x8.mxd - 3/19/2010 @ 10:28:22 AM

Prepared By: JC	Reviewed By: EC





Schematic Cross Section Illustrating Subsidence Across Four Longwall Panels

BULL MOUNTAIN COAL LEASING ENVIRONMENTAL ASSESSMENT

Figure 2.1-3
Conceptual Representation of Subsidence

ANALYSIS AREA: Musselshell & Yellowstone Counties, Montana

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Prepared By: JC | Reviewed By: EC

Other subsidence-related damage is expected to be minimal. Surface cracking is expected in some areas. Minor damage to roads and fences is possible. State regulations require the mine operator to promptly repair damage to private property. Steep slopes in the area may be prone to rockslides during subsidence. Mechanical treatment of rockslides (if any) will be assessed and appropriate repair will be completed. Landowners are provided with a mine plan schedule and notified at least six months prior to their property being undermined. The schedule would contain enough information to enable landowners to move cattle to other areas while mining is taking place. Subsidence could also negatively impact springs, wells, and stream courses. The extent of these impacts are uncertain, so groundwater monitoring wells and surface water monitoring stations have been established to measure any impacts of mining. These potential impacts are further discussed in the surface water and groundwater sections of **Chapter 4**.

2.1.2 Mine Operations

Run of Mine (ROM) raw coal is crushed underground to minus 6-inch. The coal is transferred from the underground conveyance system and discharges onto a belt conveyor connected to Stockpile #1 at a nominal rate of 7,500 tons per hour (TPH). A portion of Stockpile #1 feed conveyor is partially located in a Conveyor Tunnel (in the portal area) to allow for vehicular access over this conveyor (**Figure 2.1-4**). This conveyor discharges into Stockpile #1, which includes a stacker tube and storage for a nominal 200,000 tons of coal. A collection ditch is maintained around the perimeter of this stockpile to keep coal sediment from washing onto the adjacent native ground. Coal from this stockpile area is stored ahead of sizing, crushing and further processing. Coal from Stockpile #1 is reclaimed using feeder(s), a reclaim tunnel, and a conveyor delivering coal to the screening and crusher building at a nominal rate of 3,500 TPH (**Figure 2.1-4**). Coal from Stockpile #1 is processed for product coal at the surface facilities. The entire surface facilities complex is involved in storage and processing of the coal and loading it for shipment. Portions of the surface facilities may be upgraded. The following sections briefly describe coal storage, crushing and cleaning, coal preparation, coal waste disposal, product load-out, and the functions of ancillary facilities.

2.1.2.1 Coal Crushing and Cleaning Facilities

The raw coal from Stockpile #1 is conveyed to the screening and crusher building which contains two sizing screens and crushers. Any runoff from this area is controlled and diverted to a sediment control ditch and Sedimentation Pond D (**Figure 2.1-4**). The minus-6-inch raw coal is discharged onto the sizing screens which size the coal at 2-inch. The plus-2-inch (screen oversize) is delivered into the crushers for reduction to a minus 2-inch product size. Both the screen and crusher units are located inside a building. The minus 2-inch crusher product discharges onto a conveyor which connects to Stockpile #2. The minus 2-inch (undersize from the screens) also discharges onto this same Stockpile #2 conveyor. An elemental analyzer, capable of determining coal quality is installed on this conveyor. Depending upon analysis of the raw coal, the sized and crushed raw coal flows either into Stockpile #2 or into Stockpiles #3. Quality analysis determines the flow of the raw coal. Raw coal destined for the preparation plant flows to Stockpile #2 and raw coal determined by analysis acceptable for direct shipment and meeting contract specifications flows to Stockpiles #3. An elevated transfer conveyor connects Stockpile #2 with Stockpile #3 (**Figure 2.1-4**).

2.1.2.2 Coal Storage Area

The coal storage area has three concrete stacking tubes (Stockpiles #2, #3 and #4). Total storage capacity for the stockpiles is approximately 400,000 tons (**Figure 2.1-4**). A collection ditch is maintained around the perimeter of these stockpiles to keep coal sediment from washing onto the adjacent native ground. Any runoff from this area is controlled and diverted to a sediment control ditch and Sedimentation Pond D (**Figure 2.1-4**). An elevated conveyor, designed for a nominal 3,500 TPH, connects Stockpile #2 with Stockpiles #3. Depending upon the coal quality, this conveyor connects the stacking tubes and provides a method to transfer coal between the stockpiles for segregation, storage, blending and production purposes. Concrete reclaim tunnels, fitted with reclaim feeders are below each stockpile. Included with each reclaim tunnel is an escape tube. The reclaim tunnel from the Stockpile #2 discharges onto a conveyor to the preparation plant. This conveyor is designed for a nominal 2,000 TPH rate (**Figure 2.1-4**).

2.1.2.3 Preparation Plant

The preparation plant is a heavy media processing facility that does not require thermal dryers. The plant has a nominal production capacity of 2,000 TPH, with a maximum annual capacity of 15,000,000 tons per year (TPY). Make-up water is provided from two Madison Formation wells. A nominal 350 gallons per minute (gpm) of make-up water is required when the plant is operating at full capacity. Excess water from the underground workings would be used to supplement water from the Madison Formation wells.

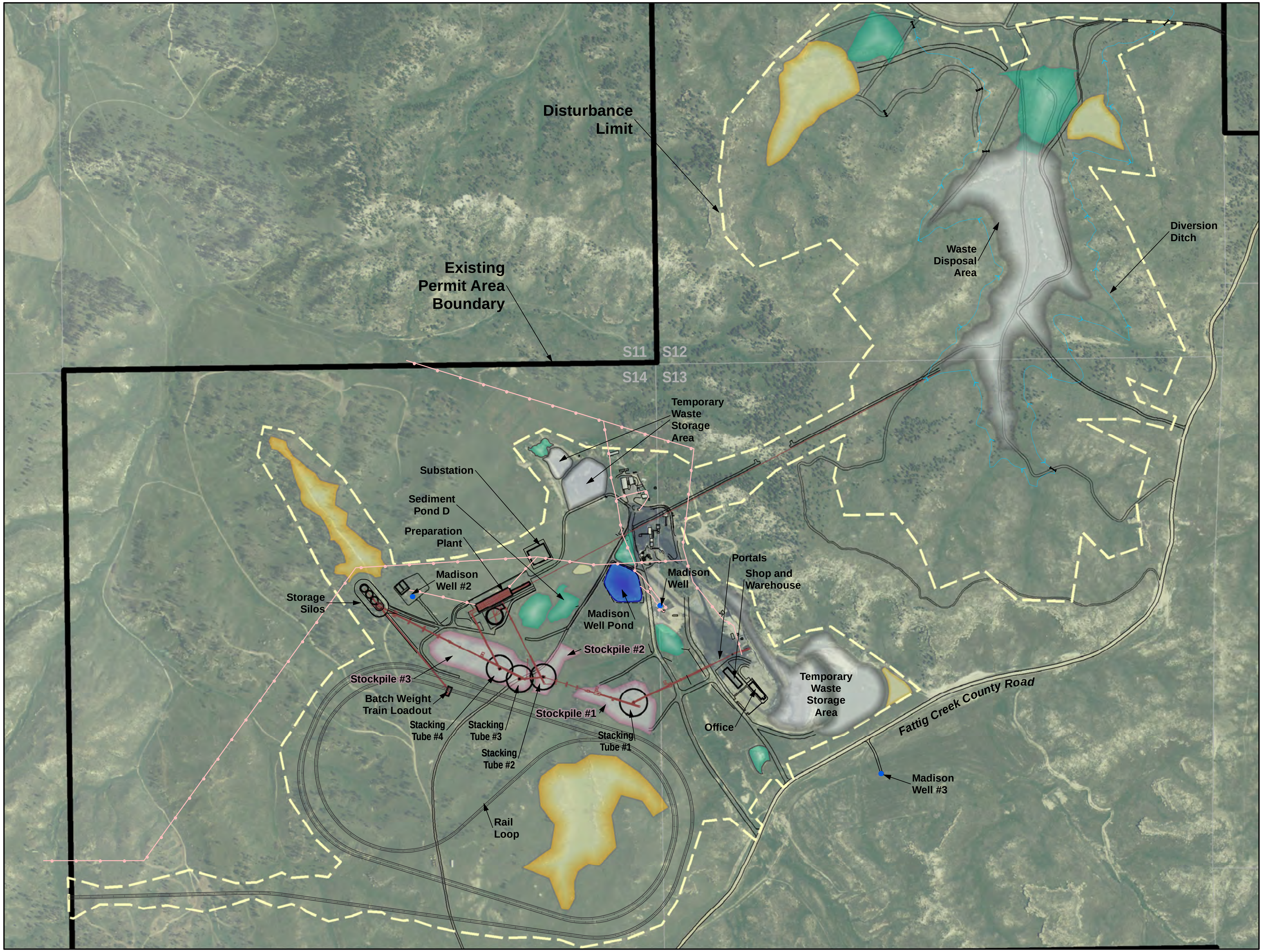
The preparation plant has been designed to process run of mine (ROM) coal into a product coal. The preparation plant processes coal at a nominal 2,000 TPH rate. Any runoff from the plant area is controlled and diverted to a sediment control ditch(es) and Sedimentation Pond D and Sedimentation Pond T2 (**Figure 2.1-4**).

2.1.2.4 Waste Disposal Area

Mine development and coal processing wastes are permanently disposed of in the Waste Disposal Area (WDA). These wastes are transported to the WDA via an overland conveyor system. The location of the WDA is shown on **Figure 2.1-4**. Generally, mine development wastes would represent poor quality coal, shale, claystones, mudstones, siltstones, etc., that are mined to access economic coal zones or to clean up roof falls, maintain floor grades, or to maintain necessary roof heights. The capacity of the WDA is designed for 29 million tons which will contain the waste material from the Life of Mine Plan.

Construction of the WDA fill, topsoil, and sub-soil stockpiles is an ongoing process during operation of the mine. SPE notifies the MDEQ 30 days prior to critical construction periods. Construction and inspections are be performed by an SPE qualified registered professional engineer experienced in the construction of waste structures and inspected by the MDEQ. Inspections are made quarterly during operation of the WDA and during critical construction periods to include at a minimum the following:

- Foundation preparation including the removal of all organic material and soil;
- Installation of final surface drainage systems;
- Final grading and revegetation of the site.



LEGEND

- Madison Well
- Existing Powerline
- Diversion Ditch
- S11 S12 S14 S13 Section Corner
- Existing Permit Area
- Waste Disposal Area (WDA)
- Sediment Pond
- Soil Stockpile
- Coal Storage Area Stockpile

0 500 1,000 Feet

NAD 83 MONTANA STATE PLANE, US FOOT

SOURCE: NAIP 2005, MUSSELSHELL COUNTY, MONTANA

BULL MOUNTAIN COAL LEASING ENVIRONMENTAL ASSESSMENT

Figure 2.1-4
Surface Facilities

ANALYSIS AREA: Musselshell & Yellowstone Counties, Montana

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Prepared By: JC | Reviewed By: EC

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The WDA includes a "head-of-hollow fill" for permanent disposal of wastes, a temporary topsoil storage stockpile, a temporary sub-soil storage stockpile, and two sedimentation ponds to control runoff and discharge of suspended solids from the respective storage areas. The topsoil and sub-soil stockpiles and the sedimentation ponds will ultimately be removed and reclaimed. The WDA does not contain any springs, natural or manmade water courses (except ephemeral flow in drainages), or wet-weather seeps.

Underground mine development waste is discharged from the mine and transported directly to the WDA without further processing. Underground development waste represents less than 10 percent of the WDA material. Only a small quantity of underground development waste and no coal processing wastes is stored underground due to a variety of physical, economic, and safety constraints.

During the mining operations, areas of the WDA are inspected to determine the moisture versus wheel compaction curves. This allows the equipment operators and personnel to know how many trips must be made across an area to achieve the 90 percent maximum dry density compaction as required by MDEQ Regulations. Moisture studies are made to determine optimum moisture for compaction. The moisture of the refuse varies between 15 to 30 percent. Air drying is accomplished by spreading and windrowing the piles of refuse before placement and compaction. Dry material is stored and blended into the wetter material as the fill is developed. A rubber-tired dozer is the spreading and compacting machine.

No underground development or coal processing wastes from outside the permit area are disposed of in the WDA without approval from the MDEQ. Underground development and coal processing waste is conveyed and placed within the permitted area. The WDA is designed to control runoff by diverting surface runoff from undisturbed and disturbed areas through sediment ponds to achieve compliance with discharge requirements. Fills are designed, permitted and constructed to ensure stability during and after construction.

The WDA will be covered with 4 feet of non-toxic material (including topsoil and sub-soil) and revegetated with an approved, weed-free native seed mix when final fill contours are achieved (both during operations and at end of life). For those areas of the WDA which have been enhanced for topographic diversity, (knobs and the top and the nose of the WDA face at the head of the valley) additional placement of spoil material is planned to further reduce potential erosion problems. The enhanced topographic areas of the WDA are constructed with the standard 4 feet of non-toxic material (topsoil and sub-soil) with the placement of an additional 6 feet of spoil located between the non-toxic material and the coal fines. Stockpiles are vegetated to minimize erosion and reclaimed to approximate original contour when the WDA is no longer in operation. The WDA will not create a public hazard either during mining operations or after reclamation and is posted to limit public access. Wastes are well-compacted and covered with non-toxic material to eliminate the possibility of spontaneous combustion.

Planned post-reclamation land use is rangeland and wildlife habitat. The final configuration of the fill area will have a 3 foot horizontal to a 1 foot vertical front slope and a relatively flat top level graded to drain at 1 to 2 percent. This configuration will have no depressions or impoundments and should be ideal for revegetation and the proposed land use.

Analyses of underground development and coal processing wastes were conducted to determine the acid-base potential of the materials to be placed in the WDA (Dollhopf 1989). The study determined that these materials are non-acid forming due to either their low sulfur content and/or lack of framboidal pyrite. The acidity from any pyrite contained in the waste will be neutralized by the inherent base chemistry of these massive morphology materials. Based on the results of the previous analyses, it was concluded that coal refuse will not produce acid upon exposure to water and oxygen. The analyses also indicated that there should be no long-term problem with pH, liberation of metals, or acidity from the waste materials. Liberation of metals was confirmed from TCLP laboratory analysis of the waste material conducted by SPE in December 2009 (SPE 2010).

2.1.2.5 Clean Coal Handling, Storage and Load-out

The preparation plant product conveyor delivers minus-2-inch plant product coal into Stockpile #4. A collection ditch is maintained around the perimeter of these stockpiles to keep coal sediment from washing onto the adjacent native ground.

Located under Stockpiles #3 and #4 is a reclaim tunnel, feeders and conveyor. This conveyor transfers coal into either of one of two coal storage silos. For additional product storage, a dozer is used to extend this stockpile area. Any runoff from the silo load-out area is controlled and diverted to a sediment control ditch(es) and Sedimentation Pond D. Product coal is reclaimed using a dozer pushing to the reclaim tunnel. Product coal is transferred using feeders onto a conveyor for transfer into two coal storage silos. The silos transfer to a conveyor connected to the batch-weigh device load-out bin. This conveyor is fitted with a scale, analyzer and a sampling system. The batch-weigh load-out system is located over the rail loop track. The batch weigh system is in a heated and insulated building. The batch weigh system consists of a surge bin and a batch weigh installed on the track loop (**Figure 2.1-4**). Any runoff from the batch-weigh load-out area is controlled and diverted to a sediment control ditch(es) and Sedimentation Pond D.

2.1.2.6 Railroad Loop and Spur

A railroad loop track is within the mine permit boundary (**Figure 2.1-4**). This loop track is constructed in a figure eight arrangement. The loop track and spur line within the mine permit area is approximately 5.7 miles in length (includes the double track sections) and is capable of handling two-150 car length unit trains with up to four locomotives per train. Based on a nominal 7,500 TPH load-out rate, the speed of the unit train during loading is approximately one mile per hour.

A 35 mile rail line has been constructed connecting the railroad loop to the Burlington Northern/Santa Fe (BNSF) mainline track near Broadview, Montana. The rail line is constructed at a 1 percent grade capable of handling unit trains of 150 car length.

2.1.2.7 Ancillary Facilities

Various surface facilities provide water, air and sewage treatment for the mine. Fresh water is supplied by a 400 foot well and stored in water tanks located in a cistern near the office for showers and toilets. Potable water for office use is supplied by the fresh water well and bottled water. A chlorine water treatment system for potable water is currently in place. Two deep

Madison Formation wells provide water used for the underground mine equipment and the coal preparation plant. Mine use is approximately 500 gpm. Excess water from underground seepage is pumped to a settling pond and is used to supplement water for mine operations. Fresh air is provided to the mine using ventilation fans located at the portals. Electrical power to the mine is supplied by Fergus Electric Cooperative facilities.

Additional mine service facilities consists of mine roads, fuel storage, fire control, water and air pollution control, and supplemental supply service centers. All disturbed areas have appropriate diversion-collection ditches and sedimentation ponds to control runoff, soil wash and erosion. Montana Pollutant Discharge Elimination System (MPDES) permit has been issued and discharge requirements are maintained for all surface discharges from the sedimentation ponds. Air quality protection is provided by equipment designed to control dust and spillage, and by applying water or other dust suppressants to roadways, parking areas, and refuse disposal areas. The MDEQ air quality permits have been obtained for the mine. There are no plans to generate Resource Conservation and Recovery Act (RCRA) type hazardous wastes at the mine. Solid and liquid wastes are handled by contractors and are recycled or disposed of at approved facilities.

2.1.3 Stipulations and Mitigation Measures

Table 2.1-1 lists the primary permit stipulations and approved mitigation measures for the existing Bull Mountains Mine No. 1 SMP 93017. These are listed by issue or potential impacts for each resource.

Table 2.1-1 Permit Stipulations and Approved Mitigation Measures

Resource	Issue or Potential Impact	Stipulation or Approved Mitigation Measures
Topography and Physiography	Subsidence of topography over mined areas	The ground surface would be surveyed prior to mining in accordance with Administrative Rules of Montana (ARM) and SMP conditions. The area over the mine would be inspected regularly. If evidence of impacts from subsidence is observed, the area would be monitored more closely. If evidence of damage is observed, treatment measures would be developed and implemented.
	Areas of short-term slope instability or rock toppling resulting from subsidence over mined areas.	Surface owners would be notified before mining would occur under their land. Areas of potential risk for slope instability or rock toppling would be identified to the land owner, and measures would be implemented to minimize the potential risk to humans and livestock
Geology, Mineral Resources and Paleontology	Impacts of subsidence	Subsidence would be limited to small areas of cracking, sloughing of some steep slopes and rock toppling. Geological strata and mineral resources would subside as a unit.
Air Quality	Pollutants	Emissions from the mine surface facilities would continue for the Life of Mine (LOM). Approved best management practices (BMPs) and mitigation measures would continue. BMPs for

Table 2.1-1 Permit Stipulations and Approved Mitigation Measures

Resource	Issue or Potential Impact	Stipulation or Approved Mitigation Measures
		pollutants include equipping below ground vehicles with scrubbers, ventilation sufficient to maintain acceptable NO_x and CO levels, and proper operation and maintenance of on-site sources. Air quality would meet MDEQ Air Quality Permit (MAQP) #3179 requirements and all state and federal standards.
	Particulates	Permitted surface facilities would continue to generate fugitive dust from ROM storage, coal processing, train loading, and other activities. Air quality would meet MAQP #3179 requirements and all state and federal standards.
Water Resources	Changes in surface drainage resulting from subsidence over mined areas.	Subsidence may affect surface drainage patterns. Surface drainage at selected sites in stream drainages, at ponds, and at small wetland areas would be monitored throughout the mining and post-mining stages. Monitoring frequency would vary depending on the size, use and location of the feature or area. Long-term mitigation to restore drainage patterns would be implemented after subsidence effects stabilize.
	Impacts to flow and quality of springs and wells (groundwater) from subsidence over mined areas	All wells, springs, and seeps in the LOM area would be monitored throughout the pre-mining, mining, and post-mining stages. Additional groundwater monitoring wells have also been developed. If flow or supply is affected, approved mitigation measures would be implemented in consultation with MDEQ. Surface water mitigation plans are in the current mine permit. The plans include restoring springs, stream reaches, and ponds by opportunistic development of springs where they appear, guzzler emplacements, horizontal wells, vertical wells, pipeline systems, deepening or rehabilitating existing wells, reclamation of stream reaches and function, and water treatment where appropriate or necessary for post-mine land uses. Surface water impacts would need to be evaluated and site-specific replacement or mitigation plans developed by SPE, in cooperation with the landowner, to ensure adequate long-term replacement of the surface water source.
Wetlands	Impacts from changes in surface and groundwater flow	Subsidence over mined areas may result in alteration of surface and groundwater flow, which may alter the flow of water to wetlands. Surface and groundwater flow would be

Table 2.1-1 Permit Stipulations and Approved Mitigation Measures

Resource	Issue or Potential Impact	Stipulation or Approved Mitigation Measures
		monitored on a regular basis, and if water flow to wetlands is disrupted, the water flow would be restored or replaced.
Soils	Erosion	Subsidence may alter surface drainage and accelerate degradation of erosive or unstable soils in some locations. In consultation with MDEQ, soil salvage, regrading, soil replacement, and seeding may be necessary to maintain stream profiles, minimize erosion, and ensure continuation of pre-mine land use.
	Ground disturbance - surface facilities	Surface disturbance would be in previously approved facilities areas. The area is already disturbed and currently permitted. Conditions of the existing reclamation plan that conforms to the ARM would be followed.
	Ground disturbance - subsidence over mined areas	Mining would result in subsidence of the overlying surface. Subsidence would be gradual and uniform and may create undulations and cracking in some areas. Soil profiles would remain intact and retain their chemical and physical characteristics. In consultation with MDEQ, mitigation of effects of surface subsidence would be evaluated on a site-specific basis.
Vegetation	Erosion and slope instability	No threatened, endangered, or candidate plant species have been identified in the LOM area. Subsidence would result in localized areas of erosion and slope instability which could disrupt the distribution of vegetation communities. Soil profiles would generally subside in-place with limited areas of cracking (see Soils). Vegetation would naturally re-colonize disturbed areas. Areas of surface disturbance would be evaluated and, if the extent of disturbance warranted, a site-specific repair and mitigation plan would be developed and implemented in consultation with MDEQ.
	Changes in surface drainage	Subsidence would result in areas of altered surface drainage which could affect the distribution of plant communities. Stabilization or reclamation of surface drainage is discussed under water resources. Areas of altered drainage would be evaluated and, if the extent of displacement of plant species warranted, a site-specific repair and mitigation plan would be developed and implemented.

Table 2.1-1 Permit Stipulations and Approved Mitigation Measures

Resource	Issue or Potential Impact	Stipulation or Approved Mitigation Measures
Wildlife	Local changes in wildlife habitat	Subsidence may result in local changes to surface and groundwater flow and to the distribution of vegetation communities. This may affect the distribution of resources available to wildlife. A number of species utilize these areas, including those that are dependent on surface water and the associated vegetation (e.g. waterfowl, shorebirds, and several songbirds) and those that are wider ranging and use the water during their movements throughout a larger home range (e.g. bats, upland game birds, raptors, deer and elk). Affects to water resources and vegetation would be mitigated as described in those sections.
Ownership and Use of Land	Impacts to buildings and structures	Impacts to existing buildings and structures over mined areas may occur as a result of subsidence. ARM and SMP conditions require that damage to structures be mitigated. SPE would repair damage to existing buildings and structures resulting from subsidence.
	Impacts to infrastructure (roads, fences, utilities, communication tower)	Impacts to existing infrastructure over mined areas such as roads, fences and utilities may occur as a result of subsidence. Subsidence-related damage is expected to be minimal. Surface cracking is expected in some areas. Minor damage to roads and fences is possible. State regulations require the mine operator to promptly repair damage to private property. SPE would repair damage to existing infrastructure.
	Livestock Grazing	For a short period (within a few months) after areas have been mined there may be a potential for slope failure and rock toppling as a result of subsidence. This would create a potential risk for grazing livestock. To minimize the potential risk to humans and livestock, SPE is required to publish the mining schedule at least six months prior to mining under an individual's land, in accordance with the ARM.
Cultural Resources	Rock toppling (rock art or rock shelters); erosion or slope instability.	All areas of steep slope (greater than 25 percent) have been surveyed for cultural resources. No potentially affected archaeological resources were identified.
Native American Religious and Traditional Concerns	Effects to Native American religious and traditional concerns	No Native American religious and traditional concerns have been identified in the LOM area. If religious and traditional concerns are identified through consultation between BLM and interested tribes, appropriate mitigation measures would be developed through government-to-

Table 2.1-1 Permit Stipulations and Approved Mitigation Measures

Resource	Issue or Potential Impact	Stipulation or Approved Mitigation Measures
		government consultation and implemented.
Visual Resources	Impacts to natural landscape	Key observation points for the mine surface facilities and LOM area are along U.S. Highway 87. The view of the approved surface facilities would be largely shielded from U.S. Highway 87 by topographic features during operation and the approved reclamation plan would minimize visual impacts after completion of mining. Impacts of dust and haze during mine operation would be minimized by air quality control measures specified in MAQP # 3179. Areas of the LOM area that would subside over mined areas are several miles from key locations along U.S. Highway 87. The overall character of the visual landscape would not change.
Noise	Noise of surface facility operation	Principal noise sources during operation of the surface facilities include the preparation plant, ventilation fans, trucks, conveyors, load-out equipment, and trains. Facilities are approximately 4,500 feet from the nearest residences. Noise control measures include maintenance of equipment and screening to contain or deflect noise.
Transportation	Employee and equipment traffic	SPE would maintain mine-related infrastructure for traffic. Mine tax revenue would contribute to maintenance of public roads. If issues requiring mitigation are identified, SPE would participate in planning.
	Railroad	Railroad traffic would not affect other traffic. There are no at-grade crossings in high-traffic areas. No need for mitigation has been identified.
Hazardous and Solid Waste	Continued generation of solid/liquid waste at surface facilities	Current approved BMPs and procedures for solid/liquid waste management would continue to be implemented.
Socioeconomics	Employment	Mine operation would improve local job opportunities. No need for mitigation has been identified.
	Tax base and tax revenues	Permitted mining operations would provide coal severance taxes and continued employment would contribute to continued federal and state income taxes. Tax revenues from mine would contribute to state, county, and nearby communities. No need for mitigation has been identified.
Environmental Justice	Disproportionate effects to communities or ethnic groups.	No need for mitigation has been identified.

2.2 No Action

Under the No Action Alternative, the federal coal lease area analyzed in this EA would not be approved for lease sale and mining would not occur within the federal lease area. In addition, private and state coal reserves to the south and east of the federal coal lease area would not be accessible under the current mine plan. Without access to the federal coal reserves, these private and state coal reserves would not be economically minable by longwall methods from the existing mine. Currently permitted operations and employment would continue until mining reaches the federal coal lease boundaries. This stage of the mine plan corresponds roughly with the eastern extent of the existing permit boundary and approved mine plan. If leasing is not approved, the current Life of Mine Plan would be shortened by approximately seven years. Approximately 133 million tons of mineable coal reserves (61.4 million tons of federal coal and 71.6 million tons of private and state coal) identified in the Life of Mine Plan would not be mined.

2.3 Proposed Action

Under the Proposed Action, the coal lease area, as applied for, would be leased to SPE for underground longwall mining in the Mammoth coal seam. The boundaries of the five coal lease tracts are shown in **Figure 1.1-1**. The legal descriptions of the proposed lease tracts are:

Township 6 North, Range 27 East, PMM, Musselshell County, Montana

Sec. 4, lot 1, S1/2NE1/4, SE1/4NW1/4 and S1/2;	479.76 acres
Sec. 8, NE1/4, NE1/4NW1/4, S1/2NW1/4 and S1/2;	600.00 acres
Sec. 10, W1/2NE1/4, SE1/4NE1/4, NW1/4 and S1/2;	600.00 acres
Sec. 14, SW1/4NE1/4, NW1/4 and S1/2;	520.00 acres
Sec. 22, W1/2 and SE1/4.	480.00 acres
Total	2,679.76 acres

Coal identified for production as a result of this lease would be produced from one coal seam referred to as the Mammoth coal seam that range from 8 to 11 feet thick. The leased federal coal reserves would be accessed from the mains of the existing Bull Mountains Mine No. 1 (**Figure 2.1-1**) and the coal would be processed at the existing surface facilities. The coal would be removed by underground longwall mining methods as an integral part of the mine plan and there would be no surface facilities or direct surface disturbance on the lease tracts. However, as a result of the longwall extraction method, the ground surface would subside over the mined areas.

Mining the coal lease tracts would allow current plans for mining private and state coal reserves in the LOM area east of the existing permit area. These private and state coal reserves would not be accessible or economically minable by longwall methods without access to the federal coal reserves. The entire LOM area contains approximately 167 million tons of mineable coal. About 34 million tons of this mineable coal is within the existing permit area. The coal lease area contains approximately 61.4 million tons of mineable coal. Another 71.6 million tons of mineable coal within the LOM area is contained in private and state mineral leases. Under the

Proposed Action, mining operations under the Life of Mine Plan would continue for approximately 10 years and would recover all of the economically mineable coal reserves in the Mammoth coal seam in the LOM area. Leasing the federal coal in the LOM area would account for 7 of the 10 years of mining.

The existing surface facilities have been established to sustain the Life of Mine Plan. No additional facilities would be needed for the Proposed Action. The Proposed Action would comply with currently approved stipulations, mitigation measures, and monitoring programs as described in SMP 93017 and summarized in **Section 2.1** of this EA. Additionally, under the proposed action, the lease would be subject to the BLM special coal lease stipulations and the standard stipulations found on the coal lease form, both of which are located in Appendix A of this document.

2.4 Summary Comparison of Alternatives and Environmental Impacts

A summary of potential effects from leasing the coal under the Proposed Action and the No Action Alternative are presented in **Table 2.4-1**.

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Table 2.4-1 Bull Mountains Coal Lease EA Comparison of Potential Effects by Alternative and Resource

Resource	Proposed Action	No Action
Topography and Physiography	Minor, lowering of topography in subsided areas. Maximum subsidence is expected to be 9.1 feet over the mined areas. Pre-mine surveys would be conducted for all surface structures. Subsidence monitoring would be conducted before and after mining. Damage to surface structures would be repaired.	The No Action Alternative would continue ongoing permitted effects of the existing mine. This would include minor lowering of topography in the subsided areas northwest of the lease areas.
Geology, Mineral Resources, and Paleontology	Minor, local steep slope instability from subsidence. Mining the coal would eliminate the mineral resource in the lease area. No paleontology resources identified in the coal lease area.	Not mining the coal reserves within and south of the federal lease areas under the proposed plan would leave these reserves uneconomical to mine in the future resulting in loss of coal royalties. Effects to geology and paleontology would be similar to the Proposed Action, but would be restricted to the mined areas north and west of the federal coal lease areas.
Air Quality	Negligible effects on air quality in the coal lease area. Emissions from the mine surface facilities would continue for the LOM, approximately 7 additional years. Approved BMPs and mitigation measures would continue. Air quality would meet existing permit requirements and all state and federal standards.	There would be no emission produced within the Federal coal lease areas. Permitted emissions from the operation of the surface facilities would continue until mining reaches the federal coal lease areas and would then end. Air quality would meet existing permit requirements and all state and federal standards.
Climate	Negligible greenhouse gas emissions would continue for an additional seven years.	Current permitted operations at the surface facilities would continue, continuing to generate the permitted, negligible emissions.
Groundwater	The effects of the Proposed Action on groundwater would be similar to the No Action Alternative, but would extend into the federal lease areas and into the private and state lands southeast of the federal lease areas. Minor to moderate effects from mining and subsidence would disrupt groundwater flow and recharge in the bedrock zones	Minor to moderate effects from mining and subsidence would disrupt groundwater flow and recharge in the bedrock zones directly above the mined coal.

Table 2.4-1 Bull Mountains Coal Lease EA Comparison of Potential Effects by Alternative and Resource

Resource	Proposed Action	No Action
	directly above the mined coal. Removal or water table reduction at private wells located on or adjacent to the coal lease areas. Mitigation measures would replace water losses. Minor changes to groundwater quality as water moves from fractured bedrock to the mine. Minor loss of recharge to downstream aquifers from inflow into the mine. Minor drawdown from underburden groundwater use and infiltration into the mine.	Removal or water table reduction at private wells located on or adjacent to the coal lease areas. Mitigation measures would replace water losses. Minor changes to groundwater quality as water moves from fractured bedrock to the mine. Minor loss of recharge to downstream aquifers from inflow into the mine. Minor drawdown from underburden groundwater use and infiltration into the mine.
Surface Water	Possible effects to surface water from the Proposed Action would be the same as the No Action Alternative, but would also extend into the federal lease areas and private and state land over mined areas southeast of the lease areas. Minor effects from subsidence; possible changes in stream channel drainage. Spring flow may increase, decrease, relocate, or be lost. Mitigation measures would replace water losses. Minor effects on ponds and stream flow from subsidence. Mitigation measures would repair channels and replace water losses. Negligible effects to surface water quality.	The potential effects over mined areas are described under the Proposed Action. Under No Action, these potential effects would be limited to the mined areas in the mine permit area northwest of the federal lease areas.
Wetlands	Minor, potential disruption of water supply to 15 springs within the coal lease area from subsidence. May temporarily impact spring-fed wetlands.	The potential effects over mined areas are described under the Proposed Action. Under No Action, these potential effects would be limited to the mined areas in the mine permit area northwest of the federal lease areas.
Soils	No surface disturbance from mine facilities. All facilities have been constructed.	No effects to the federal coal lease area and no additional surface disturbance at the mine surface facilities.

Table 2.4-1 Bull Mountains Coal Lease EA Comparison of Potential Effects by Alternative and Resource

Resource	Proposed Action	No Action
	Minor, localized soil erosion on steep slopes at the interface between non-subsidence and subsidence areas.	
Vegetation	No surface disturbance from mine facilities. All facilities have been constructed. Minor, localized changes in vegetation from soil erosion at the interface between non-subsidence and subsidence areas.	No effects to the federal coal lease area and no additional surface disturbance at the mine surface facilities.
Wildlife	Negligible, localized changes in habitat from soil erosion from subsidence.	No effects to the federal coal lease area and no additional surface disturbance at the mine surface facilities.
Threatened, Endangered, and Special Status Species	No effects from mining the lease area.	No effects to the federal coal lease area and no additional disturbance at the mine surface facilities.
Ownership and Use of Land	Minor, subsidence over longwall mined areas may damage structures. Immediate repair of damage to mitigate impacts.	No effects to the federal coal lease area and no changes in ownership and use of land at the surface facilities compared to existing permitted conditions.
Cultural Resources	No effects to cultural resources of the area.	No effects to the federal coal lease area and no additional surface disturbance at the mine surface facilities.
Visual Resources	No effects to scenic quality of the area.	No effects to the federal coal lease areas and no additional disturbance at the mine surface facilities.
Noise	No effects in the lease area. Minor, continued noise at surface facilities and railroad from mining leased coal for approximately 7 additional years.	Minor, continued noise at surface facilities and railroad corridor from mining the currently permitted coal.
Transportation Facilities	Minor, extends use of existing transportation infrastructure by employee travel to the mine and coal by railroad traffic for approximately 7 additional years.	Existing use of the transportation infrastructure for mine operations and employee travel to the mine until mining reaches the federal coal lease areas.
Hazardous and Solid Waste	No effects to federal coal lease area. Generation of solid/liquid waste from the mine surface facilities would continue for approximately 7 additional years. Solid/liquid	No effects to the federal coal lease area. Generation of solid/liquid waste from the mine surface facilities would continue. Solid/liquid waste handling would meet

Table 2.4-1 Bull Mountains Coal Lease EA Comparison of Potential Effects by Alternative and Resource

Resource	Proposed Action	No Action
	waste handling would meet existing permit requirements and all state and federal standards.	existing permit requirements and all state and federal standards.
Socioeconomics	Moderate beneficial effects; positive effects on employment, local economy and tax revenue from continued operation of mine for approximately 7 additional years. No increase in mine employment. No effects on public infrastructure or services.	Moderate negative effects; early closure of mine would result in unemployment and loss of tax revenue by eliminating mining for approximately 7 additional years.
Environmental Justice	No effects from continued mining operations.	No effects from not mining coal on federal coal lease area.

3.0 AFFECTED ENVIRONMENT

This chapter discusses the existing conditions of the physical, biological, cultural, and socioeconomic resources that could be affected by the implementation of the alternatives described in **Chapter 2** as they relate to the leasing of federal minerals in the identified tracts of the Bull Mountains Mine No. 1 LOM area. Aspects of the affected environment described in this chapter focus on the issues presented in **Chapter 2**. Baseline information is adapted from the current Bull Mountains Mine No. 1 SMP 93017 (SPE 2009), available data and literature from state and federal agencies, peer-review scientific literature, and resource studies conducted in the project area. For the purpose of this analysis, the project area is considered the Bull Mountains Mine No. 1 LOM area (containing the five coal lease tracts) and a surrounding one mile buffer. The coal lease area includes the five lease tracts as described in **Chapter 2**.

Elements of the environment specified by statute, regulation, Executive Order, or the Standards for Public Land Health are described and analyzed in this section. The following critical elements are considered in (**Table 3.0-1**). Those that could be impacted are brought forward for analysis. Any elements not affected by the alternatives were not analyzed in this document.

Table 3.0-1 Environmental Assessment Critical Elements

Critical Element	Not Applicable or Not Present	Present, But No Impact	Applicable and Present; Brought Forward for Analysis	Chapter 3 Section
Air Quality			✓	Air Quality
ACEC	✓			
Wilderness	✓			
Wild and Scenic Rivers	✓			
Cultural Resources			✓	Cultural Resources
Native American Religious Concerns			✓	Cultural Resources
Environmental Justice			✓	Environmental Justice
Farmlands (Prime & Unique)	✓			
Soils			✓	Soils
Threatened, Endangered, or Candidate Plant Species			✓	Vegetation
Invasive, Non-native Species			✓	Vegetation or Wildlife
Threatened and Endangered Species			✓	Vegetation or Wildlife
Migratory Birds			✓	Wildlife
Wildlife, Terrestrial			✓	Wildlife
Wildlife, Aquatic			✓	Wildlife
Wetlands & Riparian Zones			✓	Wetlands
Floodplains			✓	Alluvial Valley Floors

Table 3.0-1 Environmental Assessment Critical Elements

Critical Element	Not Applicable or Not Present	Present, But No Impact	Applicable and Present; Brought Forward for Analysis	Chapter 3 Section
Water Quality, Surface and Groundwater			✓	Water Resources
Wastes, Hazardous or Solid			✓	Hazardous and Solid Waste

The following non-critical elements are considered (**Table 3.0-2**). Those that could be impacted are brought forward for analysis.

Table 3.0-2 Environmental Assessment Non-Critical Elements

Other Elements	Not Applicable or Not Present	Present, But No Impact	Applicable and Present; Brought Forward for Analysis	Chapter 3 Section
Access			✓	Transportation Facilities
Transportation			✓	Transportation Facilities
Realty Authorizations		✓		
Range Management			✓	Ownership and Use of Land
Forest Management and Fire		✓		
Hydrology/Water Rights			✓	Water Resources
Noise			✓	Noise
Recreation			✓	Ownership and Use of Land
Visual Resources			✓	Visual Resources
Geology and Minerals			✓	Geology, Mineral Resources, and Paleontology
Paleontology			✓	Geology, Mineral Resources, and Paleontology
Law Enforcement			✓	Socioeconomics
Socio-Economics			✓	Socioeconomics

3.1 Topography and Physiography

The Bull Mountains Mine No. 1 is in the eastern foothills of the Rocky Mountains at the western edge of the Great Plains (**Figure 1.1-1**). The LOM area is in the Bull Mountains, which divide the drainages of the Musselshell River to the north and the Yellowstone River to the south. The federal coal lease area is in southern Musselshell County, about 30 miles north of Billings and 20 miles southeast of Roundup. The coal lease area is in mountainous terrain east of the existing surface facilities complex. The principal drainage is Rehder Creek and its tributaries, which flow to the west past the surface facilities complex, and Fattig Creek which flows northeast. Rehder and Fattig creeks are both tributaries of the Musselshell River. A small portion of the Section 22 tract is drained by Railroad Creek which flows southeast to the Yellowstone River. Dunn Mountain is on the divide between these two rivers. The lands to the north drain to the Musselshell River while the lands to the south drain to the Yellowstone River.

The general climate in south-central Montana is Middle Latitude Steppe. This is a semi-arid region characterized by low rainfall, low humidity, clear skies, and wide ranges in annual and diurnal temperatures. Average annual precipitation is about 14 inches with about one third of that falling in May and June. The driest period is from November to February. Heavy snows are not unusual during the winter. Strong downslope winds known as Chinooks have a thawing and drying effect and snow seldom accumulates to great depths.

Topography in the project area is characterized by gently sloping valleys bounded by ridges and sandstone-capped mesas. Differential erosion of rocks of varying hardness and resistance is the main process active in forming the present landscape. The underlying rocks are composed of interbedded shale, claystones, siltstones, coals, and sandstones; however, the high mesas and ridges are capped by "clinker". Clinker is a term used to describe the baked sedimentary rocks resulting from burning of underlying coal beds. The shale and claystones tend to be easily eroded, while the sandstone and clinker are more resistant to erosion. Sheet and rill erosion are active geomorphic processes in the upper drainage basins, and mass-wasting occurs locally along the steep-walled ridges.

Elevations in the coal lease area range from 3,970 feet above mean sea level along Rehder Creek in Section 8 to about 4,730 feet atop Dunn Mountain in Section 22. The terrain ranges from uplands with rock outcrops and ravines forested by ponderosa pine and Rocky Mountain juniper to sagebrush and mixed prairie grassland on lower benches, slopes, and drainage bottoms.

The project area covers a broader area of similar terrain ranging in elevation from about 3,700 feet to 4,750 feet. Average elevations in the area of the existing surface facilities complex are about 3,900 feet. Surface slopes can be as great as 15 percent in the area of the surface facilities and as great as 45 percent around mesas and ridges, including Dunn Mountain. The existing rail spur to Broadview extends westward from the surface facilities through higher terrain about five miles west of the facilities. After exiting the foothills, the rail spur crosses an area of flat-to-rolling agricultural land as low as 3,300 feet in Yellowstone County. The lowest elevations are south of Broadview.

Historical land use in the project area has been dominated by rangeland with some nearby areas of cropland and limited historical coal mining and timber production. The area contains wildlife habitat and is an attractive area for hunting and other dispersed outdoor recreation. In recent years there has been an increase in dispersed rural residential development.

3.2 Geology, Mineral Resources, and Paleontology

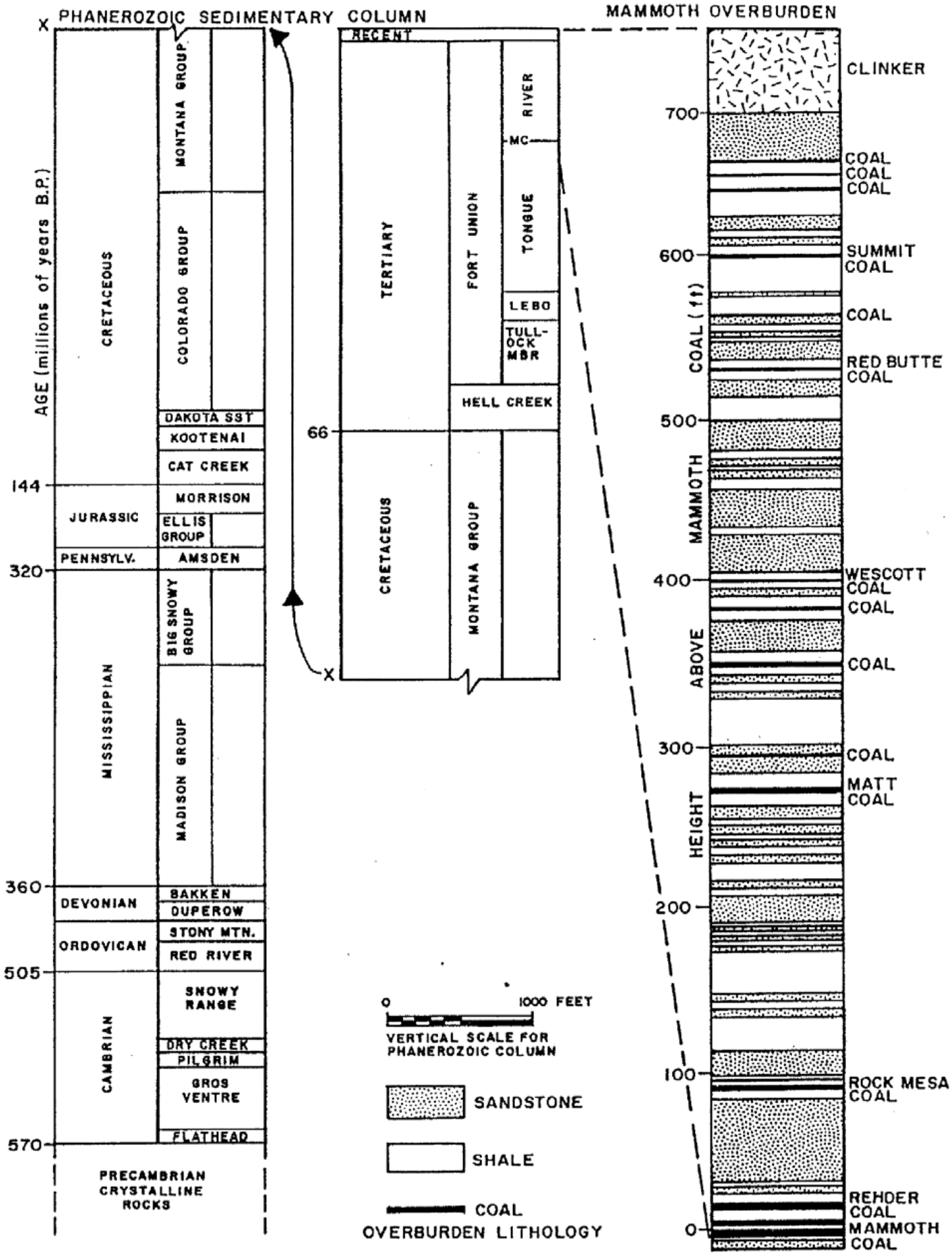
The Bull Mountains are composed of sedimentary rocks of the Fort Union Formation. This formation contains all of the commercial coal within the Bull Mountains. **Figure 3.2-1** illustrates the typical stratigraphy of the project area. The Fort Union has been divided into three members; in ascending order, these are:

- The Tullock Member, which is 400 to 500 feet thick in the study area. It consists of yellowish and darker colored sandstones and shale and contain no commercial coal beds.
- The Lebo Member, which consists of 200 to 300 feet of olive green and gray sandstone and shale. To the southeast, in the Northern Powder River basin, it contains minor coals. In the project area, however, it is less carbonaceous, and the few coal beds are thin, high in ash, and not of commercial value. The Lebo Member is less resistant to erosion than the overlying Tongue River Member and tends to form gently rolling grass covered slopes.
- The Tongue River Member, which is composed of light-gray to brownish-gray sandstones and siltstones, light-buff to dark-gray shaley siltstones and shale, brown to black carbonaceous shale, and coals. Several thin beds of buff colored limestone also have been observed in the upper portion of the Tongue River (Woolsey et al. 1917). The thick sandstones were deposited by fluvial processes as point bars and channel deposits, while the siltstones, shale, and claystones were deposited by flood plain, overbank, and lacustrine processes. The coals were deposited in peat swamps and the limestones probably were deposited in shallow lakes.

Twenty-six coal beds in the Tongue River Member, ranging in thickness from approximately one foot to 15 feet, have been named and mapped in the Bull Mountains (Woolsey et al. 1917). Numerous additional thin coal beds occur in the project area and are of no commercial value. Only the McCleary, Mammoth, and Rehder coals have been or are now of economic importance. The coal of primary interest for the Bull Mountains Mine No. 1 is the Mammoth coal.

Relatively thin valley alluvium, colluvium and mesa forming clinker are other lithologic units exposed in the Bull Mountains. The alluvium, exposed in some of the drainage bottoms, is of Quaternary to Recent age. The clinker, exposed along the ridge and mesa tops, is of Quaternary or late Tertiary age.

The Bull Mountains are underlain by a gently plunging syncline in the western portion of the Bull Mountains basin. The axis of the syncline, based on the Mammoth coal structure, trends northwest-southeast through the central and topographically highest portion of the project area. The deepest portion of the syncline is located about 8 miles north-northwest of the mine surface facilities (Connor 1988). Thickness of the overburden increases rapidly with distance from the outcrop.



SOURCE: MINE PERMIT EXECUTIVE SUMMARY (SPE 2009)

BULL MOUNTAIN COAL LEASING ENVIRONMENTAL ASSESSMENT

Figure 3.2-1
Stratigraphy of Bull Mountains

ANALYSIS AREA: Musselshell & Yellowstone Counties, Montana

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Prepared By: JC | Reviewed By: EC

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The stratigraphy of the project area has been divided into four hydrogeologic units:

- The alluvium, which includes the unconsolidated valley fill material in drainages;
- The overburden, defined as the portion of the Tongue River Member that overlies the Mammoth coal or the combined Mammoth and Rehder coals, including the clinker;
- The Mammoth coal or the combined Mammoth and Rehder coals; and
- The underburden, defined as the portion of the Tongue River Member of the Fort Union Formation that underlies the Mammoth coal.

Alluvium/Colluvium

The alluvium/colluvium includes both water and gravity deposited unconsolidated material. In the project area, it is relatively thin, and is confined to the valleys of the larger ephemeral streams, including Rehder Creek. As part of the hydrogeologic field program, numerous wells have penetrated the alluvium and indicate that it ranges in thickness from 0 to 37 feet.

The alluvium is composed of clastic material having a wide range of particle sizes including clay, silt, sand, and gravel. These materials are deposited as point bars, fine grained over bank deposits, and coarse grained basal conglomerates.

Overburden

Within the project area, the overburden varies in thickness from zero feet at the coal outcrop to more than 800 feet under the highest mesas. Within the areas planned for longwall mining, the overburden is greater than 200 feet thick.

The overburden is composed of interbedded sandstones, siltstones, shale, claystones, and coals. A few thin freshwater limestones were encountered in several of the exploration drill holes, but these represent an insignificant percentage of the overburden.

The sandstones in the project area exhibit a range of bed geometries, some sandstone, in particular that overlie the Rock Mesa coal, are massive and are up to 80 feet thick. The massive sandstones often are cross-bedded to thinly laminated, with clay ball conglomerate, fossilized wood fragments and logs, and flute casts occurring at their bases. These features are indicative of deposition by fluvial processes. Most of the sandstones occur in thinner beds, which can vary from lenticular and discontinuous to laterally continuous. The laterally continuous beds can show variations in thickness from a few inches to 70 feet. Sandstones comprise up to 50 percent of the overburden. Shale and claystones comprise 23 to 39 percent of this interval.

A number of coal beds occur in the overburden. In the project area, the Rehder coal is the first significant coal above the Mammoth coal; however, in the central portion of the project area, the interburden between these two coals thins rapidly, and the two beds merge. Other coal beds that occur in the overburden range in thickness from inches to several feet. Most are laterally continuous throughout the project area, except where they have been removed by erosion.

The most continuous coals (the Mammoth, Rehder, Rock Mesa, Matt, Lower and Upper Bull Mountains, Wescott, Strait, Red Butte, Fattig, and Summit) were correlated and mapped, and have been used to subdivide the overburden into seven stratigraphic intervals. The outcrops were used to define the areal extent of each of the seven intervals (**Table 3.2-1**).

Table 3.2-1 Overburden Stratigraphic Intervals Bull Mountains Mine No. 1

Interval 1	All rocks and clinker above the Summit coal. This interval occurs only on the tops of the highest mesas and ridges. Thickness varies from zero feet, where it has been removed by erosion, to more than 200 feet on the highest mesas. Contains several thin coals, interbedded sandstones, shale and clinker.
Interval 2	All rocks from the top of the Summit coal to the base of the Lower Strait coal. Occurs on the high mesas and ridges. Ranges from 130 to 145 feet in thickness and contains interbedded sandstones and shale, the Fattig and Red Butte coals, and several other thin discontinuous coals. The Summit coal is missing in the northwestern portion of the project area where the top of Interval 2 is inferred using the projected stratigraphic position of the Summit coal.
Interval 3	Rocks bound by the bottom of the Lower Strait coal and the top of the Wescott coal. Ranges in thickness from 75 to 105 feet and is composed of massive sandstones and interbedded sandstones and shale.
Interval 4	Rocks bound by the top of the Wescott coal and the bottom of the Matt coal. A range in thickness from 120 to 150 feet and it is composed of interbedded sandstones, shale, and numerous coals, including the Upper and Lower Bull Mountain coals. In most areas, three or four unnamed coals and the Wescott coal overlie sandstones all of which are laterally quite continuous.
Interval 5	Rocks bound by the bottom of the Matt coal and the top of the shale above the Rock Mesa coal. Ranges in thickness from 160 to 190 feet and composed predominantly of sandstone. Several massive sandstone units occur within this interval, the thickest of which occurs above the shale overlying the Rock Mesa coal throughout the southern portion of the project area.
Interval 6	In the western portion of the project area, Interval 6 consists of the rocks between the shale above the Rock Mesa coal and the top of the Rehder coal, including the Rock Mesa coal. In the eastern portion of the project area, where the Rehder and. the Mammoth coals have merged, the interval consists of the rocks between the shale above the Rock Mesa coal and the top of the combined Rehder-Mammoth coal. It ranges in thickness from approximately 40 to 110 feet. In the areas where the Rehder and the Mammoth have merged, Interval 6 is predominantly massive channel sandstone. Where the Rehder and Mammoth are split, the interval thins and is composed of interbedded sandstones and shale.
Interval 7	The Rehder coal and the Rehder/Mammoth coal interburden ranges in thickness from zero to approximately 55 feet and are composed of both a massive sandstone and thinner sandstones with interbedded shale. Based upon field observations, a thickness map, and cross-sectional geometries, Connor (1988) concluded that this interval is composed of fluvial channel sandstones and associated crevasse splay and overbank deposits.

Mammoth Coal

The Mammoth coal is continuous throughout the project area to the outcrop. Within the project area the Mammoth coal ranges from 8 to 11 feet thick. In the eastern portion of the project area, where the Mammoth coal and Rehder coal merge, the thickness of the combined Rehder-Mammoth coal (herein referred to as the Mammoth coal) is approximately 13.5 to 15.0 feet.

Underburden

The underburden is composed of the rocks below the Mammoth coal. For the baseline characterization, SPE has investigated the underburden down to 430 feet below the Mammoth coal as described in the following table.

All of the rocks outcropping within the project area, including the underburden, belong to the Tongue River Member of the Fort Union Formation. Numerous studies (Connor 1988; Shurr 1972; Woolsey et al. 1917; Flores 1981) indicate that massive sandstones are common in the Tongue River Member (including the rocks below the Mammoth coal), and that they represent large fluvial channels. The geometry of these sandstones, therefore, is more linear than tabular. Although linear in overall dimension, these channel sandstones still may be several miles wide and reflect the high sinuosity or meandering of the paleostream.

Examination of Woolsey's (1917) detailed stratigraphic sections and geophysical logs for oil and gas test wells in the Bull Mountains area shows that massive sandstones are common in the underburden of the Mammoth coal. Monitor well 62720-03 located east of the surface facilities is completed in one of these; a 50 foot thick, massive, fluvial sandstone that is approximately 350 feet below the Mammoth coal.

Associated with these fluvial channel-dominated facies are thinner sandstones; finer grained overbank deposits of siltstones, shale, and claystones; and backswamp coals. The Pompey and the Dougherty coals were encountered in several Louisiana Land and Exploration Company (LL&E) drill holes and wells and in five of the 1991 boreholes completed by Meridian.

3.2.1 Geologic Structure

The geologic structure of the area was defined using borehole information as well as photogeologic interpretation. The former was used to determine the geologic structure of the site especially with regard to the Mammoth coal and several other coal seams. The latter was used to identify fractures and lineaments within the project area.

Structural Evaluation

Drillhole data from the project area were combined with the outcrop data to construct a structure contour map on the base of the Mammoth coal. Dips on the base of the coal are generally less than 1 percent. Within the project area, the deepest portion of the syncline is located along the north-central boundary, and the highest portion is located along the south-central boundary in the vicinity of Dunn Mountain. The maximum difference in the structural elevation of the Mammoth coal is approximately 280 feet, and the base ranges from 3,960 to 3,680 feet above sea level.

The Bull Mountains Mine No. 1 permit area is located on the western flank of the syncline where the elevation of the Mammoth coal vary by approximately 180 feet, from approximately 3,920 feet in the southwest to 3,740 feet above sea level in the north. The project area is located on the northern and eastern flank of the syncline where the Mammoth coal is dipping to the north and northwest, respectively.

Fracture Interpretation

Fracturing of rocks in the area has been investigated for its importance in mine stability, subsidence, and groundwater flow. Conclusions from the fracture/lineament studies indicate:

- There is no evidence of fracturing being hydraulically significant in the deeper Fort Union Formation bedrock. In shallow bedrock (less than 100 to 200 feet deep), jointing may enhance permeability of sandstones and coals. In the near-surface, some joints may be sufficiently open to serve as conduits, focusing bedrock flow to some springs.
- Orientation sets of all scales of lineaments and of joints mapped in outcrop are similar, but there is no apparent spatial correlation between lineaments and jointing (joints striking northeast are not more frequent along northeast lineaments and are not more frequent on lineaments).
- Large, regional lineaments related to major drainage orientations are broad, diffuse features. They may be related to fracturing in higher strata that have since been removed by erosion; that is, watercourses may have been directed by structures no longer existing except as diffuse jointing in lower strata.
- No faults have been identified in the project area. All fracturing is jointing (without displacement).
- Jointing in any orientation set tends to occur in swarms, with very large unjointed areas between swarms.
- Jointing is vertically discontinuous (although the same orientation sets are seen at each horizon) and largely confined to sandstone beds. Claystones and shale have tended to absorb pre-mining strain by non-brittle deformation.
- Jointing frequency and aperture size are believed to decrease with depth, based on bedrock core studies, aquifer test results (permeability decrease with depth), and rock test results (rock strengths are low and do not favor brittle fracturing).
- Some large joints observable in air photographs do, nevertheless, appear to be associated with spring or seep occurrence. Shallow joints may, due to larger apertures under low confining overburden load, serve as conduits focusing spring emanation points.
- Joints induced by subsidence above the fragmented roof zone are very unlikely to cross shale or claystones of more than ten feet thickness and to remain open to function as significant conduits for vertical groundwater movement. These clayey strata are likely to deform in a non-brittle manner, and fractures that do open are likely to heal in the presence of water due to softening. Standard laboratory tests for plasticity and slake durability operate on very short time scales (minutes), and are not appropriate to demonstrate claystone behavior over days to months, and geologic evidence is more appropriate in predicting plastic behavior of shale and claystones.

After subsidence is complete, fractures in compressional zones should close, while shale should deform plastically and are expected to heal fractures in tensional zones; therefore, subsidence-induced fracturing should not have long term radical effects on the hydrology of aquifers above the fragmented roof zone.

Additional mineral resources in the region include sand and gravel resources that occur throughout Musselshell and Yellowstone Counties, and may also include undeveloped oil and gas resources. There has been exploration for oil and gas in the past, but there are no known plans to develop these resources.

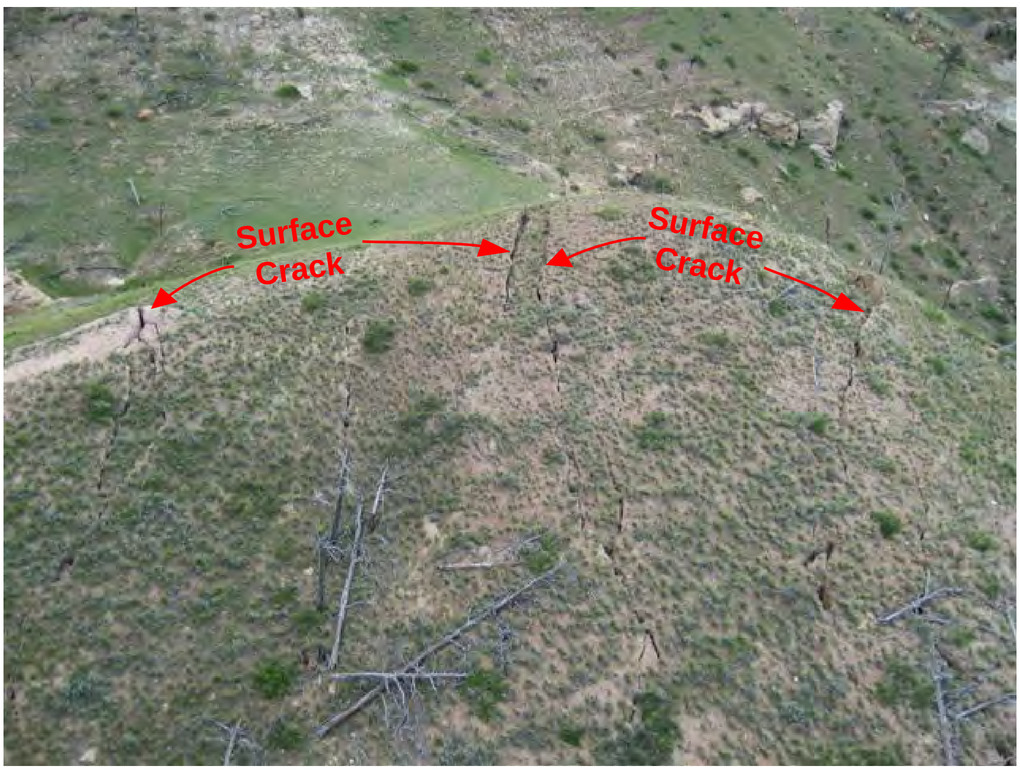
3.2.2 Mine Related Subsidence

Longwall mining began in December 2009 and has advanced approximately 12,000 feet to date, most of the first panel. Prior to longwall mining, a pre subsidence topography survey was completed for several locations above the panel. After longwall mining has progressed beyond a given survey point, topography surveys are completed again to measure subsidence. To date, seven subsidence surveys have been completed and additional surveys will continue as the longwall operations progress throughout the mine plan. In the area that has been mined, the coal seam thickness was 9.3 feet and the average overburden thickness was 259 feet. As predicted, subsidence deformation of approximately 70 percent of the coal seam height is occurring with a maximum surface elevation reduction of about six feet. Monitoring to date has shown that subsidence begins in the first week after mining and reaches near the maximum prediction within three to four weeks.

The predicted longwall subsidence mechanism includes surface cracking followed by closure of the cracks. Site surveys have been conducted by vehicle and aircraft to observe surface cracks. **Figure 3.2-2** shows some of the initial surface cracks that developed over the longwall panel. The experience to date has shown that smaller cracks have healed while some of the larger cracks are still expressed on the surface. To date, some large rocks have been displaced on the steeper slopes but only minor erosion has occurred from subsidence and has been well within the amounts contemplated by this analysis. These larger cracks may create a surface hazard to wildlife, livestock, and humans that traverse these areas. Appropriate mitigation measures would be implemented as specific hazards are identified by MDEQ as being a risk to heath and safety. There have been no observable effects to groundwater or surface water resources. Subsidence, hydrology, and ecological monitoring will continue according to the permit requirements and any associated damage related to subsidence will be repaired, as appropriate.

3.2.3 Paleontology

Paleontological resources are the physical remains, impressions, or traces of plants or animals from a former geological age. These resources may include casts, molds, and trace fossils such as burrows or tracks. Fossil localities typically include surface outcrops, areas where subsurface deposits are exposed, and special environments favoring preservation such as caves or wetlands. Paleontological resources are important primarily for their potential to provide scientific information on the evolutionary history of plants, animals, and their environments. Shale and sandstones of the Fort Union Formation are best known for their abundant plant and animal fossils. Significant accumulations of mammalian fossils (including multituberculates, marsupials,



**BULL MOUNTAIN COAL LEASING
ENVIRONMENTAL ASSESSMENT**

Figure 3.2-2
Surface Subsidence Cracks

ANALYSIS AREA: Musselshell & Yellowstone Counties, Montana

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Prepared By: JC | Reviewed By: JK

cimolestans, pantolestans, primates, condylarths, and pantodonts) have been recovered within the Tongue River Member of the Fort Union Formation in eastern Montana (Robinson and Honey 1984; Lofgren et al. 2004). However, their occurrences are neither consistent nor predictable as in other Tertiary formations such as the Wasatch. Based on variable occurrences of fossils that have potential to be scientifically significant, the Fort Union Formation is determined to be a Potential Fossil Yield Classification (BLM 2009a) Class 5 stratigraphic unit (Very High potential for significant paleontological resources). No paleontological localities have been documented in the project area, but the area is expected to yield plant and invertebrate remains. Vertebrate remains are less-likely to be encountered.

3.3 Air Quality

3.3.1 Site Specific Air Quality

An Air Quality Permit for the existing Bull Mountains Mine No. 1 has been obtained through the MDEQ (MAQP # 3179). The most recent revision of this permit (MAQP # 3179-04, issued January 20, 2009) assigns the permit to SPE. The air quality standards apply to the operation of the surface facilities complex. There would be no proposed surface facilities or activity in the coal lease area subject to the conditions and limitations of the MAQP. The conditions and limitations of the MAQP for the existing surface facilities are shown in **Table 3.3-1**.

Table 3.3-1 Conditions and Limitations of the Montana Air Quality Permit

Conditions and Limitations	Regulation
Coal production from the facility shall be limited to 15.0 million tons during any rolling 12-month time period for the primary phase of the coal mining operation.	ARM 17.8.749
SPE shall not cause or authorize any particulate stack emissions (total particulate), from pneumatic coal cleaning equipment, which exceed the following: 0.040 grams per dry standard cubic meter (0.018 grains per dry standard cubic foot); and 10 percent opacity or greater averaged over 6 consecutive minutes.	ARM 17.8.340 and 40 CFR 60, Subpart Y
SPE shall not cause or authorize to be discharged into the outdoor atmosphere from any coal processing and conveying equipment, coal storage system, or coal transfer and loading system processing coal, any emissions that exhibit an opacity of 20 percent or greater averaged over 6 consecutive minutes.	ARM 17.8.340 and 40 CFR 60, Subpart Y
SPE shall not cause or authorize to be discharged into the atmosphere, from any other source of process or fugitive particulate emissions, any visible emissions that exhibit opacity of 20 percent or greater averaged over 6 consecutive minutes.	ARM 17.8.304, ARM 17.8.308, and ARM 17.8.752
Water and/or chemical dust suppressant shall be available on site and used, as necessary, to maintain compliance with the opacity limitations in Section II.A.4 and Section II.A.5.	ARM 17.8.752
SPE shall use a fabric filter baghouse to control process particulate emissions from surface crushing and screening operations.	ARM 17.8.752
SPE shall use a fabric filter baghouse to control process particulate emissions from coal cleaning operations.	ARM 17.8.752

Table 3.3-1 Conditions and Limitations of the Montana Air Quality Permit

Conditions and Limitations	Regulation
SPE may operate one ROM coal stockpile not to exceed a surface area of 11.9 acres (520,000 square feet (ft^2).	ARM 17.8.749
SPE may operate four coal stockpiles, Stockpiles #1, #2, #3, and #4, each not to exceed a surface area of 4.6 acres (200,000 ft^2).	ARM 17.8.749
SPE shall use watering and/or chemical dust suppressants and contouring techniques to control particulate emissions from the coal stockpiles.	ARM 17.8.752
Fall distance shall be minimized during the transfer of waste material and coal to storage piles and during all transfer of material to haul trucks, material traps, hoppers, bins, and conveyors.	ARM 17.8.752
SPE may operate one topsoil storage pile not to exceed a surface area of 2.3 acres (100,000 ft^2).	ARM 17.8.749
SPE shall employ watering and/or chemical dust suppressant, contouring, compaction techniques, and re-vegetation to reduce emissions from the topsoil storage pile.	ARM 17.8.752
SPE shall employ watering and/or chemical dust suppressant, contouring, compaction techniques, and eventual covering with soil and re-vegetation to reduce emissions from waste disposal activities.	ARM 17.8.752
SPE shall enclose all coal and waste material conveyors. Conveyors shall be enclosed on the top and sides with a partial opening on the bottom.	ARM 17.8.752
SPE shall use flexible chutes, enclosures, and fabric filtration to control emissions from all coal and waste material conveying transfer points and coal load-out operations.	ARM 17.8.752
SPE shall convey coal from Stockpiles #3 and #4 to either the product load-out conveyor directly or to product silos only.	ARM 17.8.752
SPE shall operate all crushers and screens within an enclosed building.	ARM 17.8.752
SPE shall not operate more than two crushers at any given time and the maximum rated design capacity of each crusher shall not exceed 3,500 TPH.	ARM 17.8.749
Crushing production is limited to 15 million tons during any rolling 12-month time period.	ARM 17.8.749
SPE shall not operate more than two screens at any given time and the maximum rated design capacity of each screen shall not exceed 3,500 TPH.	ARM 17.8.749
Screening production is limited to 15 million tons during any rolling 12-month time period.	ARM 17.8.749
SPE shall utilize a stacker-reclaim (underground) system for movement of product into and out of stockpiles during the primary phase of operations.	ARM 17.8.752
SPE shall incorporate a radial stacker with an adjustable chute at the discharge end for both the clean coal and reject stockpiles during the development phase.	ARM 17.8.752
SPE shall incorporate a fixed stacker for both the ROM and clean coal stockpiles during the primary phase of the project.	ARM 17.8.752
SPE shall develop, implement, and maintain good housekeeping practices to keep coal and waste material transfer locations clean.	ARM 17.8.752
SPE shall not cause or authorize the use of any street, road, or parking lot without taking reasonable precautions to control emissions of airborne particulate matter.	ARM 17.8.308
SPE shall clean up all spilled material from road surfaces.	ARM 17.8.752
SPE shall treat all unpaved portions of the haul roads, access roads, parking	ARM 17.8.749

Table 3.3-1 Conditions and Limitations of the Montana Air Quality Permit

Conditions and Limitations	Regulation
lots, or general plant area with water and/or chemical dust suppressant, as necessary, to maintain compliance with the reasonable precautions limitation in Section II.A.22.	
SPE shall not operate more than two boilers at any given time and each boiler shall not exceed a maximum design capacity of 35,000 British thermal units per hour (Btu/hr) each.	ARM 17.8.749
Total coal combustion in 35,000 Btu/hr boilers shall be limited to 26 tons during any rolling 12-month time period.	ARM 17.8.749
SPE shall comply with all applicable standards and limitations, and the reporting, recordkeeping, and notification requirements contained in 40 CFR 60, Subpart Y, and Standards of Performance for Coal Preparation Plants.	ARM 17.8.340 and 40 CFR 60, Subpart Y

The conditions above include several measures for controlling airborne particulates. The Best Available Control Technology (BACT) analysis attached to the 2009 revision of the air quality permit (MAQP #3179-01) concluded that emissions of NO_x, CO, and SO_2 by the proposed facilities would be negligible and that proper operation and maintenance of onsite sources would be adequate to achieve appropriate emission standards. However, control measures and monitoring are specified for airborne particulates.

Air quality is characterized by the concentration of various pollutants and their interaction in the atmosphere. Pollution effects on receptors are a measure of the degradation of air quality. The nearest receptor is a residence located approximately 0.5 miles to the south of the surface facilities complex. Measurements of pollutants are expressed in parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). Both long-term climatic factors and short-term weather fluctuations are considered part of the air quality resource, because they affect the dispersion and concentrations of pollutants. Prevailing winds are a key element of local climate that affects the dispersion of pollutants.

Baseline data on wind patterns was collected for the mine permit in 1989 (SPE 2009 Volume 5, Section 304(8)). **Table 3.3-2** presents a tabular frequency distribution of wind direction by wind speed class. This information is also displayed graphically in **Figure 3.3-1**. Average wind speeds range from 2.5 to 6.0 m/sec (5.6 to 13.4 mph) with a mean speed of 3.9 m/sec (8.7 mph). The wind speeds were the highest from the west and west-northwest due to the stronger synoptic level forces. Hence, the westerly components can be attributed to the synoptic flow in the region. Minimum wind speeds are from the south and southeast indicating that the flow from that direction is associated with weak drainage flow.

The dominant wind flow throughout the period (February through December 1989) is northerly to westerly with an additional southeasterly component. Morning wind (0800-1200), as solar heating becomes more significant, has a more dominant flow from the southerly to westerly directions but still continues to have significant occurrences in the other directions except from the east. During the afternoon (1200-1600) the prevailing winds continue to be west-northwest but again significant flows occur from the other directions. During the late evening (2000-2400), the flow characteristics return back to those seen in the early morning hours with both northwesterly and southeasterly components being present.

Table 3.3-2 Frequency of Winds by Direction and Speed, February through December 1989

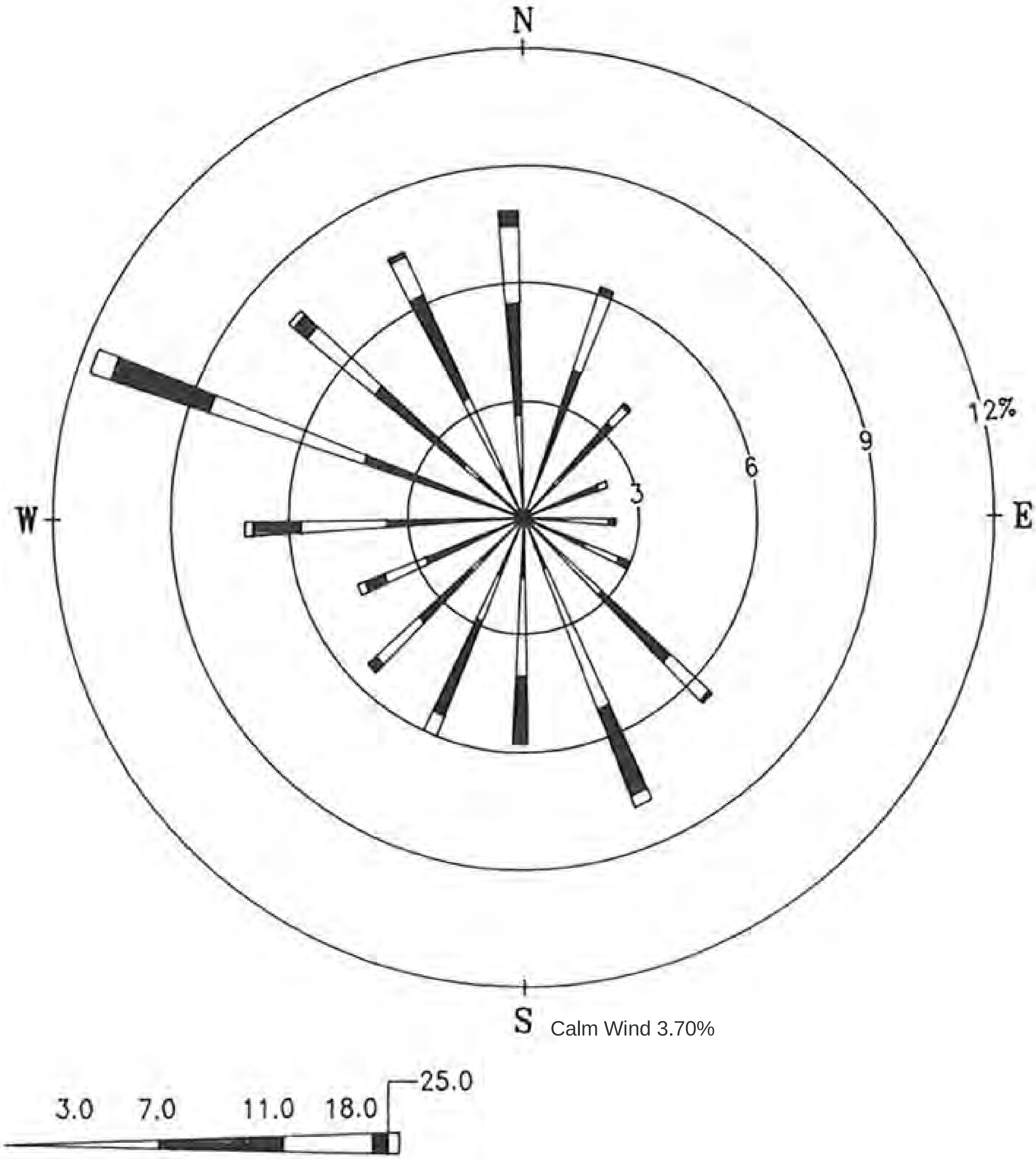
Direction	1<1.5	1.5<3	3<5	5<8	8<11	>11	Sum	Mean Speed
N	0.45	2.83	3.80	3.07	.45	.07	10.66	4.3
NNE	0.34	1.49	2.62	1.65	.13	.00	6.24	4.0
NE	0.21	1.55	1.88	.86	.08	.01	4.59	3.7
ENE	0.34	.83	.97	.56	.09	.00	2.79	3.6
E	0.29	1.08	1.42	.74	.20	.00	3.73	3.9
ESE	0.32	.95	1.56	1.19	.24	.00	4.26	4.3
SE	0.70	2.41	2.71	1.03	.00	.00	6.85	3.3
SSE	0.75	5.57	2.26	.19	.00	.00	8.77	2.6
S	0.71	3.88	1.89	.05	.00	.00	6.53	2.5
SSW	0.44	2.13	1.30	.11	.01	.00	3.98	2.7
SW	0.32	1.03	1.40	.52	.04	.00	3.31	3.5
WSW	0.21	.93	.91	.77	.13	.05	3.00	4.2
W	0.30	.81	1.06	1.72	.54	.25	4.68	5.4
WNW	0.36	1.49	2.14	3.06	2.10	.60	9.75	6.0
NW	0.40	2.31	3.03	1.59	.34	.07	7.74	4.0
NNW	0.60	3.32	3.65	1.47	.38	.00	9.42	3.6
All	**6.75**	**32.62**	**32.59**	**18.56**	**4.75**	**.04**	**96.31**	**3.9**

Speed class intervals are meters per second (m/sec)
Calm (less than one meter per second) = 3.7 percent
Period mean wind speed = 3.8 m/sec
Table entries are expressed as percent of period.
To convert from meters per second to miles per hour multiply by 2.24.

In general, measured wind speeds are low, averaging about 3.9 m/sec (8.7 mph). Winds are somewhat more common and somewhat stronger from the northwest quadrant. This would result in a slightly greater tendency for airborne pollutants to be dispersed to the south and east. There is no development south and east of the surface facilities.

Air quality standards specify upper limits of pollutant concentrations and duration of exposure. The principal standards for comparison of air quality are the National Ambient Air Quality Standards (NAAQS). Additional standards may be established for states or regions. Montana air quality standards have been established for ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter smaller than 10 micrometers in diameter, lead, hydrogen sulfide, settled particulates (dust-fall), and visibility. An area is designated by the Environmental Protection Agency as being in attainment for a pollutant if ambient concentrations of that pollutant are below the NAAQS. An area is not in attainment if violations of NAAQS for that pollutant occur. The lease areas are all within areas considered in attainment of all National and Montana ambient air quality standards.

The Federal Prevention of Significant Deterioration (PSD) program is implemented through increments and area classifications that define significance of deterioration for individual pollutants. The Clean Air Act (CAA) area classification scheme defines three classes of geographic areas and applies different increments to each class. Class I includes area of special national concern where the need to prevent significant deterioration is greatest. The nearest Class I area is the Northern Cheyenne Indian Reservation, about 75 miles to the southeast (MDEQ 2009). Class II areas are all PSD areas that are classified as in attainment or unclassified and are not Class I. Most of south-central Montana, including the project area, is classified as Class II.



Notes:
- This diagram illustrates the frequency of occurrence for each wind direction.
- Wind direction is the direction from which the wind is blowing.
- Bull Mountains example-wind is blowing from the north 8.1% of the time.
- Source for the diagram and notes: MDSL 1992.

BULL MOUNTAIN COAL LEASING ENVIRONMENTAL ASSESSMENT

Figure 3.3-1
Wind Rose for Bull Mountains
(Period: 1990)

ANALYSIS AREA: Musselshell & Yellowstone Counties, Montana

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Prepared By: JC | Reviewed By: EC

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The nearest non-attainment area is the Billings metropolitan area which is in non attainment for carbon monoxide maintenance. The Town of Laurel, about 10 miles southwest of Billings, is non-attainment for SO_2. The Class III designation consists of specific areas designated by states for higher levels of industrial development and emissions. Montana has not designated any Class III areas. As noted above, the BACT analysis (MAQP #3179-01) concluded that onsite CO and SO_2 emissions would be negligible. Furthermore, prevailing winds are to the southeast (**Figure 3.3-1**) and would not carry these negligible emissions toward Billings or Laurel.

<u>Baseline Monitoring Data</u>

MAQP # 3179-04 requires that SPE monitor total suspended particulates (TSP) and fine particulates less than 10 microns (PM-10) near the surface facilities, upwind of the surface facilities, and downwind of the surface facilities on a regular basis. Baseline air quality data is adopted from data collected by SPE for an earlier proposed mine plan. A meteorological station was established near the surface facilities area during February 1989. This station gathered baseline information through 1992 on precipitation, wind direction and speed, temperature, TSP, and PM-10. Three precipitation gages were installed; one at the Johnson Ranch house; one on Dunn Mountain; and one adjacent to the Old Divide Road 1.5 miles south of the surface facilities. Current local sources of air pollution in the area in addition to the Bull Mountains Mine No.1 surface facilities include vehicle traffic (unpaved roads), agricultural activities, and home heating.

Baseline air quality (suspended particulates) was monitored in the project area. The measurements included both TSP and PM-10. The period of record submitted with the application for MAQP # 3179-03 is from March 1989 through March 1992 shown in **Table 3.3-3**. All values are well below applicable ambient air quality standards.

Table 3.3-3 Baseline Particulate Data for the Surface Facilities Area (values reported in μg/m^3)

Year	Parameter	24-Hour High Reading	24-Hour Second Highest	Annual Average	No. of Samples
1989	TSP	39	33	14	51
	PM-10	53*	19	9	51
1990	TSP	59	58	13	59
	PM-10	29	27	9	57
1991	TSP	42	39	14	56
	PM-10	24	21	9	57

*This high PM-10 value was recorded on June 27; no TSP value was recorded on that date.

Particulate data had been collected in the project area previously in 1981. LL&E collected data for 11 months at a monitoring site just south of the PM Coal Mine in Section 13 of Township 6 North, Range 26 East. The primary SPE monitoring station is located about 1.5 miles south of the LL&E site in the extreme southeast corner of Section 23.

The state and federal PM-10 standards are Annual Average of 50 μg/m^3 and 24-hour of 150 μg/m^3 (State of Montana, Air Quality Rules, Section 16.8.821).

The LL&E data collection program consisted of three samplers, one was located just south of the PM Mine pit at the meteorological station, another located closer to the PM Mine itself, and the third was located at the PM Mine pump house. During the period of sampling, the PM Mine produced approximately 50,000 tons of coal per year. The highest measured concentration for TSP was 107 $\mu g/m^3$ measured at the PM Mine site with that site recording an arithmetic mean of 36 $\mu g/m^3$ and a geometric mean of 24 $\mu g/m^3$. This site was probably influenced by local activity. The other two sites were located farther away from the mining activity. The arithmetic mean for the met station site and the pump house site were 18 and 16 $\mu g/m^3$, respectively, while the geometric means were 14 and 12 $\mu g/m^3$, respectively. LL&E did not collect any PM-10 data.

The primary SPE monitoring station was not located near any current mining activity or any significant particulate sources. A statistical analysis of both TSP and PM-10 was performed for the months of February through December 1989. For this station, the TSP arithmetic mean was 14 $\mu g/m^3$ and the PM-10 mean was 9 $\mu g/m^3$ while the geometric mean was 12 and 9 $\mu g/m^3$, respectively. The maximum TSP concentration was 39 $\mu g/m^3$ while the maximum PM-10 was 53 $\mu g/m^3$. On the date of the maximum PM-10 reading, the TSP filter was damaged, probably during removal from the sampler, and therefore the TSP concentration could not be calculated. Ratios of PM-10 to TSP were also calculated and the average ratio for the period was 0.62 with the maximum at 1.0 and a minimum of 0.29. This average ratio indicates that 62 percent of the TSP is PM-10.

In comparing these two different locations, the LL&E sites that were located far from the activity compared quite favorably to the SPE site. The PM Mine site had much higher concentrations than the SPE site. In fact, the TSP geometric mean at the PM Mine site is almost double the mean at the SPE site. After taking the above comparisons and analyses into consideration, it is felt that the LL&E site was being influenced to some degree by the PM Mine open pit and, therefore, was not representative of the background concentrations of particulates in the area. The SPE station, the LL&E met station site, and the pump house site (being located away from any significant particulate sources) are more representative of background concentration of particulates in the project area.

3.3.2 Climate Science

Though the terms “global warming” and “climate change” are often used interchangeably, they are two distinct concepts as described in the sections below (US CCSP 2009).

3.3.2.1 Global Warming

The term “global warming” refers to the observed increase in the average global temperature of the atmosphere near the Earth's surface and in the troposphere (US CCSP 2009). Through complex interactions on a global scale, the emissions of greenhouse gasses (GHGs), along with other climate-influencing environmental factors, cause a net warming of the atmosphere. GHGs include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), water vapor, and several other gasses. These are called “greenhouse gasses” because, when released into the atmosphere, they impede the escape of reflected solar radiation and heat from the Earth’s surface back into space. In this way, the accumulation of GHGs in the atmosphere exerts a “greenhouse effect” on the earth’s temperature. GHG emissions can be anthropogenic (human-made) or naturally occurring (e.g., volcanic activity). Other than GHG emissions, factors that contribute to global warming include aerosols, changes in land use, and variations in cloud cover and solar radiation which affect the absorption, scattering, and emissions of radiation within the atmosphere and at the Earth's surface. Though the average global temperature has increased almost 2˚F over the past century, temperatures have not changed evenly from region to region. Because temperature is a part of climate, the phenomenon of global warming is both an element of and a driving force behind climate change (IPCC 2007).

3.3.2.2 Climate Change

Climate is defined as the average weather or the regular variations in weather in a region over a period of years as exhibited by temperature, precipitation, and wind velocity (Merriam-Webster's 2009). The term "climate change" refers to a substantial and persistent change in the mean state of global or regional climate or its variability, usually occurring over decades or longer (US CCSP 2009). Climate change occurs in response to changes in various aspects of Earth's environment, including, but not limited to, global warming, regular changes in earth's orbit around the sun, and plate tectonics (IPCC 2007). These climatic changes, while impacts in and of themselves, can affect other aspects of the environment including desert distribution, sea level, species distribution, species survivability, ocean salinity, availability of fresh water, and disease vectors. These effects can vary from region to region over time; some agricultural regions may become more arid while others become wetter; some mountainous areas may experience greater summer precipitation, yet have their snowpack disappear in the future (IPCC 2004).

Thus, the causes and effects of climate change can be depicted as a four step chain of events:

GHG emissions/climate drivers → global warming → climate change → environmental effects

First, GHGs are emitted and other events occur which contribute to climate change in the form of global warming. Second, climate change contributes to environmental effects around the globe.

3.3.2.3 Climate Change Cause and Effect

Although the effects of GHG emissions and other contributions to climate change in the global aggregate are estimable, it is currently impossible to determine what effect any given amount of GHG emissions (or other contribution to climate change) resulting from an activity might have on the phenomena of global warming, climate change, or the environmental effects stemming there from (US CCSP 2009). It is therefore not currently possible to associate any particular action with the creation or mitigation of any specific climate-related environmental effects. However, it is known that certain actions may contribute in some way to the phenomenon (and therefore the effects of) climate change, even though specific climate-related environmental effects cannot be directly attributed to them.

3.3.2.4 Bull Mountains Mine No. 1 GHG Emissions

An inventory of sources tied to mining of the federal coal lease includes both gasoline- and diesel-powered machinery and vehicles. An analysis of CO_2 emissions based on total annual gasoline and diesel consumption includes this inventory or sources.

During 2008, the Bull Mountains Mine No. 1 operations consumed 181,000 gallons of diesel and 11,000 gallons of gasoline fuel, which is considered to be representative annual consumption for the life of the mine. Carbon dioxide emissions from mobile sources can be determined by using the average carbon content in the fuel. The Code of Federal Regulations (40 CFR 600.113) provides values for carbon content per gallon of gasoline and diesel fuel which EPA uses in calculating the fuel economy of vehicles. Gasoline carbon content is 2,421 grams per gallon and diesel carbon content is 2,778 grams per gallon. EPA uses IPCC guideline for calculating CO_2 emissions (EPA 2009a). Carbon dioxide emissions from a gallon of gasoline equal 19.4 pounds/gallon and CO_2 emissions from a gallon of diesel equals 22.2 pounds/gallon (EPA 2009a). Given these emissions, the Bull Mountains Mine No. 1 generated approximately 100 tons of CO_2 from gasoline consumption and 2000 tons CO_2 from diesel fuel consumption in 2008. The EPA calculations and the supporting data have associated variation and uncertainty, such as fuel economy of the engine. There are no other significant sources of combustion at the mine facility. Methane emissions from the mine are monitored and at this point of the mine are either at or below detection limits. All coal mining and handling operations are powered by electricity and any GHG emissions associated with electric generation are calculated by those operations.

Emissions of CO_2 during 2009 are estimated to be about the same as estimated for 2008. Fuel consumption would not have been significantly greater. The new rail facility reduced truck traffic and implementation of all new facilities would have reduced fuel consumption over the increase in coal production.

Black carbon is also emitted by sources at the mine. Black carbon, a component of soot, is a by-product of incomplete combustion and stays in the atmosphere for days or weeks (as compared to CO_2 which can have a life time of 100 years). Black carbon reduces albedo and absorbs heats which can contribute to radiative heating. Soot can also heat the air around it. Black carbon can also contribute to visibility impairment over the short term. Because black carbon has a short life time it can have warming effects regionally (Jacobson testimony 2007).

There is a strong possibility that black carbon is the second leading cause of global warming after CO_2 and that reducing black carbon is the fastest way to reducing global warming (Jacobson testimony 2007).

The US emits about 6.1 percent of the globally-emitted fossil fuel and biofuel from black carbon. The main source in the US is, by contribution, non-road vehicles, on-road vehicles, stack emission and fugitive sources.

Black carbon from burning diesel fuel can be controlled. Diesel particulate filters (DPFs) are a proven, off-the-shelf technology that can reduce black carbon emissions by 90 percent or more (Clean Air Task Force 2009). However, the addition of a trap can decrease mileage and slightly increase CO_2 emissions (Jacobson testimony 2007). Black carbon can be estimated from diesel fuel consumption. Based on an emission rate of 1.2 grams of black carbon per gallon of diesel fuel (Clean Air Task Force 2009) and 181,000 gallons consumed at the mine in 2008, black carbon emission is calculated at 217,200 grams or 0.24 tons.

Given that the US emits 6.1 percent of the globally-emitted black carbon, it is reasonable to assume that the contribution of black carbon from sources related to mining of the federal coal would have an insignificant impact on global climate change. Additionally, control of black carbon from diesel sources at the mine would not have significant impact.

There is no detectable methane liberated from the coal seam of the Bull Mountains. In contrast to many of the thicker coal seams of the Fort Union Formation in the Powder River Basin to the east and south, the Mammoth coal seam of the Bull Mountains has a relatively low content of coalbed methane. There is no development of coalbed methane as a marketable commodity in this area and the Bull Mountains Mine has not had to develop extensive methane drainage strategies for mine safety. The mine employs basic mine ventilation systems through the longwall operations and development entries. The principal function of the ventilation fans is to provide fresh air for safe mining operations, not to vent methane. These operations do not require the gob vents and methane drainage vents that are found at many underground coal mines in other regions. It is not anticipated that methane would contribute to GHG emissions.

3.4 Water Resources

This section contains a description of the hydrologic regimes within and adjacent to the Bull Mountains Mine No. 1 LOM area. The project area includes the existing permit area, LOM area, and adjacent areas. The adjacent area is defined as that region located within 3 miles in a downgradient direction of the LOM area and one mile in all other directions. Information from this larger area is used to adequately characterize the hydrologic regime of the coal lease area.

Hydrologic baseline conditions for the project area are defined including descriptions of hydrogeologic units in terms of baseline water levels and flow, aquifer hydraulics, and water quality. Conclusions are drawn using a conceptual hydrogeologic model that explains the interaction of hydrogeologic units and the controlling mechanisms for occurrences of springs and other surface water resources.

3.4.1 Precipitation

Precipitation data have been collected at the Billings Airport since June 1946 and since June 1914 at the Montana State Cooperative station in Roundup, Montana. For the period of record, the long term average annual precipitation for the Billings station is 13.55 inches and 12.07 inches for the Roundup station. Most of the precipitation falls between April and October. Slagle (1986) has used an average annual precipitation amount of less than 14 inches for the Bull Mountains area, which corresponds favorably with the long term data records for Billings and Roundup. Within the project area, precipitation data are collected continuously at the meteorological monitoring station located at the Dunn Mountain site, installed in July 1991.

3.4.2 Regional Groundwater

The regional aquifers of primary concern to the mining operation are the Tongue River Member of the Fort Union Formation, which contains most of the currently used water resources in the project area, and the Madison Group, currently used as a source of water for the Bull Mountains Mine No. 1 surface and underground mining facilities. The Fox Hills and Hell Creek Formation aquifers are present in the area, but are not used for mine purposes. A brief description of these aquifers is provided in the following sections.

Tongue River Member: Groundwater flow is complex in the shallow Tongue River Member aquifers, as it radiates outward from an apparent local recharge area in the Bull Mountains region (Slagle 1986). Within the project area, groundwater flow in these aquifers is predominantly to the north-northwest, following the synclinal structure. The hydraulic gradient ranges from 0.002 to 0.008 feet/feet (ft/ft).

The Tongue River Member exhibits the greatest potential for water production, as it lies at the shallowest depth, and contains the largest percentage of sandstones and coals (Slagle 1986). Heterogeneities within this member make depth to water and probable yields difficult to predict however, well yields average approximately 8 gpm (Slagle et al. 1985). The overburden, the Mammoth coal, and the underburden are all included in the Tongue River Member. Generally, they are all low yielding zones.

Madison Group: Throughout the northern Rocky Mountains, the deeply buried carbonate rocks of the Madison Formation are a significant, though little used, regional aquifer. The principal recharge areas for the Madison Formation are the Little Belt, Big Snowy, Pryor, and Bighorn Mountains. The hydraulic gradient slopes away from these recharge areas and toward the northwest, north, and northeast. In the project area, groundwater flow in the Madison Formation is to the east (Feltis 1980a).

Studies by the United States Geological Survey (USGS) and Montana Bureau of Mines and Geology (MBMG) (Feltis 1980a) have resulted in a series of maps showing the aquifer potentiometric surface, and the concentration of dissolved solids and the ratios of various anions and cations in the groundwater in the Madison Group of Montana. In the project area, the potentiometric surface for the Madison Formation is approximately 3500 to 3600 feet above sea level, while ground surface is approximately 3700 to 4750 feet above sea level. Concentrations of dissolved solids range from 3000 to 5000 milligrams per liter (mg/L). The combined total of the sodium, potassium, and chloride ions constitutes approximately 25 to 50 percent of the dissolved solids. Sulfate is the dominant anion.

In 1978, the USGS cooperated with several agencies to construct a test well that fully penetrated the Madison Group (USGS 1979). This well, known as Madison Limestone Test Well 3, is in Section 35 T2N R27E, Yellowstone County, Montana, about 15 miles northeast of Billings and approximately 26 miles south of the Bull Mountains Mine No. 1. The analytical results from water samples collected during drill stem testing indicated that water from this formation is calcium - sulfate, or calcium - sodium - sulfate, type water. Dissolved solids ranged from 3100 to 4000 mg/L and pH from 6.9 to 7.0. Temperature ranged from 46.5° to 49.5° Celsius (C). While it should be noted that the samples were collected before field parameters had stabilized and that the USGS suspected possible drilling fluid contamination of the samples, the dissolved solids concentrations reported are consistent with that indicated by MBMG (Feltis 1980b). Another water sample, obtained from the upper Mission Canyon Formation of the Madison Group, was collected following the perforation of the well and after the field parameters for water quality had stabilized. The laboratory analysis for this sample also showed it to be calcium - sulfate type water with dissolved solids concentration of only 2660 mg/L.

Alluvium: On a regional basis, the silts, sands, and gravels that comprise the alluvium of the Musselshell and Yellowstone River valleys do yield significant amounts of water to wells for irrigation and domestic purposes. Alluvium in the tributaries of these rivers yields variable amounts of water for livestock and domestic use. Terrace deposits along these valleys generally are well drained and not considered to be significant aquifers (Slagle 1986). Alluvium present in small drainages in the project area is not considered a major regional aquifer because of its variable thickness, degree of saturation, and hydraulic characteristics. However, the local alluvial deposits have been monitored extensively as part of the baseline hydrologic investigation.

Fox Hills - Lower Hell Creek: The Cretaceous Fox Hills and lower Hell Creek Formation aquifers range from zero to approximately 750 feet in thickness (Slagle et al. 1985). The Fox Hills Formation consists of marine sandstones, while the lower Hell Creek Formation is a continental deposit composed of interbedded shale, siltstones, and fluvial sandstones. The shale in this sequence generally do not yield adequate water for any use, while the sandstones can yield an adequate water supply for domestic and stock use. Wells completed in this aquifer commonly yield about 5 gpm (Slagle et al. 1985). This unit is underlain by relatively impermeable claystones of the Bearpaw shale and is overlain by the upper Hell Creek Formation, which consists predominantly of claystones, siltstones, and shale. Slagle (1986) shows a hydraulic gradient of approximately 0.002 ft/ft to the east in the Fox Hills-lower Hell Creek aquifer in the vicinity of the project area.

The Tertiary-aged Tullock Member of the Fort Union Formation overlies the Hell Creek Formation and is another deep aquifer. This unit is overlain by the Lebo Member of the Fort Union Formation. The Lebo Member acts as an effective barrier between the deep and shallow aquifers, and should preclude any impact by mining activities to the deep aquifers not used for water production.

3.4.3 Site Specific Hydrogeology

Since 1981, substantial work has been done by MBMG, LL&E, Meridian, and SPE to interpret the hydrogeology of the project area. Work performed has included:

- The installation and development of monitoring wells, completed in the alluvium, overburden, Mammoth coal, and underburden.
- The performance of aquifer tests.
- The field investigation of recharge and discharge areas including springs.
- The collection of groundwater, spring, pond and stream samples for water quality analysis.
- The implementation of a groundwater and spring monitoring program, including water level and flow measurements.

These field programs and the data collected have given insight to the recharge and discharge characteristics, fluctuation of water levels, and the water quality of each of the hydrogeologic units. On the basis of these data, a conceptual hydrogeologic model has been developed to show the relationships between the various units.

3.4.3.1 Recharge

The primary source of recharge in the project area is infiltration of precipitation. No perennial streams occur within the project area although short reaches of several streams are fed by perennial spring flow. Surface water flow in the ephemeral stream channels is limited by the duration of periodic storms. Spring snowmelt probably provides the major source of recharge. To determine recharge for each of the hydrogeologic units, analysis of infiltration, and a water balance study were performed.

3.4.3.2 Infiltration Rates

It is possible to estimate the infiltration rates of soils within the project area using soil hydrologic properties defined by the Natural Resources Conservation Service of the U.S. Department of Agriculture. Approximately 90 percent of the soils fall into Hydrologic Soil Group C, which is characterized by a moderately high runoff potential and infiltration rates from 0.5 to 2.0 inches per hour (in/hr). Soil permeability is essentially all within the moderate range, varying from 0.6 to 2.0 in/hr.

3.4.3.3 Water Balance

To provide an estimate of annual groundwater recharge (which equals annual groundwater discharge for steady state conditions) a water balance analysis including estimation of Hydrologic Soil Groups (**Table 3.4-1**) are used for estimating runoff in watersheds. Soil properties are considered that influence the infiltration obtained from a bare soil after prolonged wetting. Groups include:

A - Low runoff potential (infiltration rate > 3.5 in/hr)

B - Moderately low runoff potential (infiltration rate 2.0 - 3.5 in/hr)

C - Moderately high runoff potential (infiltration rate 0.5 - 2.0 in/hr)

D - High runoff potential (infiltration rate <0.5 in/hr)

Table 3.4-1 Percent Distribution of Soil Hydrologic Properties

Hydrologic Soil Group	Percent of Mine Area
A	0
B	8.3
C	90
D	1.7
TOTAL	100
Permeability	**Percent of Mine Area**
Very Slow	-
Slow	-
Mod. Slow	-
Moderate	99.6
Mod. Rapid	-
Rapid	
Very Rapid	

Profile Permeability Class ratings are based on consideration to soil structure, texture, cracking, porosity, consolidation, drainage, weathering, bedding, and fracturing characteristics of the parent material. Infiltration rates for various classes are shown in **Table 3.4-2**.

Table 3.4-2 Permeability Class Ratings

Permeability Class	Infiltration Rates (in/hr)
Very Slow	<0.05
Slow	0.05 to 0.20
Moderately Slow	0.20 to 0.80
Moderate	0.80 to 2.50
Moderately Rapid	2.50 to 5.00
Rapid	5.00 to 10.00
Very Rapid	>10.00

In general, the quantitative recharge estimates from the surface water balance provide fairly wide bounds ranging from 0.0 to 1.1 inches/year (in/yr) depending on the value assumed for the evapotranspiration (ET) modifier coefficient. In a study of the central Powder River area of southeastern Montana, recharge was estimated to be one percent of the average annual precipitation. This would equal less than 0.14 inches of recharge per year in the Bull Mountains area. Recharge in the Bull Mountains can be expected to be higher than the central Powder River area because of the greater percentage of cross-strata exposure and better developed soils. Modeling based on water balance calculations and flow modeling of the project area suggests that the net recharge rate in this area is higher. Based on water balance results, net recharge estimates ranged from 0.1 to 1.1 in/yr, with a long term steady state recharge rate estimated to be on the order of 0.6 in/yr. Subsurface groundwater inflow likely provides minimal recharge to any of the hydrogeologic units since they are isolated by topographic relief.

Alluvium

Most of the recharge to the alluvium comes from direct infiltration and discharge from springs. A small portion of the recharge is derived from discharge from the deeper bedrock. A flow net analysis was used to determine the amount of discharge occurring from the Mammoth coal. Recharge is enhanced by burrowing animals and piping. As outlined above, alluvial soils fall into Hydrologic Soil Group C, which is characterized by a moderately high runoff potential and infiltration rates ranging from 0.5 to 2.0 in/hr.

Overburden

Like the alluvium, the overburden is recharged directly by infiltration along the outcrops, leakage from the alluvium in the valleys, and to a lesser extent vertical leakage. Based on the results of the water balance analysis it appears that infiltration rates at the weathered overburden outcrops are similar to those for alluvial soils.

Mammoth Coal

The Mammoth coal receives recharge along its western and southern outcrops in the project area. Some recharge occurs via leakage from the overburden. Based on the results of the water balance analysis it appears that infiltration rates at the weathered Mammoth coal outcrops are similar to those for alluvial soils.

Underburden

The underburden is recharged both by infiltration at the outcrop and by some leakage from overlying units.

3.4.3.4 Discharge

Groundwater discharge from the Bull Mountains is primarily through springs, wells, groundwater outflow, and evapotranspiration. Little, if any, groundwater is discharged from the project area via surface water flow.

Springs

Springs are numerous throughout the Bull Mountains. Monthly or quarterly flow measurements have been made at 141 springs in the project area. The springs are grouped by stratigraphic interval and drainage basins, respectively.

Of the 141 springs and seeps that are located in the project area, 15 of these are within the coal lease area (**Table 3.4-3**; **Figure 3.4-1**). **Table 3.4-3** also lists an additional 14 springs that are adjacent (within 1,000 feet) to the lease area. The springs supply water for livestock and wildlife, and support vegetation and local aquatic communities. Some springs have been enhanced through tank and pond installation and many discharge to local drainages. The springs vary widely in quantity and period of season of flow and were rated as to their relative importance for use (**Table 3.4-3**). Examples of these ratings include the following; High Spring (71115) located in lease Section 22 is considered very important because it feeds an extensive system of piping and stock tanks throughout a five section area and utilizes gravity flow (Charter 2010). Busse Spring (14325) is located outside of lease Section 8 and feeds two large ponds in the lease area. This spring is considered an important source of local water for wildlife and livestock. Spring 14415 and associated small pond, is located in Section 8, has a low flow rate, but it is considered moderately important. Spring 14535 in Section 8 also has a comparatively low and intermittent flow rate. This spring has no improvements, but provides some water for vegetation and wildlife. Many of the springs were not rated highly on the basis of field observations and rancher value, but provide some water for wildlife.

Alluvium

Springs emanate from the alluvium both as seeps and as measurable flow often enhanced by piping. Increases in flow rates occur in direct response to precipitation. A number of man-made ponds have been excavated into the alluvium, to intercept the water table. ET also causes discharge from the alluvial system and is a point of loss.

Overburden

The greatest number of springs and greatest total discharge emanates from shallow fractured portions of overburden Intervals 2, 4, and 5, with approximate annual volumes of 54, 80, and 67 ac ft/yr, respectively. Intervals 1, 3, and 6 produced the least water at approximately 0.6, 16, and 11 ac ft/yr, respectively. Total annual discharge through the spring system in the project area is approximately 293 acre feet.

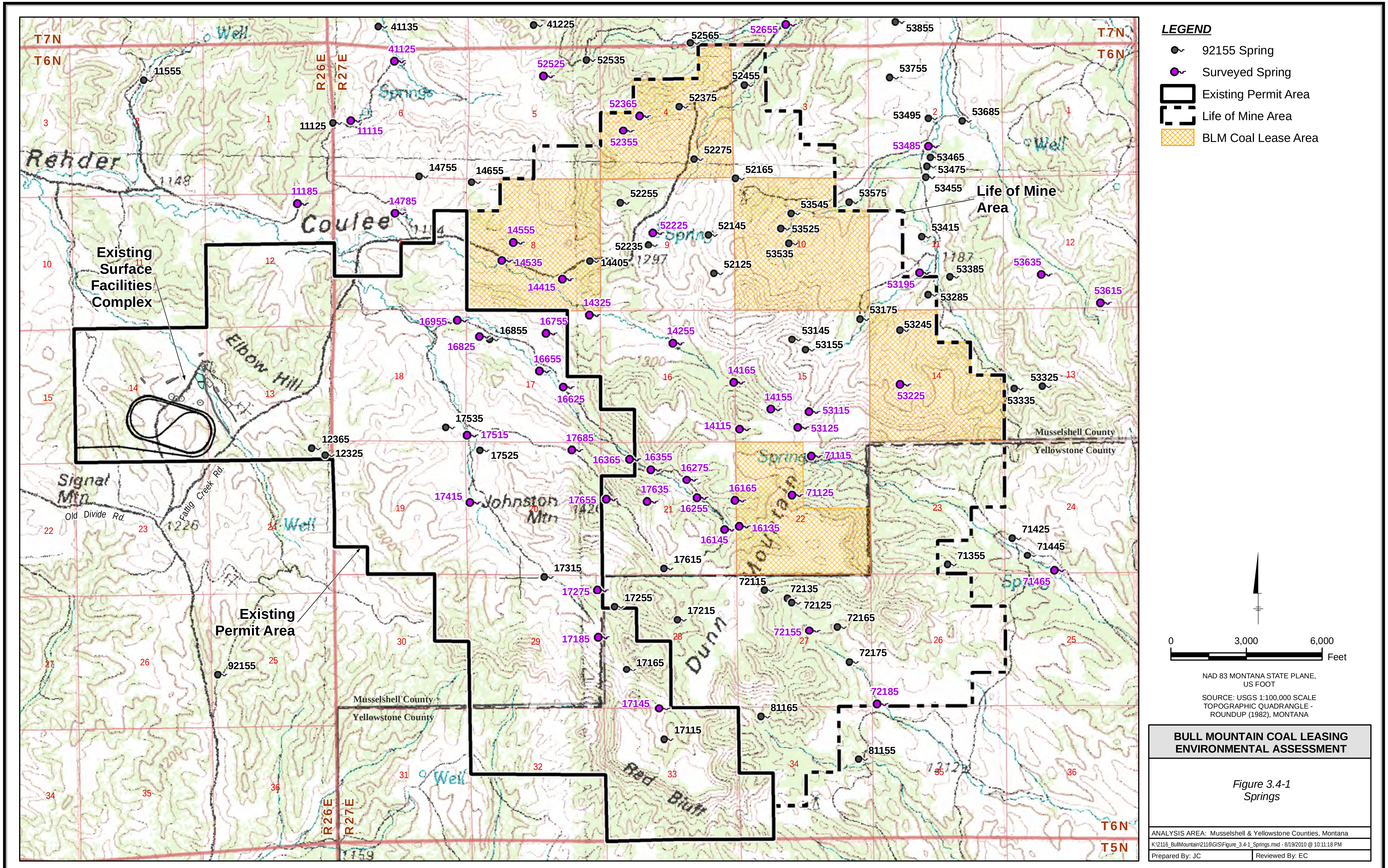
LEGEND
92155 Spring
Surveyed Spring
Existing Permit Area
Life of Mine Area
BLM Coal Lease Area
Existing Surface Facilities Complex
Existing Permit Area
Life of Mine Area
Rehder Coulee
Elbow Hill
Signal Mtn
Johnston Mtn
Dunn Mountain
Red Bluff
Old Divide Rd.
Fattig Creek Rd.
Musselshell County
Yellowstone County
T7N
T6N
T5N
R26E
R27E
0
3,000
6,000
Feet
NAD 83 MONTANA STATE PLANE, US FOOT
SOURCE: USGS 1:100,000 SCALE TOPOGRAPHIC QUADRANGLE - ROUNDUP (1982), MONTANA
BULL MOUNTAIN COAL LEASING ENVIRONMENTAL ASSESSMENT
Figure 3.4-1
Springs
ANALYSIS AREA: Musselshell & Yellowstone Counties, Montana
Prepared By: JC
Reviewed By: EC

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Table 3.4-3 Relative Importance of Springs in Coal Lease Area

Spring Name, Number	Location (TRS)	Elevation	Flow Range (gpm)	Development	Relative Score*	Value to Ranchers**
14405	6N/27E 8 NESE	4075	Dry – 1.5	None	1	No
14415	6N/27E 8 SESE	4070	dry - 1.5	small pond	3	Yes
14535	6N/27E 8 NESW	4000	dry - 0.5	None	1	No
14555	6N/27E 8 NESW	4070	dry - 0.3	small pond	2	Yes
16135	6N/27E 22 NWSW	4486	1.0 - 18.0	stream channel flow	2	Yes
52275	6N/27E 4 SWSE	3960	Dry -1.5nd	None	1	Yes
52355	6N/27E 4 NESW	4038	dry - 2.0	None	2	Yes
52365	6N/27E 4 NESW	4028	dry	None	1	No
52375	6N/27E 4 SWNE	3950	dry - 0.8	Pond	2	Yes
53525	6N/27E 10 SENW	4040	dry - 0.5	None	2	Yes
53535	6N/27E 10 SENW	4040	seep - 0.3	small pond	2	Yes
53545	6N/27E 10 SENW	4000	dry - 0.1	None	2	Yes
53225	6N/27E 14 NESW	4113	dry - 0.5	None	2	Yes
53245	6N/27E 14 SENW	3980	dry - 0.5	None	2	Yes
71125	6N/27E 22 SENW	4460	seep - 1.0	None	2	Yes
Springs near the lease boundaries (within 1,000 feet)						
Red Fork 14115	6N/27E 16 SESE	4460	seep - 3.3	None	2	Yes
Busse 14325	6N/27E 17 NENE	4095	1.0 - 39.0	two large ponds in lease area Section 4	4	Yes
14655	6N/27E 8 NWNW	4040	seep - 1.0	Pond	2	Yes
16145	6N/27E 21 NESE	4480	0.3 - 3.5	stream channel flow	2	Yes
16165	6N/27E 22 SENE	4440	dry - 1.3	None	3	Yes
16955	6N/27E 18 NENE	3961	dry - 41.8	None	2	Yes
52165	6N/27E 3 SWSW	3980	pond - 3.3	2 small ponds	3	Yes
52455	6N/27E 3 NWNW	3840	15.4 – 46.6	Small Pond	4	Yes
52565	6N/27E 33 SWSE	3960	dry – 0.5	None	1	No
53125	6N/27E 15 SESW	4400	Seep – 1.0	None	2	Yes
53175	6N/27E 15 NENE	4038	pond - 12.0	large pond	3	Yes
53335	6N/27E 13 NWSW	4080	seep - 0.6	None	2	Yes
53575	6N/27E 10 NENE	3890	seep - 0.8	None	2	Yes
71115	6N/27E 22 NWNE	4416	1.3 - 9.0	extensive piping to stock tanks and storage impoundments	4	Yes

nd - no survey or no data

*Relative Score - An average derived from relative values (1 through 4) assigned to 12 qualitative observations and range variables relating to hydrology, aquatic ecology, vegetation, wildlife and use (adapted from MDSL 1992).

**The value to rancher information was obtained from each landowner interviewed in 1992 (SPE 2009 Volume 1C Section 304(5) Appendix 304(5-6) and 304(12) Appendix 304(12)-1). Updated information obtained in 2010 from Charter (2010) and field monitoring observations (SPE 2010).

Spring occurrence from any particular overburden unit is considered to be a near-surface feature associated with flow through a mantle of shallow fractured rocks in the valleys. Groundwater flow both downward toward the valleys and through this fractured mantle, which has a relatively high hydraulic conductivity. Discharge occurs where groundwater encounters less permeable shale and then moves laterally to a discharge point. Discharge water moves down slope and eventually re-infiltrates.

Wells

The well inventory was prepared by obtaining groundwater rights records from the Montana Department of Natural Resources and Conservation (MDNRC), by obtaining a well inventory from the MBMG, by contacting local landowners, field verification, and by cross-referencing a similar inventory conducted by LL&E in 1981.

The potential source for each private well was determined, where possible, using the total depth of the well, the elevation, and the location. Approximately 89 of the private wells were completed in the underburden and 11 wells in the overburden. Although state records indicate that 12 of the private wells were completed in the alluvium, it seems more likely that these wells were completed in the shallow bedrock. None of these "alluvial" wells are located in Rehder Creek, and most are located in East Parrot Creek and Fattig Creek. The source for 47 of the wells was not determined. A recent overburden solar well installation (2003) was drilled at the head of Railroad Creek to 165 feet and produces 9 gpm. This well provides high quality seasonal water for livestock operations in that drainage (Charter 2010). Total discharge via wells is estimated as 753 ac ft/yr. Very few supply wells were completed within the overburden, so pumpage is a small percentage of the total discharge. However, ET is a mechanism for discharge from near surface overburden.

Mammoth Coal

Although springs do emanate in the direct vicinity of the Mammoth coal outcrop on the eastern flank of the syncline, the percentage of flow due to discharge of groundwater from the coal is small. To determine the amount of discharge occurring at the outcrop as a result of through flow in the Mammoth coal within Basins 41, 52, 53, and 71, a flownet analysis was completed.

The flownet construction is based on the potentiometric head map for the Mammoth coal and the drafting of "flow tubes" in which equal flow are postulated. Contours of head are slightly modified so that head is equal to coal elevation at the indicated boundaries of saturation, although the latter boundaries are not well defined. The geometric mean of the Mammoth coal's hydraulic conductivities, as determined by testing, was also used in this analysis.

In the ideal case, where it is assumed that the coal is homogeneous and isotropic, and that vertical flow is nearly equal, the flowlines are drawn to construct squares with the potentiometric contours. The lengthening of the "squares" down the direction of flow indicates that the coal is losing net vertical flow to the northwest, or that permeability is increasing in that direction. Smaller "squares" in the southeast imply higher flow rates toward Fattig Creek, due to recharge on the limb of the syncline. The results indicate that there is very little discharge to the western drainages from the Mammoth coal in the project area as shown on **Table 3.4-4**.

Table 3.4-4 Discharge in Watersheds

Watershed	Discharge (GPD)	Discharge (GPM)
Fattig Creek	1,160	0.81
East Parrot Creek	110	0.08
West Parrot Creek	670	0.47
Halfbreed Creek	360	0.25
Rehder Creek	15	0.10

These discharge values for flow from the Mammoth coal are very low. The flow contribution predicted from the Mammoth coal to the Fattig Creek drainage basin (0.81 gpm), for example, is less than four percent of the average flow from all springs (23.6 gpm) that emanate in the vicinity of the Mammoth coal outcrop in this basin. The flow contribution from the coal is a small fraction of the total flow because where the coal outcrops in the valleys; it is only a small fraction of the fractured and weathered bedrock system in which most of the groundwater flows.

A few stock water wells were completed within the Mammoth coal and account for only a small amount of the total discharge from this unit. ET plays a discharge role only at outcrops.

Underburden

Springs that issue from the underburden discharge under the same mechanisms as those occurring in the overburden and the Mammoth coal, with discharge occurring mainly in valleys. Wells constitute another major source of discharge from the underburden. Approximately 157 private wells exist within the project area or immediately adjacent to it. Most were completed in units below the Mammoth coal or over large intervals that include the Mammoth coal. Of the 157 wells in the area, 62 are used for domestic purposes and 95 are used for stock water or domestic purposes.

The average potential discharge of stock wells in the region is about 10 gpm. Slagle (1985) estimates that stock wells average approximately 9.4 gpm and are in use about 50 percent of the time. If 95 wells are present and used at this rate, the annual discharge by stock wells is approximately 720 acre feet. Field observations indicate that actual usage is considerably less than this within the project area.

Annual pumpage for domestic use can be estimated using per capita consumption and the number of persons per household. Per capita consumption was estimated at 150 gallons per day with an average household size of 3.2 persons (Slagle 1985). If 62 domestic wells are present in the project area and used at this rate, the annual discharge would be 33 acre feet. Total discharge from wells, therefore, is estimated to be 753 ac ft/yr; twice the amount discharged by springs.

3.4.3.5 Baseline Groundwater Levels

Water level data from these wells were used to generate potentiometric surface maps and determine seasonal variability in water levels within the alluvium, overburden, Mammoth coal, and underburden. The maps show potentiometric surfaces that are roughly parallel. Areas along the flanks of the syncline (western and southern boundary of the project area) are unsaturated. Horizontal hydraulic gradients in the project area range from approximately 0.004 to 0.01 ft/ft toward the north-northwest. The horizontal gradient appears to level off to approximately 0.002 ft/ft in the northern part of the area, based on the structural contours on the base of the aquifers. Hydraulic heads in each unit increase from zero in the unsaturated portion, through a zone with water table conditions, to a maximum of approximately 100 feet of head in the center of the syncline.

Vertical hydraulic gradients have been calculated at four well pairs and eight nests of three wells using water level measurements. Vertical hydraulic gradients were calculated by dividing the difference in water level elevation by the difference in the elevation at the base of the screened interval for neighboring pairs of wells.

All vertical gradients trend downward, and range between 0.065 and 0.998 ft/ft. In all cases, vertical gradients between wells in overburden Intervals 4 or 5 and wells in the Mammoth coal are greater than 0.6 ft/ft. Vertical gradients between wells screened in the Mammoth coal and wells screened in the upper portion of the overburden range from 0.06 to 0.3 ft/ft in all pairs.

Alluvium

The alluvium is present only in the valley bottoms of the larger ephemeral stream channels, and represents an unconfined aquifer within the project area. Twenty five monitoring wells were completed in the alluvium. The saturated thickness in the alluvial wells has ranged from zero feet in the dry wells to nearly 20 feet. The alluvium cannot be considered a major aquifer in the project area due to its limited thickness and areal distribution. However, it is considered important because of the recharge/discharge interaction with the shallow bedrock.

The flow direction in the alluvium is variable. Flow from bedrock into the alluvium occurs in the vicinity of springs, either by spring discharge and infiltration at the surface, or directly from shallow bedrock into the alluvium. Flow from the alluvium back into bedrock would be downgradient from many of the springs. Much of this water may flow in the shallow subsurface bedrock and subsequently discharge to the alluvium farther down the drainage. In areas where the alluvium is saturated, a significant component of flow would also be through the alluvium, down the valley. In areas where shallow bedrock is recharging the alluvium, there is a component of flow toward the stream axis, and in areas where the alluvium is losing water to the bedrock, there is a component of flow downward and away from the stream axis.

Overburden

The overburden has been divided into seven stratigraphic intervals. Water in the overburden is believed to exist under both confined and unconfined conditions depending upon the proximity to the outcrop and the occurrence of unsaturated zones in the overburden. Water level information for the overburden comes from wells, borehole packer tests, and lithological and geophysical logs. These data indicate that water in the overburden exists in perched aquifers, with intervening low permeability layers and unsaturated zones beneath. Twelve of the wells in the current monitoring program are screened in the lower portion of overburden Interval 5 (the sandstone above the Rock Mesa coal). These wells and springs would report from the lower portion of Interval 5. The water column height in the Interval 5 overburden wells range from zero to 64.7 feet. Flow in overburden Interval 5 is generally toward the north-northwest and tends to follow the axis of the synclinal structure at an average gradient of approximately 0.004 to 0.008 ft/ft.

Mammoth Coal

The edge of the unsaturated zone was delineated along the intersection of the contoured potentiometric surface and the structural elevation of the base of the Mammoth coal. Information from the dry Mammoth coal wells also was used to verify the extent of the unsaturated zone.

Groundwater in the Mammoth coal is known to exist under both confined and water table conditions. These wells are, or were, located within 4000 feet of the Mammoth coal outcrop. The overburden thickness in these wells range from a few feet to over 250 feet. Wells located near the outcrop have been dry for the entire period of baseline monitoring. The head in the Mammoth coal wells typically range from 20 to 100 feet.

Underburden

Flow in the underburden is to the north-northwest at a gradient ranging from 0.005 to 0.007 ft/ft. Groundwater in the underburden is generally under confined conditions. Natural water level fluctuations in wells appear to be less than 2 feet. However, due to the low hydraulic conductivity of some portions of the underburden, stabilization of water levels after well installation or bailing is slow, and perturbations occur on some of the hydrographs.

Seasonal variability is not readily evident in these hydrographs; however, slight fluctuations may be linked to barometric pressure or precipitation. Wells located near the underburden outcrop are more susceptible to seasonal effects.

3.4.3.6 Aquifer Characteristics

Aquifer tests have been conducted within the Bull Mountains Mine No. 1 project area by MBMG and SPE. In total, 75 aquifer tests have been performed (**Table 3.4-5**). Of these, 55 were performed by SPE within the project area as part of the baseline monitoring, and 20 were performed on selected LL&E wells by MBMG personnel.

Aquifer testing techniques, such as slug, pumping, and recovery tests, have been used to determine aquifer characteristics. Average hydraulic conductivity and storativity values in an aquifer are best represented as the geometric mean and arithmetic mean, respectively (Dagan 1989). Hydraulic conductivities (K) determined from the aquifer tests suggest that this characteristic tends to be lower in the deeper intervals than in the shallow fractured and weathered intervals.

Table 3.4-5 Summary of Hydraulic Conductivity (K) Results

Hydrogeologic Unit	No. of Tests	Geometric Mean of K (ft/day)	Min. K (ft/day)	Max. K (ft/day)
Alluvium	7	28	0.075	150
Shallow Fractured Overburden	7	6.1	1.5	23
Overburden	13	0.018	0.00061	0.6
Mammoth Coal	15	0.16	0.011	6.2
Underburden	33	0.013	0.0012	1.0

(ft/day = feet per day)

This is not meant to imply that there is a linear or other fixed mathematical relationship between permeability and depth below ground surface such that permeability continues to decrease with depth. But the hydraulic conductivity within the shallow bedrock generally is two to four orders of magnitude greater than that of the deeper bedrock. This shallow permeable zone may not exist in some areas where shale and claystones outcrop or sub-crop beneath saturated alluvium. Where the zone does exist, its depth appears to range from 10 to more than 125 feet below the ground surface.

The available aquifer test data and the hydrogeologic field observations for five of the 1991 boreholes (62717-12, 62718-19, 62710-03, 62720-07, and 62721-10), and nearby wells and springs are grouped (**Table 3.4-6**) by location and listed in order of increasing depth from ground surface. Again, this presentation shows that in many places there are shallow zones of relatively high permeability. The rocks below this zone are unsaturated, and the deeper bedrock below the unsaturated zone is saturated. Hydraulic conductivities of the deeper bedrock generally are low, ranging from two to four orders of magnitude less than those measured in the shallower bedrock.

Table 3.4-6 Hydraulic Conductivity as a Function of Depth at Selected Sites

Well Borehole No.	Hydrogeologic Unit	Top of Tested Interval (ft)	Bottom of Tested Interval (ft)	Kh (ft/day)	Comments
Site 1 62717-11	Alluvium	8.1	13.1	DRY	
62717-13	Overburden	29.5	33.0	1.5E+00	
62717-12	Overburden	31.0	71.0	DRY	
62717-12	Overburden	65.0	190.0	1.6E-02	
62717-12	Overburden	217.0	274.0	5.1 E-03	
62717-12	Mammoth Coal	265.0	304.0	1.1 E-02	
62717-12	Underburden	304.0	367.0	5.6E-03	
62717-12	Underburden	362.0	414.0	1.2E-03	
62717-12	Underburden	362.0	414.0	1.5E-02	
62717-12	Underburden	414.0	466.0	6.3E-03	
62717-12	Underburden	466.0	518.0	3.5E-03	
62717-12	Underburden	466.0	518.0	1.3E-02	
62717-12	Underburden	518.0	570.0	1.8E-02	
62717-12	Underburden	518.0	570.0	9.8E-03	
62717-12	Underburden	583.0	614.0	1.6E-03	
62717-12	Underburden	614.0	645.0	3.5E-03	
62717-12	Underburden	645.0	676.0	8.7E-03	
62717-12	Underburden	676.0	707.0	2.6E-03	
Site 2 62718-21	Alluvium	9.5	14.5	DRY	
62718-22	Overburden	39.5	49.5	1.5E+01	
62718-22	Overburden	39.5	49.5	2.3E+01	
62718-19	Overburden	62.0	71.0	DRY	
62718-19	Mammoth Coal	144.0	155.0	7.0E-01	
62718-19	Underburden	159.0	195.0	1.6E-02	
62718-19	Underburden	316.0	327.0	2.8E-02	
62718-19	Underburden	326.0	443.0	9.8E-03	
Site 3 62720-03	Alluvium	0.0	13.0	Saturated	Not tested, interval cased during drilling; Spring 17315
62720-03	Overburden	29.0	99.0	DRY	
62720-03	Overburden	287.0	297.0	DRY	
62720-03	Mammoth Coal	299.0	309.0	DRY	
62720-03	Underburden	309.0	379.0	4.4E-03	
62720-03	Underburden	653.0	703.0	4.5E-01	

Table 3.4-6 Hydraulic Conductivity as a Function of Depth at Selected Sites

Well Borehole No.	Hydrogeologic Unit	Top of Tested Interval (ft)	Bottom of Tested Interval (ft)	Kh (ft/day)	Comments
62720-03	Underburden	653.0	703.0	2.9E-01	
Site 4 62720-07	Alluvium	0.0	0.0	DRY	
62720-07	Overburden	10.0	20.0	Saturated	Not tested; cascading water, interval cased during drilling; Spring 17685
62720-07	Overburden	69.0	77.0	DRY	
62720-07	Overburden	80.0	88.0	DRY	
62720-07	Overburden	117.0	234.0	1.3E-02	
62720-07	Mammoth Coal	345.0	356.5	1.8E-02	
62720-07	Underburden	360.0	371.5	1.7E-02	
62720-07	Underburden	448.0	522.0	2.8E-03	
Site 5 62721-10	Overburden	105.6	26.1	4.9E+00	Water cascading from interval
62721-10	Overburden	105.6	126.1	7.5E+00	
62721-10	Overburden	179.0	212.0	6.1 E-04	
62721-10	Overburden	219.0	241.0	2.3E-03	
62721-10	Overburden	241.0	251.0	Dry	
62721-10	Overburden	325.0	365.0	Dry	
62721-10	Overburden	365.0	407.0	Dry	

DRY=test section is dry

Alluvium

Hydraulic conductivity of the alluvium range from 0.075 to 150 ft/day based on six slug tests and one aquifer test. The geometric mean of the data is 28 ft/day. Transmissivity varies from 0.4 to 1420 ft^2/day due to variations in saturated thickness. The pumping test conducted in well 21-01 indicated that the alluvium in places could sustain a significant yield (greater than 10 gpm).

Overburden

Twenty aquifer tests have been conducted in the overburden. Seven tests were conducted in the shallow fractured and weathered system, and the remaining 13 were performed in the deeper overburden. Hydraulic conductivities in the shallow fractured and weathered system range from 1.5 to 23 ft/day. The geometric mean of these data is 6.1 ft/day. In addition, cascading water from this shallow zone has been observed in a number of boreholes. However, these zones were often cased-off to facilitate drilling and, therefore, not tested.

Generally, rocks in the deeper overburden have very low permeabilities. Hydraulic conductivities range between 0.00061 ft/day to 0.6 ft/day with a geometric mean of 0.018 ft/day.

The reported storativity values in the project area range from $1x10^{-3}$ to $1x10^{-6}$ with an arithmetic mean of $5x10^{-4}$. These values are typical of confined aquifers. Greater storativity values can be expected in the overburden, particularly in shallow fractured and weathered bedrock, where this system is often unconfined.

Mammoth Coal

Fifteen slug and aquifer tests have been performed on the Mammoth coal. Hydraulic conductivity varies from 0.011 ft/day to 6.2 ft/day. The geometric mean of these data is 0.16 ft/day. Higher values appear to occur near outcrops where the coal may be more fractured and weathered. Transmissivities vary (based on the thickness of the coal) from 0.21 ft^2/day to 28 ft^2/day.

Comparison of this average K value with the lower intervals of the overburden suggests that the coal is generally more permeable than the deeper overburden. Storativity values range from $1x10^{-3}$ to $6x10^{-6}$, which are typical for confined conditions (Freeze and Cherry 1979).

Underburden

Thirty-three slug and aquifer tests have been performed in the underburden. Values for hydraulic conductivities are generally low, ranging from 0.0012 ft/day to 1.0 ft/day. The geometric mean for these data is 0.013 ft/day.

Some of the massive, fluvial channel sandstones in the underburden have the potential to produce sustained yields exceeding 10 gpm. Aquifer recovery test data collected from well 62720-03 yielded a transmissivity of about 22 ft^2/day. The aquifer reached steady-state conditions during a 16-hour test.

Private wells nearby completed in the underburden also have the capabilities of producing sufficient water for stock watering and domestic purposes. Most of the private domestic and stock wells in the area were completed in the underburden. These wells are all considerably deeper than most of the monitoring wells, and they are screened across larger intervals. Thus, the private wells encounter more sandstone units, some of which are thicker and higher yielding than those immediately beneath the Mammoth coal.

Calculated storativity values range from 0.1 to $4x10^{-6}$ with a mean of 0.02. The typical storativity values for confined aquifers range from $5x10^{-3}$ to $5x10^{-5}$, while storativity values for unconfined aquifers usually range from 0.01 to 0.30 (Freeze and Cherry 1979).

3.4.3.7 Water Quality

Water quality data are available from numerous wells and springs located throughout the project area. With some exceptions, seasonal variability is not evident in the major ion concentrations, and in no case is it a factor in the suitability of water for various uses.

Springs

The water quality of the springs is quite variable and is dependent on the residence of time of the water in various lithologic units, the position of the spring in a particular drainage basin; and for some parameters, such as pH, carbonate, and potassium, the season during which the sample was collected.

Total dissolved solids (TDS) concentrations for all of the spring waters range from 226 mg/L to 6030 mg/L with a mean concentration of 1118 mg/L; sulfate concentrations range from 11 mg/L to 3020 mg/L with a mean concentration of 466 mg/L; and the laboratory pH range from 7.1 to 10.0 with a mean of 7.9. The pH of 10.0 represents a single reading from ponded waters at 41125 in July 1990, and is confirmed by field measurement. Except for this measurement, the highest laboratory pH measurement is 8.9.

Of the sampled springs, only 16135, 41215, 52525, and 71115 have met the National Secondary Drinking Water Standards of 500 mg/L for TDS and 250 mg/L for sulfate. Spring 41215 issues from overburden Interval 1. Springs 16135, 52525, and 71115 issue from overburden Interval 2. Water from all other springs, including all springs within the permit area, have exhibited TDS and sulfate concentrations in excess of these standards on at least one occasion, and are not suitable for domestic use.

Only six springs, including the four mentioned above, and 16355 and 16365 have met the criterion for Montana Class I groundwater (**Table 3.4-7**) with a specific conductance of less than 1000 micromhos/cm in all samples. Specific conductance of seven springs (11185, 41125, 41335, 41625, 51255, 53225, and 53485) has exceeded the criterion for Class II groundwater (specific conductance of 1000 to 2500 micromhos/cm) on at least one occasion, and is therefore Class III groundwater. Class III groundwater is not considered suitable for livestock or agriculture. With the exception of these springs, water from all other springs is classified as Class II groundwater.

Table 3.4-7 Classification of Groundwater (ARM 16.20.1002)

A.	Class I groundwater is generally suitable for public and private water supplies, culinary and food processing purposes, irrigation, livestock and wildlife watering, and for commercial and industrial purposes with little or no treatment. Class I groundwater has a specific conductance of less than 1000 micromhos/cm at 25° C.
B.	Class II groundwater is generally marginally suitable for public and private water supplies, culinary and food processing uses and are suitable for irrigation of some agricultural crops, for drinking water for most wildlife and livestock, and for most commercial and industrial purposes. Class II groundwater may be used for municipal or domestic water supplies in areas where better quality water is not readily available. Class II groundwater has specific conductance ranging from 1000 to 2500 micromhos/cm at 25° C.
C.	Class III groundwater is suitable for some industrial and commercial uses and as drinking water for some wildlife and using special water management practices. In some cases Class III groundwater is the only economically feasible source for municipal or domestic water supplies. Class III groundwater has specific conductance ranging from 2500 to 15,000 micromhos/cm at 25° C.
D.	Class IV groundwater may be suitable for some industrial, commercial and other uses, but are unsuitable or, for practical purposes, untreatable for higher class beneficial uses. This groundwater has specific conductance greater than 15,000 micromhos/cm at 25° C.

For the most part, the plotted cation/anion ratios for all samples from each individual spring show relatively little variation. Plots showing the variability of concentration over time for the major cations and anions (carbonate, bicarbonate, sulfate, sodium, potassium, magnesium, and calcium), and for pH and total dissolved solids. These plots illustrate both the wide range of compositions between springs, and the general consistency of water quality in individual springs over time.

A subtle, but consistent seasonal trend is evident in pH values, with the highest values seen in midsummer, and fluctuation over a range of approximately 0.4 pH units at individual springs. A corresponding trend is seen in carbonate concentrations, which were detected most frequently and at the greatest concentrations in the summer. All samples in which carbonate was detected had a pH of 8.4 or greater. Seasonal fluctuations of less than 3 mg/L are also evident in potassium concentrations. Anomalously high potassium values were observed in several springs (11185, 41125, 17515, and 17315) in July and October 1990. Fluctuations in bicarbonate concentrations have been seen in some springs, particularly 11185, 17185, 17315, 17515, 41125, 52225, and 52355. These fluctuations do not appear to be seasonal and do not correlate with fluctuations in pH. Significant seasonal trends are not evident for other parameters, and do not affect the suitability of the water for various uses.

Some anomalous samples are evident in these plots. In particular, the anomalously high pH and $HC0_3$ values in July 1990 were observed at spring 41125, and anomalously low concentrations for multiple parameters were observed at spring 17315 and 17515 in July 1990. Some variability in composition should be expected from spring samples. In additions to changes in flow rate and conditions at the surface (some springs are variously flowing, ponded, or frozen) many springs are developed to some degree, and any recent activity near a spring is likely to stir-up sediment. Incomplete mixing of ponded waters and stirred-up sediments can be expected to be variable at each visit, and to affect water quality.

It is believed that spring water is a combination of water discharging from various strata and the alluvium, and local recharge from infiltration of precipitation. Spring water quality varies between surface water basins. Within a particular basin, ion concentrations tend to increase down gradient in response to increased residence time.

Alluvium

Alluvial water in the project area is generally of a magnesium-sulfate composition with relatively low TDS. TDS concentrations in the alluvium range between 493 mg/L and 1850 mg/L with a mean concentration of 1184 mg/L. Sulfate concentrations range from 143 mg/L to 1000 mg/L with a mean of 535 mg/L. The laboratory pH range from 6.5 to 8.3 with a mean of 7.8. TDS concentrations in all alluvial wells and sulfate concentrations in most alluvial wells exceed National Secondary Drinking Water Standards of 500 mg/L and 250 mg/L, respectively. Under the Montana Groundwater Classification, all water is suitable for livestock and agricultural uses (Class II or better). Magnesium is consistently the dominant cation, and bicarbonate and sulfate are the dominant anions. Concentrations of bicarbonate and sulfate are approximately equivalent in the other alluvial wells.

Extensive development of alluvial aquifers is limited by their areal distribution and saturated thickness.

Overburden

Twenty-two wells are currently used to monitor overburden water qualities. Historical baseline water quality analyses are also available. Water quality in the overburden is highly variable. No single cation is consistently dominant in the overburden water; sulfate anions tend to be present in slightly greater proportions than bicarbonate anions.

Water in most overburden wells is relatively poor in quality due to sulfate and/or TDS concentrations which exceed the National Secondary Drinking Water Standards of 250 mg/L sulfate and 500 mg/L TDS. Water in all of these wells is Class II groundwater. As a result, current baseline data TDS concentrations in the overburden range between 250 and 2700 mg/L with a mean concentration of 1143 mg/L. Sulfate concentrations range between 12 mg/L and 1410 mg/L with a mean concentration of 457 mg/L. The pH values range between 6.8 and 8.7 with a mean value of 7.7.

Water in all of the deeper overburden wells is suitable for livestock and for most agricultural uses. Only a few wells contain water that is suitable for domestic use and is classified as Class I groundwater. Wells 30-2 and 62721-10W were constructed to intersect the upper portions of the overburden, in order to monitor the shallow sources of a number of springs (71115, 71125, 16135, and 16145). Wells 30-2 and 62721-10W, and Springs 71115 and 16135 exhibit similar good water quality. A pumping test conducted in well 62721-10W indicates that this portion of the shallow overburden is capable producing more than 10 gpm of water.

Water from other overburden wells should not be used for irrigation, as they exhibit high sodium adsorption ratios (SAR), in excess of the Montana limit of 18 for irrigation water. SAR has significance mainly in respect to the suitability of water for irrigation. Water with high values of SAR have a tendency to donate sodium to the soil and gain calcium and magnesium in exchange (Hem 1989). This process makes the soil progressively more unsuitable for agriculture, and therefore water with high SAR is not desirable for use in irrigation. Most wells in the project area have water suitable for irrigation.

The composition of water quality samples from overburden wells is diverse, even among wells screened in the same interval. The four wells screened in overburden Interval 5 (a thick sandstone overlying the Rock Mesa coal) all exhibit widely differing water qualities, ranging in composition from sodium-magnesium-bicarbonate to sodium-sulfate to calcium-magnesium-sulfate.

Mammoth Coal

Fourteen wells are being used to monitor the Mammoth coal. Historical baseline data are also available for twelve other Mammoth coal wells located within the project area. Generally, sodium and sulfate are the predominant ions in water obtained from most of the Mammoth coal monitoring wells. TDS and sulfate concentrations overall tend to be slightly greater than those observed in the overburden. Concentrations ranged from 862 mg/L to 2970 mg/L for TDS and 251 mg/L to 1690 mg/L for sulfate. All samples exceed the National Secondary Drinking Water Standards of 500 mg/L TDS and 250 mg/L sulfate. All groundwater samples from Mammoth coal wells are Class II or Class III groundwater types. The Class III wells are not suitable for livestock watering and high SAR values would limit the use of water from many of the wells for other agricultural purposes such as irrigation.

The mean TDS concentration in the Mammoth coal is 1608 mg/L. The mean sulfate concentration is 798 mg/L. The pH values range from 7.0 to 9.8 with a mean value of 8.1. It appears that calcium and magnesium concentrations tend to be greater in those wells closest to the coal outcrop. However, this is not a universal rule, and other factors such as possible fracture flow from overlying sources may also influence Mammoth coal water quality.

Underburden

Most of the underburden monitoring wells were installed to monitor the groundwater in rocks immediately below the Mammoth coal; therefore, most of the underburden water quality, data are from this zone. Generally, the underburden in this stratigraphic position is composed of interbedded thin channel sandstones associated with crevasse splays, and overbank and floodplain deposits of siltstone and shale. Although saturated, these rocks have low hydraulic conductivities.

Monitoring well 62720-03, however, was completed in a massive fluvial channel sandstone encountered approximately 350 feet below the Mammoth coal. The hydraulic conductivity of this 50 foot thick sandstone is relatively high and a pumping test showed that this well is capable of sustaining a yield of more than 10 gpm. This well was installed to demonstrate the usability of the underburden as a source of replacement water for impact mitigation.

The quality of the water in the underburden is very similar to that in the Mammoth coal. Sulfate is the dominant anion while sodium tends to be the primary cation. Calcium and magnesium rich water also exists. These wells are located beyond the outcrop of the Mammoth coal and have very shallow completion intervals.

As with the coal water, TDS and sulfate concentrations in the underburden water exceed the National Secondary Drinking Water Standards of 500 mg/L and 250 mg/L, and they are classified as Class II and III type water. The iron standard of 0.3 mg/L has been exceeded in water samples from a number of the monitored wells; however, iron concentrations from some of these wells also have fluctuated to below the standard in other samples. For unknown reasons, both arsenic and mercury standards were exceeded, and lead was elevated in the sample collected from well 62719-1 by LL&E in 1981.

The water sample collected from 62720-03 has a TDS concentration of 1390 mg/L, conductivity of 1620 mmhos/cm, sulfate of 693 mg/L, and pH of 7.8. The TDS concentrations in water samples from the upper portion of the underburden range from 943 mg/L to 4520 mg/L with a mean concentration of 2139 mg/L. Sulfate concentrations range from 216 mg/L to 2680 mg/L with a mean of 1121 mg/L. The pH values range from 6.4 to 9.1 with a mean value of 7.8.

Many underburden wells can be classified as acceptable for livestock use only, but others are Class III. High SAR values in several of the wells limit their application for agricultural purposes. However, many wells have SAR values acceptable for irrigation use.

3.4.3.8 Conceptual Groundwater Model

The water geochemistry of the project area suggests that most groundwater flow occurs in the shallow fractured bedrock and the alluvium. It is uncertain as to why these shallow fractured zones exist. One explanation may be that the fracturing occurs due to the relief of compressional stress in valleys as overlying rocks are removed by erosion. Weathering then works to enhance the shallow fracturing. The extent of fracturing in any particular bedrock unit is dependent on the lithology of the unit. For instance, fractures in sandstone would have a greater tendency to remain open than fractures in a shale, which would tend to close due to shale's more plastic nature. Understanding groundwater flow in the shallow mantle of fractured bedrock, and the interaction of the groundwater in this zone and the alluvium are the keys to interpreting the groundwater flow system.

In the fractured bedrock mantle, groundwater derived from this zone, the alluvium, and the deeper bedrock units undergoes mixing. The mantle is also a conduit for groundwater flow. In general, groundwater from the shallow bedrock flows toward the fractured mantle and then flows down gradient in the fractured rock.

Water discharge via springs occurs where the downward flow is interrupted by shale which forms an impermeable barrier to prevent further downward migration. Spring flow occurring at these points recharges the alluvium. The discharged groundwater flow then continues as surface flow or as through flow in the shallow alluvium. Surface and shallow groundwater flow in the alluvium cease and the fractured mantle is recharged when the stream or saturated alluvium crosses a contact between underlying shale and a more fractured bedrock unit, especially in sandstone.

Nine hydrogeologic examples found in the field illustrate this conceptual model.

- The Litsky Spring (17415) area including the valley in the vicinity of monitoring wells 62718-21, and -22 provide examples of the alluvium being unsaturated because the groundwater has drained into the underlying more permeable bedrock. The alluvial wells at both of these locations are dry, while the shallow bedrock wells contain water. These shallow bedrock wells were completed in sandstones underlain by less permeable or dry claystones and shale.
- The pumping test conducted at shallow bedrock well 62718-22 indicated that this zone is capable of producing as much as 30 gpm (K of 23 ft/day). The value of 6.0×10^{-1} ft/day obtained by slug testing monitoring well 62720-09 is not representative of the shallow bedrock above Litsky Spring. Examination of the lithologic log and the well completion form shows that the well was completed with five feet of screen, and that most of the screen was placed opposite the underlying claystone, with only a couple of feet extending into the shallow sandstone aquifer. It is doubtful, therefore, that test results are representative of the aquifer's true hydraulic characteristics.
- Monitoring well 62721-10W was completed in the Fattig coal and the sandstone below it. Water in this zone is perched on shale that tested dry during the packer tests. Borehole 62721-09, drilled in 1990 in the vicinity of this well, encountered cascading water coming from the same shallow fractured bedrock unit. The pumping test conducted at well 62721-10W indicated that this zone is capable of producing approximately 10 gpm (K of 7.5 ft/day).
- At borehole 62717-12, the shallow bedrock (less than 41 ft) has hydraulic conductivity two to three orders of magnitude higher than the deeper bedrock units. The water in this shallow zone is perched above dry shale and discharges into nearby Cold Water Spring (16655).
- There are shallow zones of relatively high permeability, underlain by unsaturated rocks. Below this unsaturated zone all of the rocks are saturated. Hydraulic conductivities of the deeper bedrock generally are low, ranging from two to four orders of magnitude less than those measured in the shallower bedrock.
- Discharge at Cold Water Spring (16655) issues from the sub-crop of the Matt coal and an overlying sandstone.

- The Matt coal varies in degree of saturation. The Matt coal is dry at a depth of 75 feet below ground surface (fbgs) in monitor well 62720-07W, and a packer test on the Matt coal in borehole 62721-10W showed it was dry at a depth of 365 fbgs. The Matt coal is saturated in monitor well 2-02 at a depth of 217 fbgs with a hydraulic conductivity of only 0.01 ft/day; however, at 62717-13 the Matt coal is part of the shallow fractured and weathered bedrock. It has a K value of at least 1.5 ft/day.
- Spring 17315 includes a man-made pond excavated into the alluvium, which intercepts the water table. During the drilling of the borehole for well 62720-03, water was encountered at the contact of the alluvium and the bedrock, as would be expected given the presence of alluvial spring 17315. The geophysical and the geologist logs for this hole indicate that the shallow bedrock in this area is composed of interbedded shale and siltstones. The packer test of this bedrock interval showed it to be unsaturated.
- The distribution of groundwater quality parameters indicates that spring water originates from recharge to a basin and is controlled by local rather than regional groundwater flow. The dissolved constituents in the spring water increases down gradient in both basins. However, comparison of water quality of intra-basinal springs indicates a similarity in overall type of water and dissimilarity to the water quality of springs in other basins.
- The chemical evolution of the groundwater indicates that there is considerable mixing of water in the shallow bedrock and within the alluvium.
- The most direct evidence of fracture controlled permeability comes from observations made at a number of locations where water cascaded into boreholes from narrow zones encountered during drilling. A direct visual example of this was documented in November 1991, during the drilling of the monitoring piezometers.
- Piezometers 72716-01 through 72716-03 were installed in one borehole. These piezometers are located beyond the outcrop of the Mammoth coal, therefore, 72716-01 and 72716-02 were completed in the underburden. During the drilling of this borehole, water was seen gushing from fractures in the shallow underburden bedrock. The observation supports the theory that groundwater flow may be controlled by flow through fractures in the shallow bedrock (in this case underburden)
- Piezometer 72716-03 was completed in the alluvium, and was dry; piezometer 72716-02 was completed across the fractured underburden zone; and piezometer 72716-01 was completed in the massive sandstone beneath the fractured zone.

To further verify this conceptual groundwater model, several baseline modeling efforts were undertaken. These were:

- A water balance or catchment yield model. This model estimated evapotranspiration and runoff for a gauged basin to characterize infiltration to bedrock.
- A groundwater mass balance model. This was a spreadsheet model which balanced infiltration or recharge rates, withdrawal from wells, and spring flow against flow calculated from hydraulic assumptions. The results of this model were used to predict infiltration recharge to the mine, and define baseline conditions for modeling of mine impacts.

- A MODFLOW numeric model to simulate steady state conditions and predict impacts of dewatering the flow into the mine (see Chapter 4 discussion).
- A flow net analysis of the Mammoth coal. This evaluated steady state flow through the Mammoth coal and provided estimates of discharge along the coal's sub-crop in major drainages in the project area.

Conclusions from the various baseline modeling efforts are:

- Recharge of the bedrock occurs horizontally along the outcrops and vertically through this material. Under the Groundwater Mass Balance assumption that all recharge is vertical, approximately 35 percent to as high 65 percent of the recharge would flow through the entire vertical section. The remaining recharge moves through the system laterally.
- Lateral flow in overburden is approximately 10 times the vertical flow with horizontal hydraulic conductivities being three orders of magnitude higher than vertical. This allows for discharge of groundwater into the shallow weathered, fractured, mantle and to springs.
- Parts of the overburden hydrogeologic system are unsaturated and this reduces the effective vertical permeability of the system. The modeling suggests that vertical flow rates are higher in some areas than others. This is due the unsaturated nature of the overburden including the clinker and the presence of some perched systems.
- The difficulty in calibrating the numerical model, MODFLOW, to the site conditions is consistent with the site conceptual model or having a shallow flow system with horizons of unsaturated bedrock.

Finally, horizontal flow in the Mammoth coal is generally along the syncline axis toward the northwest. Flow rates are small (between 150 to 1160 gpd depending on the drainage) and suggest that springs which appear to originate from the coal are fed from the shallow fractured system which comprise the valleys.

3.4.4 Surface Water Resources

The proposed coal lease area lies within the upper reaches of Rehder, Fattig and Railroad Creek drainage basins. All of the existing mine facilities are located in Rehder Creek. No other drainages would be affected by the proposed federal mining activities within the project area.

The streams of the coal lease area are ephemeral drainages which may be classified as prairie streams. The topography of the project area is characterized as mountainous terrain with broad valleys. The surrounding elevations range from 4750 feet at the top of Dunn Mountain to 3700 feet in the lower reaches of Rehder Creek. Average annual precipitation and snowfall for the period 1914 to 2008 at Roundup and Billings are 12.07 and 13.55 inches, respectively.

3.4.4.1 Drainage Basin Characteristics

Drainage networks in the project area display dendritic drainage patterns characteristic of flow through relatively flat-lying strata. The watersheds contain both forested and open grassland slopes. The coal lease area contains drainage basins in Rehder, Fattig and Railroad creeks and the project area contains drainage basins in Halfbreed, East Parrot, Dutch Oven, Pompey's Pillar, and Razor creeks.

Table 3.4-8 is a list of basin characteristics for major drainage basins within the project area. Drainage basins or portions of drainage basins identified within the project area range in size from 30 acres for Dutch Oven Creek to 23.1 mi^2 (14,825 acres) for Rehder Creek. Within the coal lease area, Rehder Creek and Fattig Creek have the largest drainage areas, greatest stream lengths, lowest basin slopes, greatest sinuosity indexes, and greatest times of concentration. These observations indicate that relative to the other drainage basins, Rehder Creek and Fattig Creek have the greatest degree of meandering and the slowest response to precipitation events.

The lower segments of these two creeks are best characterized as mature channels formed in alluvial valleys and are formed by deposition of sediments eroded from the upper portions of the drainage.

3.4.4.2 Stream Classification

There are no perennial streams within the project area. The nearest perennial stream of consequence is lower Halfbreed Creek which flows into the Musselshell River approximately 18 miles to the north. However, some drainages within the project area contain perennial, intermittent and ephemeral reaches, which vary from year to year depending upon precipitation received in the drainages. These perennial reaches are associated with significant spring flow which originates from the upper overburden zones surrounding Dunn Mountain. Outcrop of springs provide water to the surface, and depending on the channel morphology at the outcrop location, the water may flow on the surface for some distance or is absorbed into the alluvium/colluvium. Generally, surface drainage from the project area may be classified as ephemeral flow.

3.4.4.3 Channel Morphology

Channel morphology cross-sections were measured at each of the twelve surface water gaging stations. Channel morphology for various drainages within the project area can best be described by channel width/depth ratios as reported in **Table 3.4-9**. Mature drainage basins such as lower Rehder and Fattig creeks have stream channels with high width/depth ratio values and are relatively stable in terms of channel erosion. These streams are characterized as shallow, wide channels which dissipate their energy by eroding laterally to form larger and new meanders. Young drainage basins such as upper Railroad Creek (station 71426) have lower width/depth ratio values and are relatively unstable in terms of channel erosion. Streams in these drainages are characterized as deeper, narrow channels which dissipate their energy by eroding downward rather than laterally. These younger basins are characterized by steep-walled, V-shaped valleys that contain streams with a current flowing down a steep irregular slope, often over riffles and rapids. The channels are rocky and contain little sediment.

General observations within the project area indicate that erosion (scouring) has taken place along the steeper drainages within the project area (such as in the headwater drainages of upper Rehder and Fattig creeks) while the deposition of fine grained sediment is occurring along the flat drainages in lower Rehder Creek. The classification of recent stream deposits in lower

Table 3.4-8 Study Area Drainage Basin Characteristics

Drainage Basin Subbasin	Drainage Area (acres)	Basin Relief (feet)	Stream Relief (feet)	Stream Length (miles)	Mean Slope %	Mean Slope ft/mile	Time of concentration	Sinuosity index	Weighted Curve #
Rehder Cr. Basin	14,825	1,080	1,080	9.09	2.25	119	2.26	1.16	78
Subbasin 11	4,760	805	238	5.25	0.84	45	1.30	1.24	73
Subbasin 12	3,300	640	400	4.28	1.77	93	1.16	1.15	77
Subbasin 13	311	260	150	1.06	2.68	142	.33	1.0	78
Subbasin 14	2,388	840	780	4.55	3.25	171	1.12	1.0	78
Subbasin 15	583	395	255	1.74	2.78	147	.49	1.0	79
Subbasin 16	1,240	800	780	3.52	4.20	222	.85	1.0	84
Subbasin 17	2,986	814	770	4.17	3.50	238	1.03	1.0	76
Halfbreed Cr. Basin	2,110								
Subbasin 21	1,230	NA	NA	NA	NA	NA	NA	NA	78
Subbasin 22	880	NA	NA	NA	NA	NA	NA	NA	78
East Parrot Cr. Basin	5,998								
Subbasin 41	5,998	NA	NA	NA	NA	NA	NA	NA	78
Fattig Cr. Basin	11,898	NA	NA	NA	NA	NA	NA	NA	76
Subbasin 51	4,298	NA	NA	NA	NA	NA	NA	NA	78
Subbasin 52	2,832	885	825	3.79	4.12	218	.89	1.04	73
Subbasin 53	4,768	910	690	4.28	3.05	161	1.01	1.0	78
Dutch Oven Cr. Basin	30								
Subbasin 61	30	NA	NA	NA	NA	NA	NA	NA	78
Railroad Cr. Basin	3,315								
Subbasin 71	2,377	NA	NA	NA	NA	NA	NA	NA	84
Subbasin 72	938	NA	NA	NA	NA	NA	NA	NA	84
Pompey's Pillar Cr. Basin	210								
Subbasin 81	210	NA	NA	NA	NA	NA	NA	NA	84
Razor Cr. Basin	2,057								
Subbasin 91	359	NA	NA	NA	NA	NA	NA	NA	84
Subbasin 92	1,428	NA	NA	NA	NA	NA	NA	NA	84
Subbasin 93	270	NA	NA	NA	NA	NA	NA	NA	73

Rehder Creek is a silt loam indicating high percentages of silt and clay. The classification for stream deposits in the headwaters of upper Rehder Creek is sandy loam and gravel indicating an environment of erosion as opposed to deposition.

Site observations and results of the channel morphology study indicate that the landforms and drainage networks within the project area appear to be stable under existing environmental conditions. There is little evidence of widespread accelerated erosion except in the steep areas of Dunn Mountain. The major stream channels do not appear to be undergoing extensive active gullying except around dams placed across an alluvial channel.

3.4.4.4 Drainage Basin Sediment Yields

An analysis of baseline sediment loss within the affected drainage basins was attempted using the Modified Universal Soil Loss Equation (SPE 2009). The mean suspended solids values collected from these samples were 994 mg/L. A relative measure of sediment yield can also be made through determination of soil erodibility. The affected area drainage basins were ranked from low to high in soil erodibility based on weighted K factors. The K factors were determined from the Musselshell County Soil Survey (SCS 1989). All of the drainage basins examined in the Rehder, Fattig, and Railroad Creek drainages have been classified as having high soil erodibilities (**Table 3.4-9**).

3.4.4.5 Spring Outcrop Flow

Approximately 141 springs and seeps are monitored for the Bull Mountains Mine No. 1 program in the project area. **Figure 3.4-1** shows locations of these water resources. The shallow alluvium or colluvium and bedrock outcrops in the project area are generally conducive to natural spring discharges. As discussed in the groundwater section above, these springs are an expression of groundwater as the geologic units outcrop. At these outcrops, surface flow is initiated. The length of the surface expression is dependent on a number of variables, including amount of flow, width and depth of alluvium/colluvium, and landowner manipulation of the drainage for livestock use. This landowner manipulation has a dominate effect on surface flow as indicated at the major springs in the project area including 14325 (Busse Water), 17415 (Litsky), and 16655 (Cold Water). At these locations, embankments have been constructed across the drainages to form ponds which impound water for livestock. These ponds control downstream drainage and in some cases (17415 Litsky) the ponds are large enough to eliminate downstream flow. Spring flow contribution has been measured from each of the springs in the project area.

3.4.4.6 Surface Water Flow

Flow at all of the surface stations is seasonal and limited to snowmelt runoff during the April/May period and significant rainfall events during the summer months. This limited flow indicates the ephemeral nature of the drainages in the project area.

Baseline peak flow and runoff volumes for drainage basins were estimated utilizing multiple regression equations developed by Omang et al. (1986) for the project area. The values reported in **Table 3.4-10** were determined using procedures outlined in the report. Peak flow and runoff volumes were determined for each of the drainage basins for the 24-hour storm with recurrence intervals of 2, 5, 10, 25, 50, and 100 years. Results of this analysis are presented in **Table 3.4-10**.

Table 3.4-9 Channel Morphology Characteristics

	Station Number	Channel Width (ft)			Channel Depth (ft)			Width/Depth Ratio	Cross Sectional Area (ft^2)	Weighted K Factor	Soil Erodibility
		Min	Max	Avg	Min	Max	Avg				
Lower Rehder	11756	14	200	92	.89	4.68	2.94	31.29	225.66	.37	high
Lower Rehder	11256	24	40	32	.41	4.08	2.15	14.88	45.19	.37	high
Lower Rehder	12456	12	16	13	.43	1.86	1.07	12.15	9.45	.37	high
Upper Rehder	12186	6	20	14	.46	2.19	1.08	12.96	9.25	.37	high
Upper Rehder	15116	12	24	17	.17	2.44	1.05	16.19	17.96	.37	high
Upper Rehder	16956	16	30	21	.32	2.19	1.43	14.69	16.42	.37	high
Upper Rehder	17516	10	30	18	.92	2.19	1.54	11.69	8.66	.37	high
Upper Fattig	52786	6	150	34	.55	2.41	1.43	14.89	12.67	.37	high
Lower Fattig	52996	17	250	48	.66	4.53	2.84	26.90	26.76	.37	high
Upper Fattig	53486	12	48	18	.43	3.65	1.27	15.63	19.21	.37	high
Upper Fattig	53796	14	150	23	.36	3.28	1.53	19.71	22.46	.37	high
Railroad	71426	4	25	11	.40	1.95	1.18	9.32	6.55	.37	high

Table 3.4-10 Estimated Peak Flow for Study Area Gaging Stations

Gaging Station Data				
Gaging Station	**A (SQ MI)**	**E (FT)**	**S**	**Gf**
11756	19.98	3680	0.62	0.9
11256	12.43	3800	0.74	0.9
12456	2.68	3800	0.860.9	0.9
12186	1.04	3880	1.34	0.9
16956	1.88	3960	1.88	0.9
17516	4.04	4000	0.77	0.9
52786	4.22	3730	1.00	0.9
52996	11.93	3680	1.10	0.9
53486	3.72	3780	1.90	0.9
53796	7.02	3700	0.70	0.9
71426	1.36	3940	1.84	0.9
A=Drainage Area	E=Avg Basin Elev S= Slope Gf=Geographical Factor			

Peak Discharge Estimates (CFS)						
Gaging Station	**Recurrence Interval**					
	50	**20**	**10**	**4**	**2**	**1**
11756	97.0	290.3	498.9	838.6	1155.9	1543.8
11256	81.7	241.2	412.6	693.6	956.0	1276.8
12456	47.1	132.6	223.4	375.4	517.5	691.2
12186	33.5	91.7	153.0	257.1	354.4	473.3
16956	41.4	115.5	193.8	325.8	449.1	599.8
17516	54.5	155.6	263.2	442.4	609.9	814.5
52786	55.4	158.3	267.8	450.2	620.6	828.8
52996	80.5	237.4	405.9	682.3	940.5	1256.0
53486	52.9	150.7	254.7	428.1	590.1	788.1
53796	66.6	193.0	328.3	551.9	760.7	1016.0
71426	36.9	101.8	170.3	286.2	394.6	526.9

Lower flows appear to be somewhat over-estimated in comparison to those actually calculated for the gauging stations. The primary reason for this over-estimation is land owner manipulation of the drainages to retain surface and spring flow in surface impoundments.

Analysis of historic surface water flow data was examined for drainages in the project area. Slagle (1986) examined various drainages within south-central Montana and northern Wyoming. The Rehder Creek drainage was included in this analysis. For the 1978 to 1981 period of record, no flow was measured at station 06126450 established at the mouth of Rehder Creek. The nearest perennial stream to the project area is lower Halfbreed Creek (Rehder Creek receiving stream).

Floodplains may exist within the upper reaches of Rehder Creek in T6N, R27E, sections 7, 13, 17, and 18. Floodplains can be defined as that surface of relatively flat land adjacent to a stream channel, constructed by the present stream in its existing regime and covered with water when the stream overflows its banks. They consist of alluvium carried by the stream during floods and deposited in the sluggish water beyond the influence of the swiftest current. Some remanent terrace deposits have been mapped in the Rehder Creek drainage and soil pit analyses indicate shallow stream-laid deposits in areas along the existing channel. Analysis of the peak discharge routing through the channel cross-sections surveyed for the channel morphology study indicates that during a 100-year runoff event, water flow could be outside of the Rehder Creek channel banks. However, landowner manipulation of nearly all of tributary drainage basins through the use of spreader dikes and impoundments to catch and hold water for livestock has reduced the normal floodplain area. Slagle (1986) identified 100-year floodplains within the region and did not identify the project area as a flood-prone area as defined by the National Flood Insurance Act of 1968 or the Flood Disaster Protection Act of 1973.

3.4.4.6 Ponds

Most ponds in the project area are associated with springs and runoff water catchments. Spring ponds maintain a relatively stable water level as provided by the consistent spring flow. This is a result of the springs issuing immediately above the pond or into the dugout area of the pond. The location of these ponds is either in the drainage bottom or higher on the side slopes where the springs issue. These ponds are directly related to the groundwater/surface water interface and exhibit water table expression.

Perennial/intermittent ponds are located in the drainage bottoms and intercept surface flow originating from either springs or precipitation runoff. These ponds exhibit extensive variation in water levels which is dependent upon their location in the drainage with respect to springs and precipitation received during a given year. These ponds retained water throughout or for the majority of the year.

Ephemeral ponds are also located in the drainage bottoms and are utilized to retain surface runoff from major storm events. Retention of surface water promotes availability of water from livestock and wildlife and infiltration of water which is utilized for alluvial aquifer recharge and spring flow. Several of these ponds are located directly above developed springs and are utilized for protection and infiltration enhancement of the springs. These ponds have been dry except following major precipitation events.

3.4.4.7 Surface Water Quality

Surface water quality for the project area is detailed in the Bull Mountains Mine No. 1 Permit Document (SPE 2009). Limited water quality data was collected from monitoring stations located on Halfbreed Creek at sites approximately 10 and 15 miles downstream of the project area, at the mouth of Rehder Creek, and just north of the study area on Fattig Creek. This geochemistry data is representative of prairie streams which have elevated conductivity, TDS and pH concentrations during low flow. In contrast to low flow, direct runoff from rainfall or snowmelt typically has lower concentrations of these parameters. During direct runoff, water is routed quickly into stream channels with little opportunity for leaching of minerals from the soil. The larger volume of water present during runoff also has a diluting effect. Trace metal concentrations of analyzed samples was low.

There are twelve surface water quality monitoring stations currently being monitored by SPE in the project area. These waters are classified as a calcium-bicarbonate with lower conductivity and TDS than the adjacent springs. These surface water samples are also lower in ionic composition but higher in suspended solids due to high flow and erosion of soils during runoff events. Elevated quantities of aluminum and iron were also observed in these samples. Since limited surface water runoff samples have been collected during the monitoring program, water samples collected from springs were examined. Spring and seep water quality in the project area is predominantly a calcium-magnesium carbonate-bicarbonate water with elevated hardness or secondary alkalinity. A detailed discussion of spring quantity and quality is presented in the groundwater section above.

A total of 26 perennial/intermittent and ephemeral ponds exist within the project area. Analysis of water chemistry of the ponds indicates qualities similar to that of springs and seeps discussed above.

3.4.4.8 Surface Water Use

Surface water rights in the project area are summarized in **Table 3.4-11**. The majority of these rights are related to spring flow which outcrop at the surface. Site identification numbers are also cross-referenced on the table. The Rehder Creek drainage basin is contained within the project area and includes seven surface water rights. These surface rights are within T6N, R27E, sections 17, 18, and 20. Five of the seven rights are associated with springs 16655, 16755, 17415, 17515, and 17685. The other two rights are associated with surface water pond sites 17517 and 17417, one of which has a decreased flow of 2.50 cfs for irrigation use. No irrigation techniques are currently being utilized in this area. Surface station 17516 was located at this approximate location to monitor surface flow and use. Usage of water from the other six rights is designated as stock water.

3.5 Soils

Detailed soil information for Musselshell County has become available relatively recently and is available through the on line Web Soil Survey (NRCS 2008). Eleven soil units have been mapped in the federal coal lease area (**Table 3.5-1**). The two Korchea loams occur only on nearly level terrain along the bottoms of Rehder Creek. Barvon-Cabba-Shambo loams, Doney-Cabba-Macar loams, and Cabba-Barvon loams occur on gentle to moderate slopes (4 to 15 percent) in many parts of the lease area, but not on Dunn Mountain (Section 22). Cabba-Doney loams occur on moderate to very steep slopes (8 to 45 percent) from Rehder Creek north (sections 4, 8, and 10). The remaining five loams and channery loams occur in most of the lease area on rocky plateaus or on moderate to extremely steep (4 to 65 percent) rocky slopes. With the exception of the limited areas of Korchea loams along Rehder Creek, these Cabba and Lamedeer-Ringling loams are comparatively coarse to channery loams associated with steep or rocky terrain.

Table 3.5-1 Soil Units in Lease Area

Soil Map Unit	Map Unit Description	Sections
245C	Lamedeer-Ringling channery loams, 2 to 8 percent slopes	8, 10, 14, 22
245F	Lamedeer-Ringling channery loams, 4 to 45 percent slopes	4, 8, 10, 14, 22
246F	Lamedeer-Ringling channery loams, moist, 4 to 45 percent slopes	4, 8, 10, 14, 22
255C	Shambo-Korchea-Barvon loams, 2 to 8 percent slopes	8
255D	Barvon-Cabba-Shambo loams. 4 to 15 percent slopes	4, 8, 10
281D	Doney-Cabba-Macar loams, 4 to 15 percent slopes	4, 8, 10
283F	Cabba-Rock outcrop complex, 8 to 45 percent slopes	4, 8, 10, 14, 22
284D	Cabba-Barvon loams, 4 to 15 percent slopes	8, 10, 14
285F	Cabba-Doney loams, 8 to 45 percent slope	4, 8, 10
289F	Cabba-Barvon loams, 15 to 65 percent slopes	4, 8, 10, 14, 22
292A	Straw-Korchea loams, 0 to 2 percent slopes	8

Source: NRCS 2008.

Table 3.4-11 Surface Water Rights

Location	Water Right ID	Owner	Priority Date	Source Name	Flow Rate[1]	Trib[2]	Use[3]	Meridian Station
06N 26E 12 AAB	40A-W-197948-00	Schenk Family Trust	06/23/04	Rehder Creek	0.72 C	UT	IR	11185
06N 26E 25 CBA	43Q-W-108654-00	Glacier Park Co	08/06/50	Razor Creek			AR	92155
06N 26E 27 ADC	43Q-C-014317-00	Van Luchene M Rosa	07/27/77		50.00 G		WI	Drainage
06N 26R 27 BCB	43Q-W-198337-00	Majerus Ranch Inc	06/01/48	Razor Creek			ST	Drainage
06N 27E 02 ABC	40C-W-188740-00	Charter Ranch Inc	12/31/58	Fattig Creek		UT	ST	53757
06B 27E 02 BBD	40C-W-188754-00	Charter Ranch Inc	12/31/20	Fattig Creek		UT	ST	53755
06N 27E 02 DAB	40C-W-188756-00	Charter Ranch Inc	12/31/20	Fattig Creek		SP	ST	53685
06N 27E 02 DBB	40C-W-188758-00	Charter Ranch Inc	12/31/20	Fattig Creek		SP	ST	53495
06N 27E 02 DCB	40C-W-188755-00	Charter Ranch Inc	12/31/20	Fattig Creek		SP	ST	53485
06N 27E 03 BBD	40C-W-108668-00	Glacier Park Co	12/31/14	Fattig Creek		SP	ST	52455
06N 27E 03 CBD	40C-W-108667-00	Glacier Park Co	12/31/14	Fattig Creek		SP	ST	Spring
06N 27E 03 CCC	40C-W-108669-00	Glacier Park Co	06/30/73	Fattig Creek		UT	ST	52165
06N 27E 05 ABC	40C-E-064815-00	Yellowstone Basin Properties Inc	00/00/25	Groundwater	10.00 G		ST	52525
06N 27E 06 CBA	40A-W-188417-00	Glacier Park Co	12/31/10	Rehder Creek		SP	ST	11115
06N 27E 07 AAA	40A-W-188413-00	Glacier Park Co	12/31/10	Rehder Creek		SP	ST	14655
06N 27E 07 ABC	40A-W-188412-00	Glacier Park Co	12/31/10	Rehder Creek		SP	ST	14785
06N 27E 07 BDC	40A-W-212187-00	Glacier Park Co	06/23/04	Rehder Creek	0.50 C	UT	IR	Drainage
06N 27E 07 BDD	40A-W-188410-00	Glacier Park Co	12/31/57	Rehder Creek			ST	Drainage
06N 27E 08 CAB	40A-W-188405-00	Glacier Park Co	12/31/10	Rehder Creek		SP	ST	14555
06N 27E 08 CAB	40A-W-188407-00	Glacier Park Co	12/31/10	Rehder Creek		SP	ST	Spring
06N 27E 08 CAC	40A-W-188404-00	Glacier Park Co	08/31/72	Rehder Creek		UT	ST	14535
06N 27E 08 DDC	40A-W-188409-00	Glacier Park Co	12/31/20	Rehder Creek			ST	14415
06N 27E 09 ABC	40C-W-108666-00	Glacier Park Co	12/31/14	Fattig Creek		SP	ST	Spring
06N 27E 09 ADC	40C-W-108665-00	Glacier Park Co	06/30/73	Fattig Creek		UT	ST	52145
06N 27E 09 DAD	40C-W-106923-00	Glacier Park Co	06/30/73	Fattig Creek		UT	ST	52125
06N 27E 10 AAD	40C-W-188762-00	Charter Ranch Inc	12/31/20	Fattig Creek		SP	ST	53575
06N 27E 10 CAC	40C-W-188761-00	Charter Ranch Inc	12/31/20	Fattig Creek		SP	ST	53525
06N 27E 13 ADB	40C-C-052558-00	Glacier Park Co	09/12/83		1.00 G		ST	53615
06N 27E 14 CAA	40C-W-188760-00	Charter Ranch Inc	12/31/20	Fattig Creek		SP	ST	53225
06N 27E 15 AAA	40C-W-108662-00	Glacier Park Co	12/31/14	Fattig Creek		SP	ST	53175
06N 27E 15 AAA	40C-W-108663-00	Glacier Park Co	09/01/50	Fattig Creek		UT	ST	53175
06N 27E 15 CBB	40A-W-106925-00	Glacier Park Co	12/31/14	Rehder Creek		SP	ST	14165
06N 27E 17 AAA	40A-W-188401-00	Glacier Park Co	12/31/20	Rehder Creek		SP	ST	14325
06N 27E 17 ABC[4]	40A-W-188402-00	Glacier Park Co	12/31/10	Rehder Creek		SP	ST	16755
06N 27E 17 ACC[4]	40A-W-188403-00	Glacier Park Co	12/31/10	Rehder Creek		SP	ST	16655
06N 27E 18 DDA[4]	40A-W-188421-00	Glacier Park Co	04/10/03	Rehder Creek	2.50 C	UT	IR	17517
06N 27E 18 DDD[4]	40A-W-188400-00	Glacier Park Co	12/31/03	Rehder Creek		SP	ST	17515
06N 27E 20 AAB[4]	40A-W-188416-00	Glacier Park Co	12/31/10	Rehder Creek		SP	ST	17685
06N 27E 20 BCB[4]	40A-W-188419-00	Glacier Park Co	12/31/50	Rehder Creek		UT	ST	17417

Table 3.4-11 Surface Water Rights

Location	Water Right ID	Owner	Priority Date	Source Name	Flow Rate[1]	Trib[2]	Use[3]	Meridian Station
06N 27E 20 BCC[4]	40A-W-188418-00	Glacier Park Co	12/31/10	Rehder Creek		SP	ST	17415
06N 27E 20 DCC	40A-W-188764-00	Glacier Park Co	07/09/03	Rehder Creek		SP	ST	17315
06N 27E 20 DCC	40A-W-188766-00	Glacier Park Co	06/21/03	Rehder Creek	1.52 C	UT	IR	17315
06N 27E 21 BBD	40A-W-188414-00	Glacier Park Co	12/31/10	Rehder Creek		SP	ST	16355
06N 27E 22 ABC	43Q-W-108658-00	Glacier Park Co	00/00/14		10.00 G		ST	71115
06N 27E 22 CBB	40A-W-188763-00	Two Lazy Two Ranch Inc	12/31/20	Rehder Creek		SP	ST	16135
06N 27E 23 BB	43Q-T-021782-00	Two Lazy Two Ranch Inc	00/00/00	Railroad Creek			ST	71156
06N 27E 23 BB	43Q-T-023341-00	Burlington Northern Railroad Co	00/00/00	Railroad Creek			ST	Drainage
06N 27E 23 BDC	43Q-C-060354-00	Glacier Park Co	08/27/85		1.00 G		ST	Drainage
06N 27E 23 DCD	43Q-C-052557-00	Glacier Park Co	09/12/83		0.50 G		ST	71355
06N 27E 24 CCB	43Q-W-188739-0	Two Lazy Two Ranch Inc	00/00/50	Railroad Creek	1.60 C	UT	ST	71425
06N 27E 24 CDC	43Q-W-188731-00	Two Lazy Two Ranch Inc	00/00/20	Lower Rr Creek Spring		10.00 G	ST	71445
06N 27E 24 CDD	43Q-T-023344-00	Two Lazy Two Ranch Inc	00/00/00	Railroad Creek			ST	71456
06N 27E 24 CDD	43Q-T-021783-00	Charter Ranch Inc	00/00/00	Railroad Creek			ST	Drainage
06N 27E 25 CCC	43Q-W-106427-00	Glacier Park Co	06/30/73	Railroad Creek		UT	ST	Pond
06N 27E 27 BAC	43Q-W-195687-00	Pfister Serena L	00/00/42	Mountain Spring	1.10 G		ST	72125
06N 27E 27 BBA	43Q-W-195677-00	Pfister Serena L	00/00/59	Tractor Wheel Spring	1.00 G		ST	72115
06N 27E 28 CBD	40A-W-195704-00	Pfister Serena L	09/20/14	Rehder Creek		UT	ST	17165
06N 27E 28 CBD	40A-W-195676-00	Pfister Serena L	06/05/15	Rehder Creek		SP	ST	17165
06N 27E 29 AAA	40A-W-188408-00	Glacier Park Co	12/31/10	Rehder Creek		SP	ST	17275
06N 27E 29 ABA	40A-W-188415-00	Glacier Park Co	12/31/65	Rehder Creek		UT	ST	17317
06N 27E 29 ADD	40A-W-188406-00	Glacier Park Co	12/31/10	Rehder Creek		SP	ST	17185
06N 27E 29 ADD	40A-W-188411-00	Glacier Park Co	12/31/65	Rehder Creek		UT	ST	17187
07N 26E 25 CAC	40C-W-109286-00	Wheeler Sallie Busch Trust	12/31/11	East Parrot Creek		SP	ST	41425
07N 26E 36 BAC	40C-W-025839-00	Montana, State Of Board Of Land	08/01/70	East Parrot Creek		UT	ST	Drainage
07N 26E 20 DAC	40C-W-109288-00	Wheeler Sallie Busch Trust	12/31/30	East Parrot Creek		SP	ST	Spring
07N 26E 21 BDB	40C-W-108653-00	Glacier Park Co	07/31/69	East Parrot Creek		UT	ST	Drainage
07N 26E 21 DDD	40C-W-108652-00	Glacier Park Co	08/31/69	East Parrot Creek		UT	ST	41817
07N 26E 24	40C-W-185054-00	Twin Beaches LLC	02/12/06	Fattig Creek			ST	Drainage
07N 26E 24 BDB	40C-W-183597-00	Twin Beaches LLC	12/31/00	Fattig Creek		SP	ST	Spring
07N 26E 25 BAC	40C-W-183594-00	Twin Beaches LLC	12/31/61	Fattig Creek		SP	ST	Spring
07N 26E 25 BAC	40C-W-183593-00	Twin Beaches LLC	12/31/27	Fattig Creek		SP	ST	Spring
07N 26E 25 CCA	40C-W-182442-00	Twin Beaches LLC	12/31/72	Fattig Creek		UT	ST	Drainage
07N 26E 28 BCA	40C-W-109306-00	Wheeler Sallie Busch Trust	12/31/40	East Parrot Creek		UT	ST	41635
07N 26E 28 BCA	40C-W-109294-00	Wheeler Sallie Busch Trust	12/31/00	East Parrot Creek		SP	ST	41625
07N 26E 28 DDC	40C-W-109305-00	Wheeler Sallie Busch Trust	09/23/70	Fattig Creek		UT	ST	51117
07N 26E 29 ABB	40C-W-108647-00	Wheeler Sallie Busch Trust	06/30/73	East Parrot Creek		UT	ST	41545
07N 26E 30 DBB	40C-W-109290-00	Wheeler Sallie Busch Trust	12/31/12	East Parrot Creek		SP	ST	41335

Table 3.4-11 Surface Water Rights

Location	Water Right ID	Owner	Priority Date	Source Name	Flow Rate[1]	Trib[2]	Use[3]	Meridian Station
07N 26E 31 AAA	40C-W-109295-00	Wheeler Sallie Busch Trust	12/31/11	East Parrot Creek	10.00 G	SP	ST	41275
07N 27E 31 ABA	40C-W-109293-00	Wheeler Sallie Busch Trust	12/31/11	East Parrot Creek	10.00 G	SP	ST	41175
07N 27E 31 ABB	40C-W-109300-00	Wheeler Sallie Busch Trust	12/31/11	East Parrot Creek	10.00 G	SP	ST	41165
07N 27E 31 CDD	40C-W-109289-00	Wheeler Sallie Busch Trust	12/31/12	East Parrot Creek			ST	41135
07N 27E 33 DCC	40C-W-108651-00	Wheeler Sallie Busch Trust	12/31/14	Fattig Creek		SP	ST	52565
07N 27E 34 CAD	40C-E-064817-00	Yellowstone Basin Properties Inc	00/00/25	Groundwater	10.00 G		ST	Drainage
07N 27E 34 CDA	40C-W-188759-00	Charter Ranch Inc	12/31/20	Fattig Creek		SP	ST	52655
07N 27E 34 DBC	40C-W-188757-00	Charter Ranch Inc	12/31/20	Fattig Creek		SP	ST	Spring
07N 27E 36 DBD	40C-W-042865-00	Montana, State Board Of Land	05/15/65	Fattig Creek		SP	ST	51255

1 G = Gallons per minute. C = Cubic feet per second.

2 SP = Spring. UT = Unnamed tributary

3 ST = Stock water. IR = Irrigation water. WI = Wildlife Water

4 Water rights within the permit area

* Updated Montana DNRC Water Right Query System 08/17/2010

Soils in the lease area are predominantly loams, ranging from silty loams to channery loams. As would be expected, soils are shallower along upper slopes and fans and deeper on lower terraces and drainage bottoms. The lease areas away from Rehder Creek are predominantly areas of upper slopes and fans. Observed soils in these upland areas are predominantly Cabbart soils. These soils are well-drained, have limited available water capacity, and are easily eroded. Above the slopes and fans, sandstone and clinker characterize plateaus and rims.

3.6 Vegetation

Vegetation of the project area is characteristic of the Eastern Sedimentary Plains of Montana in the 10 to 14 inch precipitation zone (SPE 2009). Vegetation cover varies from ponderosa pine and Rocky Mountain juniper forests on uplands, rock outcrops, and ravines at higher elevations, to sagebrush and mixed prairie grassland communities on benches, slopes, and drainages where soils are deeper.

Existing influences on local distribution of plant communities include soils, topography, surface disturbance, availability of water, management boundary fence lines, and soil salinity. Livestock grazing, fire suppression, and a large wildfire in 1984 have substantially affected plant succession in the project area. For over a century there have been localized disturbances by farming, mining, and road-building. These disturbances are more extensive to the west in the area of the surface facilities complex.

3.6.1 Vegetation Communities

Eight broad vegetation communities plus disturbed areas were identified for the project area: silver sagebrush-mixed grassland; mixed grassland; ponderosa pine-mixed grassland; burned ponderosa pine-mixed grassland; improved pasture; agriculture; alkali-saltgrass; wetlands; and disturbed. These eight broad types summarize 19 vegetative communities (SPE 2009).

Silver-sagebrush-mixed Grassland

The silver-sagebrush-mixed grassland community occurs on lower valley slopes near drainages, especially where soils are deeper. This setting is absent or very limited in extent in the lease area.

Mixed Grassland

The mixed grassland community is interspersed with the ponderosa pine-mixed grassland community in the higher elevations on upland plateaus and benches with deeper soils. Due to this topographic positioning, it has received limited grazing, resulting in a perennial grass dominance and relatively high forage production. In this community, western wheatgrass, needle-and-thread, green needlegrass, blue grama, and prairie junegrass typically account for over 60 percent of total vegetative cover and 75 percent of total production. Forbs account for 29 percent of cover and 18 percent of production.

Ponderosa Pine-mixed Grassland

The ponderosa pine-mixed grassland community generally occurs on moderate-to-steep upland slopes on shallow soils. Ponderosa pine is a minor component of the community canopy cover, but is characteristic of the type. Fifty-two percent of canopy cover is provided by grasses, including bluebunch wheatgrass, western wheatgrass, and prairie junegrass, with forbs comprising about 41 percent of cover and 50 percent of herbaceous production.

Burned Ponderosa Pine-mixed Grassland

The burned ponderosa pine-mixed grassland community is a transitional community resulting from a wildfire in 1984. Grasses and forbs have proliferated in the post-fire community, while ponderosa pine reproduction is not evident. This burned community differs from ponderosa pine-mixed grassland and mixed grassland by the greater occurrence of colonizers such as crested wheatgrass, Japanese brome, cheatgrass brome, Kentucky bluegrass, and common dandelion as well as diverse shrub and forb components.

Improved Pasture

The improved pasture community consists of several cultivated areas planted to introduce grasses (crested and intermediate wheatgrass) or alfalfa. They are grazed and are limited to very small areas in the bottoms of the Rehder Creek drainage basins.

Agriculture

The agriculture community is not present in the lease area.

Alkali-saltgrass

The alkali-saltgrass community occurs on saline-alkaline soils in lower basins southwest of the Bull Mountains and outside the lease area.

Wetland Vegetation

The wetland vegetation community accounts for less than 0.1 percent of the project area communities, but is important in local ecosystems. Wetlands provide watering points for wildlife and livestock and provide habitat diversity. Species include several sedges, rushes, bulrush, cattail, western rose, and snowberry. At higher elevations, such as the majority of the lease area, they are associated primarily with springs, seeps, and intermittent streams. Precipitation-dependent wetland sites fluctuate annually, in a range from dry to wet, in direct response to seasonal moisture, temperature, and wind.

Disturbed Vegetation

The disturbed type includes subdivision home sites, ranch sites, industrial, commercial, roads, powerlines, and other manifestations of human use. These areas are more common near the mine facilities and in the western portion of the project area, and are very limited in extent in the lease area. Localized residential development is occurring in Section 4 in the northern lease tract along Fattig Creek Road and several roads that branch from it. Several home sites are proposed in this subdivided area.

3.6.2 Sensitive Plant Species

Information from the Montana Natural Heritage Program website (MNHP 2009) indicates that there are no known occurrences of federal sensitive plant species in or near the coal lease area, nor are there any known occurrences within Musselshell County itself. The BLM further confirmed that there are no known BLM specific sensitive species in the coal lease area (Taylor 2009). USFWS (2009) sensitive species lists also do not indicate any known occurrences in the project area. Further, no USFWS threatened or endangered plant species are known to occur in Musselshell County (USFWS 2009).

The Montana Natural Heritage Program (MNHP 2009) also indicates that there are no known occurrences of *state sensitive* plant species (vascular and non-vascular) within Musselshell County. NatureServe (2009) database recognizes one species within Musselshell County: Poison Suckleya (*Suckleya suckleyana*). This species has a state S1 status (critically imperiled in the State of Montana). However, an associated footnote explains that this species is likely extirpated from the area, thus explaining the lack of known occurrences as indicated by the Natural Heritage Program.

3.6.3 Invasive, Non-Native Species

Competition from invasive, non-native plants constitutes a potential threat to native plant species and wildlife habitat within the project area. Several invasive, non-native plant species occupy the LOM area including crested wheatgrass (*Agropyron cristatum*), Japanese brome (*Bromus japonicas*), cheatgrass (*Bromus tectorum*), intermediate wheatgrass (*Thinopyrum intermedium*), and foxtail barley (*Hordeum jubatum*). Crested wheatgrass and intermediate wheatgrass occur in the area as a result of being planted to increase forage production to cattle. Cheatgrass, Japanese brome, and foxtail barley are all aggressive invasive species that out-compete desirable vegetation for water and soil nutrients. These species also reduce cattle grazing performance. Cheatgrass is an invasive species well known for completely replacing native vegetation and changing fire regimes.

Several noxious weed infestations are also prevalent and appear to be actively spreading in the LOM area, particularly within the alkali/saltgrass community (SPE 2009). Literature is not available indicating which species of noxious weeds are actively spreading within this community; however several species are known to occur in Musselshell County and that may occur within the LOM area.

3.7 Wildlife

Wildlife and preferred habitats are influenced by vegetation composition, structure, spatial management, recreational use of roads and trails, and management activities. This section describes the affected environment of wildlife related to the coal lease area in the project area.

The eight broad vegetation communities described in the Vegetation Section provide wildlife habitat in the project area. These communities are generally synonymous with wildlife habitat types (SPE 2009). Ponderosa pine-mixed grasslands and burned ponderosa pine-mixed grasslands are most common at higher elevations, with mixed grasslands occurring at intermediate elevations. Relatively small areas of wetlands occur near springs, seeps, or intermittent drainages throughout the area. Larger springs and associated wetlands are of high importance to wildlife, particularly those of Rehder and Fattig creeks (SPE 2009).

Mining-related wildlife studies have occurred extensively for many years in the Bull Mountains area, beginning in the early 1970s (Dusek and McCann 1973; Bergeron 1978). More recently, SPE has conducted annual wildlife monitoring in the project area (WESTECH 2003-2008). The following information is derived from baseline data compiled for the Bull Mountains Mine No. 1 and subsequent data in these annual monitoring reports.

3.7.1 Big Game

Four species of big game have been recorded in the Bull Mountains area, including mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), pronghorn (*Antilocapra americana*), and white-tailed deer (*Odocoileus virginianus*). Mule deer and elk are the most abundant game species in the project area (MFWP 2008). Pronghorn and white-tailed deer are relatively less abundant in the area (SPE 2009). **Table 3.7-1** includes the numbers of big game observed by habitat types in the Bull Mountains during annual monitoring in 2007 (WESTECH 2007).

Mule Deer

Mule deer are the most abundantly observed game species in the project area (Butts 1997). Mule deer in this area are essentially non-migratory, making modest seasonal movements in response to changes in forage conditions and weather (Jay Newell, wildlife biologist, Montana Department of Fish, Wildlife and Parks (MFWP), personal communication, January 29, 2002; Butts 1997). In the winter, populations concentrate in the Rehder Creek, Elbow Hill, and Fattig Creek areas during inclement weather; but are typically more widespread during mild winter conditions.

In general, mule deer follow a clumped or aggregate group pattern, using all vegetation communities during all seasons in the area (WESTECH 2008; SPE 2009). In lower elevations, mule deer use agricultural lands, particularly crop fields where cover is tall and dense. In higher elevations, mule deer use the ponderosa pine-mixed grassland community (SPE 2009). WESTECH (2008) has suggested that mule deer are less common in the western portion of the project area, due to the paucity of forested cover (a consequence of the 1984 fire), less topographic relief than central and eastern portions of the area, and a relatively greater concentration of homes and associated human activities.

Elk

As discussed previously, elk are the second-most common big game species in the project area (WESTECH 2008; SPE 2009). Elk are migratory within the area; and although populations have increased considerably in recent years, their migratory distribution has not changed dramatically (Dusek 1978; WESTECH 2008).

Elk are most commonly observed from spring through autumn at higher elevations that are removed from human activity and livestock, using habitats that provide abundant forage and security cover (Butts 1997). Portions of the Rehder and Fattig Creek drainages as well as ponderosa pine and grass/burned pine habitats are used as summer range. Railroad and Pompeys Pillar Creek drainages and portions of Dunn Mountain serve as occasional winter range, where elk concentrate on south-facing slopes or other slopes blown free of snow (SPE 2009). BLM (Parks 2009) is not aware of any elk migration corridors. The coal lease area should be considered elk winter range.

Table 3.7-1 Big Game Sightings by Habitat Type

Species	Habitat[a]													Total
	001 Rock	002 Water	122 Pipo/Jusc	123 Pipo/Grass	212 Artr	222 Arca	231 Rhtr	260 Breaks	410[b] Grass	530 Pasture	610 Recl	630 Barren	640 Bldg	
Elk			1(1)	2(26)[c]					7(103)					10(130)
Mule Deer			2(2)	5(12)[c]					8(16)					15(30)
Pronghorn		1(1)		1(1)[c]		1(2)			10(22)	1(1)				14(27)

[a] Habitat types:
Rock = rock outcrops, cliffs, etc.
Water = includes riparian and mesic shrub habitat adjacent to ponds, dams, stream courses, etc.
Pipo/Jusc = Ponderosa pine/Rocky Mountain juniper
Pipo/Grass = Ponderosa pine/grassland
Artr = Big sagebrush
Arca = Silver sagebrush
Rhtr = Skunkbush sumac
Breaks = Highly eroded areas, often with complex vegetative cover
Grass = Dominated by native sod-forming and bunchgrass grasslands
Pasture = Dominated by introduced grass and forb species
Recl = Mine reclamation
Barren = Mine pits, waste areas, etc.
Bldg = Building sites
[b] Includes burned Ponderosa pine stands
[c] No. groups (no. individuals)

Pronghorn Antelope

The central Bull Mountains are marginal pronghorn habitat. Pronghorns are migratory in the area, using open habitat such as silver sagebrush-mixed grassland, mixed grassland, and agriculture communities that are fragmented and interspersed with the ponderosa pine-mixed grassland communities. Pronghorn distribution in the project area is both seasonal and relatively dispersed, occurring in the spring, summer, and early fall (Butts 1997; SPE 2009). No critical pronghorn habitat types have been identified, but they use most major drainages in the area. Higher elevations in the area generally lack suitable habitat and cover for antelope. The western portion of the area has regular pronghorn use of agricultural and crop fields. In summer and particularly winter, pronghorn tend to be concentrated in large herds in the more open areas of the Hay and Comanche basins about 10 miles southwest of the mine surface facilities.

White-tailed Deer

White-tailed deer have been observed in low numbers and recorded infrequently in the project area (Butts 1997). There have been past observations in the vicinity of Fattig Creek in the ponderosa pine-mixed grassland and grassland communities (WESTECH 2008).

3.7.2 Predators

Five species of predators have been observed in the project area: coyote, red fox, mountain lion, badger, and bobcat (WESTECH 2008). Coyotes are the most common predator in this area and have been recorded in almost all habitats. Coyotes are relatively more tolerant of human activity than the other described predators (WESTECH 2008).

Red fox and mountain lion activity have been confirmed in the project area; however, it has been infrequently recorded. Mountain lions are a secretive species, which is likely a causing factor to this infrequency (WESTECH 2007 and 2008). In 2007, a mountain lion was observed in Section 4 of the lease area (WESTECH 2008). This area likely constitutes the predator's territory. Bobcats have been observed in low numbers throughout the history of wildlife monitoring in the project area. Badgers, on the other hand, are more frequently observed and reported in the area. This species is widespread and uses a variety of habitats in the area (WESTECH 2007).

3.7.3 Raptors

Eighteen raptor and owl species have been observed in all major habitat types within the project area. A wildlife monitoring survey conducted in 2007 observed eight of these species as shown on **Figure 3.7-1** (WESTECH 2008). Most of these species are migratory and are protected under the Migratory Bird Treaty Act (MBTA). The MBTA provides that it is unlawful to pursue, hunt, take, capture or kill; attempt to take, capture or kill; possess, offer to or sell, barter, purchase, deliver or cause to be shipped, exported, imported, transported, carried or received any migratory bird, part, nest, egg or product, manufactured or not (16 U.S.C. 703-712; Ch. 128; July 13, 1918; 40 Stat. 755). Executive Order (EO) 13186, signed January 10, 2001, lists responsibilities of federal agencies for protection of migratory birds. **Table 3.7-2** lists raptor species that have been observed in the project area. Many of these species are state listed Species of Concern and are indicated by an asterisk.

The greatest numbers of raptor species typically occur during spring and fall migration. Common spring and summer residents include red-tailed hawks (most commonly observed), American kestrels, and great-horned owls (SPE 2009). Recently, in 2006, active red-tailed hawk and great-horned owl nests were located in coal lease area (WESTECH 2007). Rough-legged hawks are the most common winter raptor species. Other comparatively infrequently observed raptors include prairie falcons, ferruginous hawks, Cooper's hawks, turkey vultures, northern harriers, sharp-shinned hawks, Swainson's hawks, bald eagles, short-eared owls, and burrowing owls (SPE 2009).

Table 3.7-2 Raptor Species Observed in the Bull Mountains Area

Common Name	Species
American Kestrel	*Falco sparverius*
*Bald Eagle	*Haliaeetus leucocephalus*
*Burrowing Owl	*Athene cunicularia*
Cooper's Hawk	*Accipiter cooperii*
*Ferruginous Hawk	*Buteo regalis*
Golden Eagle	*Aquila chrysaetos*
Great-horned Owl	*Bubo virginianus*
Merlin	*Falco columbarius*
Northern Goshawk	*Accipiter gentilis*
Northern Harrier	*Circus cyaneus*
*Peregrine Falcon	*Falco peregrines*
Prairie Falcon	*Falco mexicanus*
Red-tailed Hawk	*Buteo jamaicensis*
Rough-legged Hawk	*Buteo lagopus*
Sharp-shinned Hawk	*Accipiter striatus*
Short-eared Owl	*Asio flammeus*
*Swainson's Hawk	*Buteo swainsoni*
Turkey Vulture	*Cathartes aura*

*State Listed Species of Concern
Source: (WESTECH 2003 – 2007).

Golden eagles have been observed at all times of the year. In recent years, three golden eagles southwest of Dunn Mountain have been observed. Bald eagles are occasionally observed during winter and seasonal migrations as well. Both golden and bald eagles are protected under the Bald and Golden Eagle Protection Act (WESTECH 2008).

3.7.4 Upland Game Birds

There are two primary species of upland game birds in the project area: wild turkey (*Meleagris gallopavo*) and sharp-tailed grouse (*Tympanuchus phasianellus*). Other species such as ring-necked pheasant (*Phasianus colchicus*), gray partridge (*Perdix perdix*), and greater sage-grouse (*Centrocercus urophasianus*) may be present in low numbers (WESTECH 2008).

Wild turkeys are year-round residents of the project area. These turkeys were introduced in 1958 and have since spread throughout the area. Their preferred habitat is the ponderosa pine-mixed grassland, as well as the agricultural community (SPE 2009). The ponderosa pine-mixed grassland community provides roosting trees year-round, thermal cover during cold weather and food during all seasons. Many have been observed in this vegetation community along the Fattig Creek Road (WESTECH 2008).

Sharp-tailed grouse are also year-round residents of the project area, but use somewhat differing vegetation communities seasonally and are comparatively uncommon (SPE 2009; WESTECH 2007). Sharp-tailed grouse use silver sagebrush-mixed grassland and mixed grassland communities for courtship, nesting, and brood rearing in the spring and summer, and use the other communities to some degree for food cover during the fall and winter. One Lek (breeding grounds) has been identified (SPE 2009) as shown on **Figure 3.7-1**.

Non-native gray partridges and ring-necked pheasants are not observed frequently in the area, but are present in the western agricultural community. With about 50 percent of agricultural land converted to Conservation Reserve Program (CRP), both species should benefit from increased, undisturbed permanent cover and respond with an increase in numbers and area occupied (WESTECH 2008).

Sage grouse are sagebrush obligate species, and their habitat is very limited in the project area due to their habitat being converted to agriculture land in past years. Existing habitat is in valleys that are primarily dominated by silver sagebrush. A few sage grouse have been seen in the area; however, due to the dependency this bird has on sagebrush (particularly in the winter), there is little potential for the lease areas support this species (WESTECH 2008). Sage Grouse are State Species of Concern and BLM Sensitive Species (MNHP 2008).

3.7.5 Other Birds

One hundred sixty other bird species, including waterfowl, shorebirds, and land birds (including migratory birds) are known to inhabit the project area, using all vegetation communities (SPE 2009 Volume 7 Section 26.4.304(10)). The burned ponderosa pine-mixed grassland community provides an extraordinary abundance of snags as nesting habitat for cavity-nesting small birds such as woodpeckers, swallows, bluebirds, and wrens.

Habitat for shorebirds, waterfowl, and other wetland species is relatively limited and confined to small wetlands in the project area. According to mine-related wildlife monitoring surveys (1989-2006), 14 shorebirds, waterfowl, or species associated with wetlands have been documented in the area (WESTECH 2007). Land bird species diversity was comparatively higher in respect to these monitoring surveys; species of the Passeriformes family were the most documented (WESTECH 2007).

3.7.6 Bats

Acoustic and capture sampling for bats has been conducted in the project area (Butts 2006). During this sampling effort, 12 bat species were detected. Big brown bat (*Eptesicus fuscus*) and western long-eared myotis (*Myotis evotis*) were the most commonly observed species. Three lactating pallid bats (*Antrozous pallidus*) were observed, indicating that the species was reproducing in the project area. Townsend’s big-eared bat (*Corynorhinus thownsendii*), a state Species of Concern and BLM sensitive species, was also observed in Section 8 of the lease area. A variety of other species were recording during this survey effort and preceding surveys, including: silver-haired bat (*Lasionycteris noctigagans*), hoary bat (*Lasiurus cinereus*), spotted bat (*Euderma maculatum*), small-footed myotis (*Myotis ciliolabrum*), long-legged myotis (*Myotis volans*), eastern red bat (*Lasiurus blossevellii*), fringed myotis (*Myotis thysanodes*), northern long-eared bat (*Myotis septentrionalis*), and little brown bat (*Myotis lucifugus*) (Butts 2006; SPE 2009).

3.7.7 Amphibians, Reptiles, and Aquatic Species

Aquatic habitat in the area includes streams, ponds, springs, seeps, and areas associated with the wetland community. The Rehder, Fattig, and Railroad Creek drainages are ephemeral; however, there are perennial ponds and stream reaches created by flow from springs. Approximately 15 acres of wetland habitat occurs in the project area, 3 acres of which are open water. A number of wet sites remain relatively undisturbed by current land use practices; however, many aquatic sites have been modified by livestock grazing or development of livestock watering facilities. Additional disturbances to the aquatic environment of the area include the 1984 fire and subsequent loss of insulating cover, and increases in siltation from runoff and cattle disturbance. All animals found in the area use streams, ponds, springs, and related habitat to a greater or lesser degree (SPE 2009).

The aquatic invertebrate community is characterized by low-to-moderate species diversity, densities, and productivity. Species are predominantly those typically of standing water; however, a number of the taxa represented are found only in lotic (flowing water) habitats. The dominant invertebrate species are generally tolerant of widely varying conditions and are typically transient in nature or bottom dweller that prefer standing water. Species from the midge (*Chironomidae*), mayfly (*Ephemeroptera*), and fly (*Diptera*) families dominate the invertebrate community, with aquatic earthworms (*Oligochaeta*) and amphipods also well represented. The periphyton communities (e.g. algae, bacteria, and protozoa) present in the springs, ponds, and streams are not common in eastern Montana, and indicate a higher water quality than is usually encountered in this part of the state. Tiger salamanders are common in pond sites associated with springs. No fish species are known to exist in the project area.

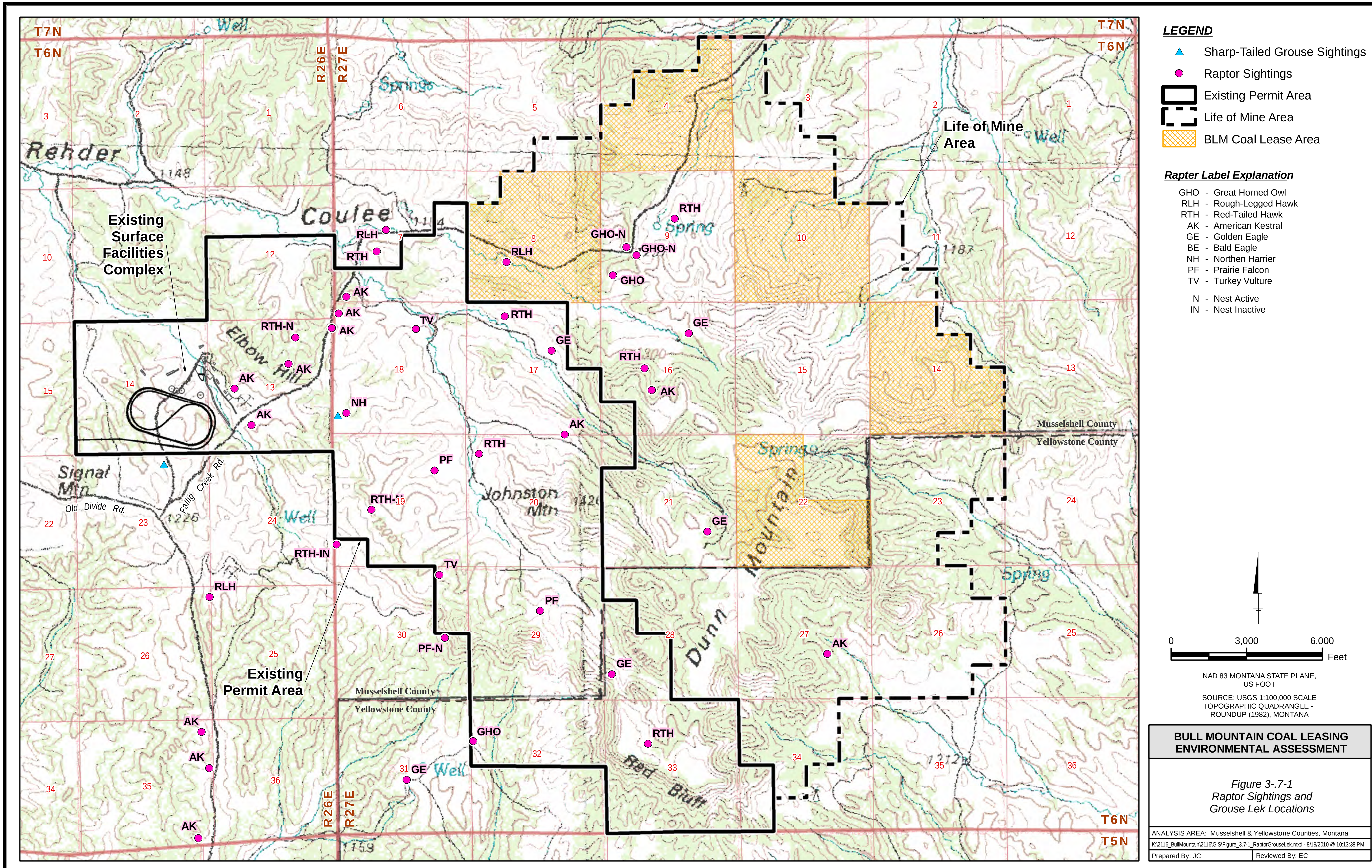
3.8 Threatened or Endangered Species and Special Status Species

3.8.1 Federally Threatened or Endangered Species

The US Fish and Wildlife Service (USFWS) provided a list and regular updates federally threatened or endangered species with potential to occur in Musselshell and Yellowstone counties, Montana (USFWS 2008). According to this list, the black-footed ferret (*Mustela nigripes*) and Whooping Crane (*Grus americana*) have potential habitat in these counties. However, wildlife monitoring surveys (1989 to 2008) have not indicated the presence of these species in the project area (Butts 1997; WESTECH 2003-2008; MTNHP 2008). It is not expected that either species would occur in the lease areas.

3.8.2 Special Status Species

The State of Montana regularly updates a Species of Concern list. Species of Concern include taxa that are at-risk due to rarity, restricted distribution, habitat loss, or other factors. The term also encompasses species that have a special designation by organizations or land management agencies in Montana (e.g. BLM). **Table 3.8-1** lists Special Status Species that have been documented during mine related studies in the project area. Some are also listed as BLM Sensitive Species, and are indicated by an asterisk.



LEGEND
Sharp-Tailed Grouse Sightings
Raptor Sightings
Existing Permit Area
Life of Mine Area
BLM Coal Lease Area
Rapter Label Explanation
GHO - Great Horned Owl
RLH - Rough-Legged Hawk
RTH - Red-Tailed Hawk
AK - American Kestral
GE - Golden Eagle
BE - Bald Eagle
NH - Northen Harrier
PF - Prairie Falcon
TV - Turkey Vulture
N - Nest Active
IN - Nest Inactive
Existing Surface Facilities Complex
Existing Permit Area
Life of Mine Area
Musselshell County
Yellowstone County
0 3,000 6,000 Feet
NAD 83 MONTANA STATE PLANE, US FOOT
SOURCE: USGS 1:100,000 SCALE TOPOGRAPHIC QUADRANGLE - ROUNDUP (1982), MONTANA
BULL MOUNTAIN COAL LEASING ENVIRONMENTAL ASSESSMENT
Figure 3-.7-1
Raptor Sightings and Grouse Lek Locations
ANALYSIS AREA: Musselshell & Yellowstone Counties, Montana
Prepared By: JC
Reviewed By: EC

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Table 3.8-1 Special Status Species Documented in the Project Area

Species	1989-1996[a]	2001[b]	2002[b]	2003[c]	2004[d]	2005[e]	2006[f]
Birds							
*Bald Eagle (*Haliaeetus leucocephalus*)	X			X			X
*Swainson's Hawk (*Buteo swainsoni*)	X						
*Ferruginous Hawk (*Buteo regalis*)	X						
*Peregrine Falcon (*Falco peregrinus*)							X
*Greater-sage Grouse (*Centrocercus urophasianus*)	*has been observed in the Bull Mountains area (MDSL 1992)*						
*Long-billed Curlew (*Numenius americanus*)	✓						
*Burrowing Owl (*Athene cunicularia*)	*has been observed in the Bull Mountains area (MDSL 1992)*						
Lewis' Woodpecker (*Melanerpes lewis*)	✓						✓
*Red-headed Woodpecker (*Melanerpes erythrocephalus*)	✓	✓	✓	✓	✓	✓	✓
Cassin's Kingbird (*Tyranns vociferans*)	✓		X				✓
*Loggerhead Shrike (*Lanius ludovicianus*)	✓						
Brewer's Sparrow (*Spizella breweri*)	✓						
Lark Bunting (*Calamospiza melanocorys*)	✓			✓			
Grasshopper Sparrow (*Ammodramus savannarum*)	✓		✓				✓
*Chestnut-collared Longspur (*Calcarius ornatus*)	✓						
Gray-crowned Rosy Finch (*Leucosticte tephrocotis*)	✓						
Mammals							
Bats							
*Townsend's Big-eared Bat (*Corynorhinus townsendii*)	✓						✓
*Spotted Bat (*Euderma maculatum*)	✓						✓
*Northern Myotis (*Myotis septentrionalis*)							✓
*Fringed Myotis (*Myotis thysanodes*)							✓
Amphibians							
*Great Plains Toad (*Bufo cognatus*)	✓[g]						
*Northern Leopard Frog (*Rana pipiens*)	✓	✓	✓	✓	✓	✓	
Reptiles							
Sagebrush Lizard (*Sceloporus graciosus*)	✓						

Sources: [a] Butts (1997), [b] Westech (2003), [C] Westech (2004), [D] Westech (2005), [E] Westech (2006), [F] Westech (2007), [g] MTNHP (2008)

* BLM Sensitive Species

3.9 Ownership and Use of Land

The proposed lease area is both federal and private surface with underlying federal mineral reserves administered by the BLM. Approximately 22 percent of the land overlying the federal coal lease area is federal land administered by the BLM. Lands and minerals surrounding the federal coal lease area are privately owned. Musselshell County and nearby Yellowstone County are predominantly agricultural, including rangeland, forest areas including commercial forest, cropland, and pasture. Land in the lease area is dominated by forest and rangeland with limited areas of dispersed residential development. Section 4 of the proposed lease area has been subdivided into parcels for home sites. Several of these sites have homes or cabins and others are proposed in the future. Some out-buildings and fences have also been built. Other structures that have been built to enhance land use include livestock fences in all five lease tracts, improvements to spring sites (such as ponds, water tanks, and piping) in all five lease tracts, water conveyance systems for livestock in all five lease tracts, and roads and trails in all five lease tracts. Ranch improvements in Section 22 of the lease area consist of development of High Spring (71115) and a solar well that distribute water to an extensive system of three lined storage pits, about 8 miles of pipeline and 29 reliable water points (with a mixture of permanent and portable stock tanks) serving approximately 5 sections of land in the Railroad Creek drainage. Identified structures in the coal lease area are shown on **Figure 3.9-1**.

The ARM defines "land use" as the specific uses or management-related activities for particular parcels of land. These parcels may have a single use. However, they may also serve other uses.

All but one of the land uses identified in the ARM presently apply to the project area. They occur singly or in combination, although commercial forest land, as defined in the ARM, has not been identified in the project area. Minimally, land within the project area is capable of supporting this use. All land uses in the project area are described below.

3.9.1 Current Uses of Land within the Project area

Land uses presently occurring within the project area have been classified into the following eight groups.

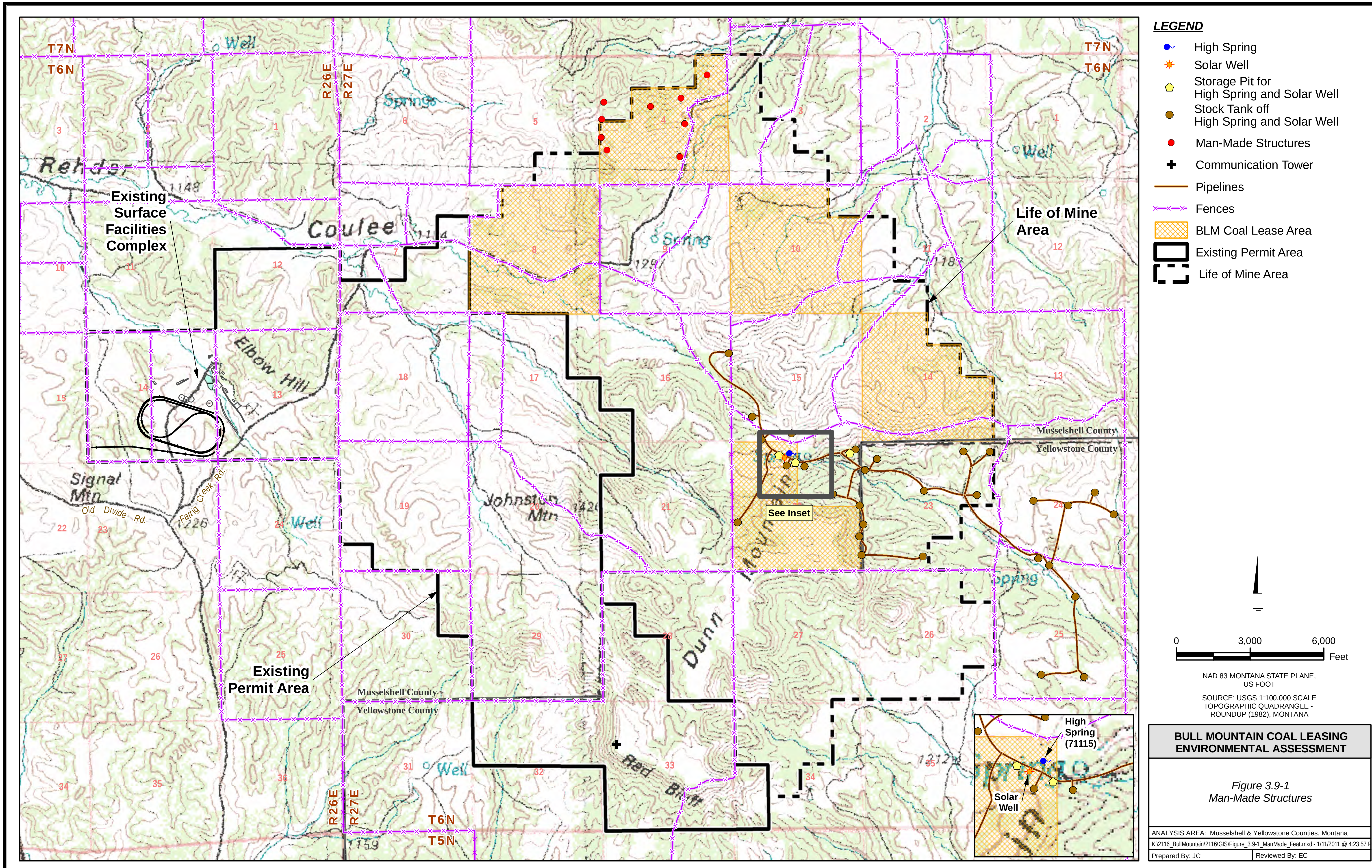
The Grazing Land, Fish and Wildlife Habitat, and Recreation Land Use Type

The grazing land, fish and wildlife habitat, and recreation land use type can be considered the most important type within the project area. Comparatively, it occupies more of the project area than all the other types combined. It also serves three land use functions.

Livestock grazing is the primary use of land classified under this type. The principal use of the federal land in sections 8 and 10 is livestock grazing. Within the project area, livestock grazing principally involves cattle. A few horses are raised by some landowners. Sheep are not present. Details concerning cattle production and grazing management are provided in the land productivity discussion below.

Although land placed in this category provides fish and wildlife habitat, none is specifically managed as fish and wildlife habitat. Wildlife species are allowed to exist throughout this type as long as they do not interfere with livestock operations. Therefore, this type functions secondarily as fish and wildlife habitat.

Like the fish and wildlife habitat use, areas identified as grazing land, fish and wildlife habitat, and recreation provide some dispersed and undeveloped human recreation. Hunting is essentially the only recreational activity occurring in areas designated with this land use type. No developed recreational facilities exist. Additionally, none of the landowners manages their property for recreation.


LEGEND
High Spring
Solar Well
Storage Pit for High Spring and Solar Well
Stock Tank off High Spring and Solar Well
Man-Made Structures
Communication Tower
Pipelines
Fences
BLM Coal Lease Area
Existing Permit Area
Life of Mine Area
Existing Surface Facilities Complex
Life of Mine Area
Existing Permit Area
See Inset
High Spring (71115)
Solar Well
Musselshell County
Yellowstone County
T7N
T6N
T5N
R26E
R27E
0
3,000
6,000
Feet
NAD 83 MONTANA STATE PLANE, US FOOT
SOURCE: USGS 1:100,000 SCALE TOPOGRAPHIC QUADRANGLE - ROUNDUP (1982), MONTANA
BULL MOUNTAIN COAL LEASING ENVIRONMENTAL ASSESSMENT
Figure 3.9-1 Man-Made Structures
ANALYSIS AREA: Musselshell & Yellowstone Counties, Montana
K:\2116_BullMountain\2116\GIS\Figure_3.9-1_ManMade_Feat.mxd - 1/11/2011 @ 4:23:57 PM
Prepared By: JC
Reviewed By: EC

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The Residential, Fish and Wildlife Habitat, and Recreation Land Use Type

The residential, fish and wildlife habitat, and recreation land use type occurs only in the north-central portion of the project area. None of the acreage occupied by this type is located near the mine surface facilities. The residential, fish and wildlife habitat, and recreation acreage consists of a subdivision being developed in Section 4 of the lease area. The subdivision is north of Rehder Creek and is accessed from Fattig Creek Road.

Because the development of the subdivision is relatively dispersed, it still serves as fish and wildlife habitat. A variety of species occupy the area, including elk and mule deer. However, because the ultimate goal is to develop the properties, none of the acreage is managed for fish and wildlife.

The subdivided parcels are also presently used for recreational activities. As with the grazing land, fish and wildlife habitat, and recreation type, hunting is essentially the only recreation activity. However, as more residences are developed, hunting would likely cease to be a recreational activity.

Development of the subdivision's parcels is likely to bring forth another form of leisure-time recreation. Based on an examination of Musselshell County records, many of the new landowners are from outside of Montana. For these people, the land may serve as a summer or vacation site. These parcels would provide relaxing recreation for their owners. Thus, the subdivision would still function as private recreation.

The Special-Use Pasture, Fish and Wildlife Habitat, and Recreation Land Use Type

This land use type occurs over a relatively small portion of the project area. Special-use pasture is the primary land use. However, the acreage also functions as fish and wildlife habitat and provides for human recreation.

Within the project area, areas of special-use pasture have been tilled and seeded to improve vegetative production. This increased production is used directly and indirectly for livestock. Indirectly, portions are harvested as hay and put up for winter livestock feed. The rest is left uncut and directly grazed by cattle. Intermediate and crested wheatgrass are the primary introduced species in the special-use pastures.

This land use type also functions as the secondary uses of fish and wildlife habitat and recreation. Wildlife species, such as elk and deer, often use the special-use pastures for grazing. People also hunt on these areas, so they serve limited recreational uses.

The Industrial or Commercial Land Use Type

Within the project area, there is one general area that has been used for industrial or commercial purposes. This area has two components. One is the PM Coal Mine. The other is the Meridian test pit. The Bull Mountains Mine No.1 surface facilities have also been developed in the same general area.

The primary use of land in this land use type is for extraction of coal. However, this use of land by SPE was relatively recent. Before being opened in 1990, the Meridian test pit acreage located south of the Fattig Creek Road would have been placed in the grazing land, fish and wildlife habitat, and recreation land use type.

The Special-Use Pasture, Fish and Wildlife Habitat, and Industrial or Commercial Land Use Type

This land use type occurs solely within the area of the PM Mine. This includes areas within the PM Mine that were tilled and seeded and are used for livestock grazing. This acreage has only experience limited direct mine-related disturbance.

As is the case with the special-use pasture, fish and wildlife habitat, and recreation land use type, this type is accessible to and used by wildlife. Therefore, fish and wildlife habitat is considered to be a secondary use.

The Grazing Land, Fish and Wildlife Habitat, Industrial or Commercial Land Use Type

This land use type occupies all areas within the PM Mine and the Meridian test pit permit boundaries not defined as either of the two land uses described above. These areas have not been disturbed by mining activities and have not been tilled or seeded to improve vegetative production.

The Cropland and Grazing Land - Land Use Type

This land use type occupies a relatively small portion of the project area. Landowners seed these fields with alfalfa or wheat. Between the season's final cutting and the following spring's seeding, the landowners allow cattle on the fields to graze the un-harvested vegetation. Thus, the fields function secondarily as grazing land.

The Developed Water Resources Land Use Type

Many of the landowners within the project area have created ponds to catch and store water. Because these ponds serve a beneficial use for livestock, they are considered developed water resources. However, these resources are relatively small and widely scattered. In addition, they collectively occupy the smallest portion of the project area.

3.9.2 Capability of the Land within the Life of Mine area to Support Other Uses before Mining

One of the primary land use types identified in the ARM was not identified as presently existing in the project area. This use is commercial forest. Although several of the landowners in the project area occasionally have the ponderosa pine on their property harvested, SPE does not believe this activity qualifies the area as commercial forest.

To qualify as commercial forest land, the land must produce or be managed to produce stands of industrial wood that would be used as such. None of the landowners manages their land to produce these stands. Consequently, none of the permit or mine plan areas qualifies as commercial forest land based on management.

The only other way land within the two areas could qualify as commercial forest land is if it produces more than 20 cubic feet of industrial wood per acre annually. Actual production is presently unknown. However, data from similar environments in the Rocky Mountains suggest that this level of production is unlikely in the project area.

The land within the project area is generally most suitable for rangeland or, in areas of gentle slopes and adequate available moisture, non-irrigated cropland. Soil series in the project area include the Bainville, Blackhall, Cabbart, Delpoint, Havre, Rentsac, Travessilla, Yamac, and Yawdim series. The majority of the project area is characterized by Cabbart, Delpoint, and Yamac soils, with the other three series forming relatively minor components of the area.

The majority of upland within the project area, which include the Blackhall, Cabbart, Delpoint, Rentsac, Travessilla, and Yawdim, and portions of the Bainville series, possess significant limitations for most of the potential land uses. In general, steep slopes and a minimal depth to bedrock preclude most alternative land uses in much of the project area. Within most of the above soils, as steeper slopes are encountered, the capability of the land to be utilized for building development, water development, recreational development, and other uses is greatly reduced. Areas with the greatest potential for utilization for alternative land uses are the Yamac, Delpoint, or Havre (areas with low flooding potential) soils where slopes are relatively gentle and soils are deeper. However, the relatively low annual precipitation of the area is the major climatic factor limiting land use.

The most appropriate use of the majority of lands within the project area is for rangeland. Potential rangeland production in the project area varies with the soil series from approximately 800 to 1,800 pounds per acre dry weight in a normal year.

The following section describes the productivity of the project area with respect to forage, livestock, and agricultural crops. Since grazing management techniques have a considerable influence on livestock productivity, a description of grazing management and operational systems used by local ranchers is also presented.

3.9.3 Forage and Livestock Productivity

Table 3.9-1 shows the estimated Animal Unit Months (AUMs) for cattle for the various vegetation communities in the project area, respectively, based upon estimated forage production. Productivity estimates for the native vegetation communities are based on field survey data. The productivity estimate for improved pasture is based on discussions with landowners throughout the mine plan area. AUMs were calculated assuming a 50 percent utilization rate and 1,000 pounds of dry forage per animal unit. Total AUMs in the project area are approximately 3,932 and 1,794, respectively. Mean AUMs per acre for the project area for all vegetation communities combined are 0.36 and 0.43, respectively.

Landowners in the project area achieve varying levels of livestock productivity on area lands. This is due to the variability in grazing management techniques implemented by area ranchers, as well as differences in land characteristics (slope, soils, available forage and water, etc.). A total of about 2,060 to 2,120 animal units (cattle) are maintained annually by landowners operating at least partially within the project area. Lands located both within and adjacent to the project area are included in the support of these animal units.

Table 3.9-1 Forage Productivity and Animal Unit Months (AUMs) in the Project Area by Vegetation Type

Vegetation Type	Acreage	Production	AUMs/Acre	Total AUMs
Silver Sagebrush-Mixed Grassland	1,257	515.6 lbs/acre	0.26	326.8
Mixed Grassland	3,090	834.9 lbs/acre	0.42	1,297.8
Ponderosa Pine-Bluebunch Wheatgrass	2,866	424.6 lbs/acre	0.21	601.9
Burned Ponderosa Pine-Mixed Grassland	3,192	723.4	0.36	1,149.1
Wetland	9	5,421.6	2.71	24.4
Improved Pasture	266	4,000.0	2.0	532.0
Disturbed Types	174	0.0	0.0	0.0
Open Water	2	0.0	0.0	0.0
Total	**10,856**	**n/a**	**n/a**	**3,932.0**

Information from a limited number of landowners indicates that approximately 25 to 30 acres are required to support one animal unit, with supplemental feeding in winter. Average annual weight gain of calves appears to be about 575 to 625 pounds on most lands grazed from early spring to late fall. However, an average of about 665 pounds per calf is achieved on lands along the western Rehder Creek drainage. For landowners grazing native vegetation during summer and early fall only, weight gains average approximately 1.5 to 2.0 pounds per day during summer.

3.9.4 Grazing Management

Livestock grazing in the project area is primarily limited to the vegetative growing season because of the winter snow cover and cold temperatures. Grazing management in the project area generally follows a deferred rotation system. This system is the recommended long term grazing management system because deferred rotation grazing provides benefits to livestock gains, pasture improvement (both vegetation and soils), and net returns.

The savory or intensive grazing management system is also utilized in the project area by a few ranchers. As mentioned above, this system involves intensive management and grazing of the available forage. This method promotes better utilization of the forage and, when managed correctly, would benefit the range condition by the removal of the standing crop that promotes root and plant development during the non-grazing periods. The disadvantage of this system is the high level of management by the operator, increased fencing costs, and the added stress to the animals during pasture rotation.

Grazing management in the project area is influenced primarily by the weather. Snow cover and cold spring temperatures would sometimes delay utilization of the spring pastures. However, precipitation is the primary factor for determining pasture utilization. During moist years, pastures would sustain longer and heavier use. During dry years, livestock would be moved more frequently or be grazed at a lesser stocking rate.

All ranching currently being conducted in the project area is for cattle production with the cow-calf operation being the most popular. In general, calves would be born during the period of January to March in the winter pasture or winter feeding areas. From March to May, the cow-calves are transferred to the spring-summer pasture which begins the grazing season rotation. Calves would be removed from the summer-fall pastures during October or November and sold at market. General weight gains during the grazing season for a calf would be 550 to 650 pounds for a full grazing period and 450 to 550 pounds for a shorter grazing period which may be conducted on the higher elevation areas or for cattle which are trucked in from other areas.

The areas of federal surface are managed by the BLM under the Standards for Rangeland Health and Guidelines for Livestock Grazing Management (BLM 2009b). These areas are shown on **Figure 3.9-2** and the associated acreage is shown on **Table 3.9-2**. These standards apply primarily to rangeland health and only indirectly address by-products of healthy rangeland such as higher livestock productivity and healthy wildlife. The standards must meet the Fundamentals of Rangeland Health listed at 43 CFR 4180 and conform to other applicable federal regulations and guidelines. The fundamentals of rangeland health include:

- Maintain or promote adequate amounts of vegetative ground cover;
- Maintain or promote subsurface soil conditions;
- Maintain, improve or restore riparian-wetland functions;
- Maintain or promote stream channel morphology;
- Maintain or promote appropriate kinds and amounts of soil organisms, plants and animals;
- Promote the opportunity for seedling establishment;
- Maintain, restore, enhance water quality;
- Restore, maintain or enhance T&E habitat;
- Restore, maintain, enhance T&E candidate and special status species habitat;
- Maintain or promote native populations and their communities;
- Emphasize native species in the support of ecological function; and
- Only incorporate the use non-native plant species when native species are not available or are incapable of achieving proper functioning condition.

Table 3.9-2 Grazing Allotment Acreages within the Project Area

Grazing Allotments	Acres
Within Project Area	**7,587.9**
Montana State Trust Land Surface Ownership	606.2
BLM Surface Ownership	600.0
Private Ownership	6,381.7
Within Bull Mountains Mine No. 1 Permit Area	**4,694.4**
Montana State Trust Land Surface Ownership	31.5
BLM Surface Ownership	336.1
Private Ownership	4,326.8
BLM Coal Lease Area	**2,195.4**

3.9.5 Agricultural Productivity

Cultivated croplands are relatively scarce in the project area. Primary crops include wheat, alfalfa, and hay (grass). Areas under cultivation vary from year to year, and crops are sometimes rotated. Production information has been obtained from local landowners throughout the project area.

Crop production varies with annual precipitation as well as the local moisture regime. In the relatively moist Rehder Creek bottom, annual alfalfa production range from 1.5 tons per acre (one cutting) during dry years to a maximum of about 5 tons per acre (three cuttings) in relatively wet years. Alfalfa production along the PM Road, where conditions are considerably drier, have averaged approximately 700 pounds per acre. These are the only known locations where alfalfa is grown or has recently been grown in the project area.

Wheat is also grown in the Rehder Creek drainage. Production averages approximately 45 bushels per acre. Yields over the last 30 years have ranged from a low of about 32 bushels per acre to a maximum of 74 bushels per acre.

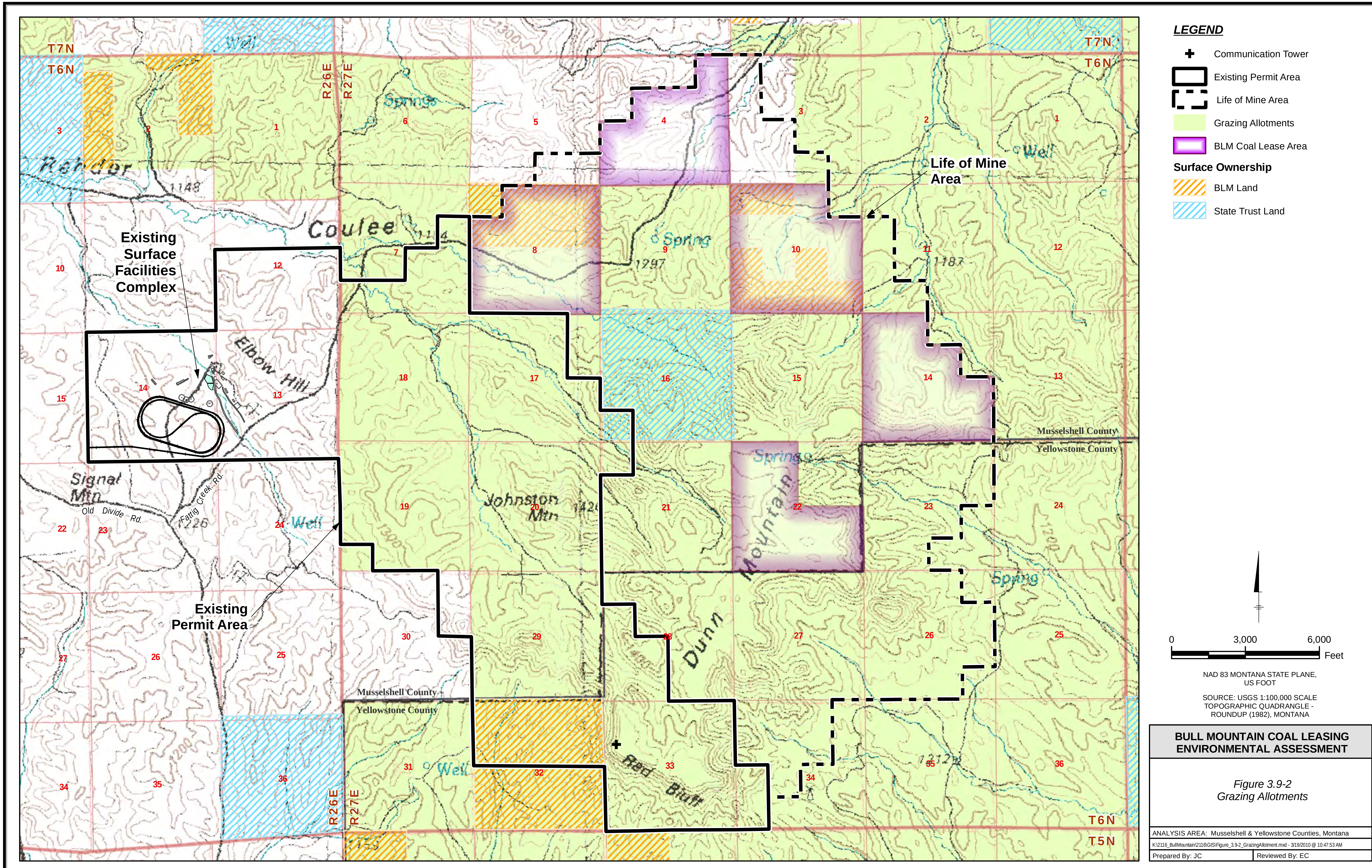
The most common crop harvested in the project area is grass hay on areas of special-use pasture. Landowners vary the management of special-use pasture from year to year. Portions are harvested as hay, while other areas are left standing and grazed or cut and then grazed. As with other crops, yields vary with available moisture. Production probably averages about 2 tons of hay per acre annually in most of the project area. A minimum yield of about 1.5 tons per acre per year generally results during dry years or on drier sites. Wetter sites such as the Rehder Creek drainage produce greater yields, with an average of about 3 tons per acre annually. A maximum known yield in the project area of about 4.5 tons per acre has been harvested in the Rehder Creek drainage during wet years.

Development of land in the project area is not occurring under the direction of a comprehensive land use plan. Musselshell County does not have land use regulations. Although land use regulations have been proposed in the past, they were rejected by voters (most recently in November 1988). Neither Yellowstone County nor Musselshell County currently has land use regulations.

3.10 Cultural Resources

3.10.1 Prehistoric and Historic Resources

Prehistoric resources are artifacts and features resulting from human activity predating written records. These are identified either as isolated artifacts or as sites. Typically, prehistoric sites in the region consist of scatters or clusters of artifacts such as stone tools and pottery sherds; features such as hearths, stone circles, or rock art; or plant and animal remains. Depending on their age, complexity, integrity, and association, sites may be important for the information that they contain and their potential to contribute to our understanding of past cultures and settlement patterns. Prehistoric site types in the Bull Mountains area include camps, log structures, limited activity loci, rock art, rock cairns, lithic quarries, and workshops. Prehistoric pottery is not common in the Bull Mountains area.



LEGEND
Communication Tower
Existing Permit Area
Life of Mine Area
Grazing Allotments
BLM Coal Lease Area
Surface Ownership
BLM Land
State Trust Land
Life of Mine Area
Existing Surface Facilities Complex
Existing Permit Area
Musselshell County
Yellowstone County
T7N
T6N
T5N
R26E
R27E
0
3,000
6,000
Feet
NAD 83 MONTANA STATE PLANE, US FOOT
SOURCE: USGS 1:100,000 SCALE TOPOGRAPHIC QUADRANGLE - ROUNDUP (1982), MONTANA
BULL MOUNTAIN COAL LEASING ENVIRONMENTAL ASSESSMENT
Figure 3.9-2
Grazing Allotments
ANALYSIS AREA: Musselshell & Yellowstone Counties, Montana
Prepared By: JC
Reviewed By: EC

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Historic resources are artifacts, features, buildings, and structures that were created within the period of historic written records. Historic sites include buildings and structures such as dams and bridges, and historical archaeological features such as artifact scatters, building foundations, landscape modifications, and trails. Historic resources may also include known locations of historic events that may not retain physical traces of those events. Historic resources may have the ability to yield information in the same manner as prehistoric sites, but are more often considered important for their association with important historical persons or events, or as examples of distinctive architectural, engineering, or artistic styles.

Cultural resource surveys have been conducted in areas of planned surface disturbance within the project area (Rood 1990; Tetra Tech, Inc. 1991) and of 19 springs that may be affected by subsidence (Pool 1992). These surveys were predominantly outside the lease area. The 19 springs that were surveyed included three that are within or near the lease area (16135, 16145, and 16165). Prehistoric lithic scatters were found at four of the 19 springs, including one found at a spring adjacent to one of the lease area. The latter site (24ML667) is currently listed by the SHPO as unevaluated for the National Register of Historic Places (NRHP).

More recently, cultural resource surveys were conducted on the surface within the lease area that are above proposed areas to be mined and may be affected by subsidence (Ferguson 2009). Five sites and three isolated finds were recorded during this survey. Four newly recorded sites and one previously documented site were addressed in this study. Sites included one possible prehistoric campsite (previously recorded site 24ML667), a historic homestead (24ML835), a historic graffiti site (24ML836), prehistoric lithic reduction site (24ML837), and a prehistoric lithic source (24ML838). All of the isolated finds are prehistoric artifacts. Site 24ML667 is unevaluated for the NRHP because of the potential for deeply buried cultural deposits. All other sites recorded during this survey were not eligible for the NRHP.

3.10.2 Native American Religious Concerns

Native American religious concerns are sites, areas, and materials important to the ongoing culture of Native American groups for religious or heritage reasons. Sensitive resources may include some types of prehistoric resources, features and artifacts, contemporary sacred sites, traditional use areas such as traditional plant gathering areas, and sources of materials used to produce sacred objects and traditional tools. Some prehistoric or historic archaeological sites that are also Native American traditional concerns may be considered eligible for the NRHP because of their association with Native American traditions and cultural identity and may be considered Traditional Cultural Properties (TCPs). Although archaeologists may identify sites as potential TCPs, the evaluation of these sites must be done through government-to-government consultation. Sensitive places in the area may include mountain peaks or springs that are elements of cultural traditions or beliefs.

Native American groups with traditional ties and concerns in the Bull Mountains area include the Crow, Blackfeet, Gros Ventre, Sioux (or Lakota), Northern Cheyenne, Assiniboine, Shoshone, and Arapaho. Contacts for consultation were made with representatives of the Crow, Eastern Shoshone, Assiniboine, Gros Ventre, Oglala Sioux, Blackfeet, Flathead, and the Medicine Wheel Alliance (Kooistra-Manning and Deaver 1993). These studies were baseline data gathering and did not include government-to-government consultation. Several locations have been identified in the general area of the project that may contain resources sensitive to these groups. There are three broad classes of sensitive cultural concerns that may apply to the project area: sites that may qualify as TCPs; locations with intangible spiritual attributes (ISAs); and contemporary prayer and offering locales. Sensitive site types that may qualify as TCPs may include burials, rock art, vision quest and fasting sites, large rock features, dance grounds and associated lodges, large or complex stone circle sites, sweat lodges, and historic battle sites (Kooistra-Manning and Deaver 1993). Culturally significant geological or landscape features and traditional resource gathering areas may also qualify as TCPs or be sensitive to these groups. Sites with ISAs are locations or features recognized as culturally or spiritually important by Native American groups, but cannot be defined as TCPs. These sites are protected under the American Indian Religious Freedom Act, and respectful treatment is appropriate to avoid adverse impacts to the spiritual qualities of these sites. The third class of sensitive localities includes traditional prayer and offering localities that are currently in use for ceremonial purposes. Tribal representatives also expressed concern that underground mining disturbs the quiet zone of the deep earth and disrupts or destroys elements of the spiritual environment. They were particularly concerned about disruption to springs and the spirits that dwell in these waters. The mining may also indirectly impact resources through subsidence.

Several potential TCPs were identified during consultation for the project area and railroad corridor. None of these were within the lease area. Archaeological sites at springs and the springs themselves were identified as potentially culturally sensitive, but locations in the lease area were not addressed in consultation.

3.11 Visual Resources

The project area is characterized by wooded rolling hills and low mountains, and areas of open, flat grasslands and farmlands. The highest mountain in the project area is Dunn Mountain with an elevation of about 4,750 feet south of the lease area. Within and near the lease area, flat open grasslands are restricted to the bottom of the Rehder Creek valley and portions of open mesas. In general, the project area is a mix of rural scenery that is fairly common to the region.

The project area is characterized by low mountains and sloping valleys covered in a mix of upland grasslands, ponderosa pine, and rock outcrops. The visual features in the project area itself are fairly common to the region. More distant vistas from the project area, especially from portions of Dunn Mountain, are the Snowy, Big Horn, Pryor, Beartooth, and Crazy mountains. Within the lease area, there are no identified areas of special, critical, or unique scenic significance and no National Landmarks.

Structurally, the project area occupies a shallow basin, with no outstanding features or unique surface expressions. Faults are rare, and none occur in the project area. SPE contacted the MBMG regarding any "unique geologic formations and special characteristics" in the project area. The MBMG has no knowledge of any unique or special geologic features. In addition, no such features have been observed by professional geologists while working in the project area.

The project area is about 1 mile east of U.S. Highway 87. U.S. Highway 87 is the closest major road and the most likely perspective that the project area may be seen from. The project area is not a common recreational destination. There are no public recreational areas in the project vicinity. The mine surface facilities are shielded from the highway by Signal Mountain and a series of low ridges. Fattig Creek Road is a maintained county road that crosses through the northern portion of the lease area. This road crosses from U.S. Highway 87 by way of Old Divide Road to U.S. Highway 12 near Delphia. The road runs along Rehder Creek in Section 8, then swings north through Section 4 across the divide to Fattig Creek. Minor roads branch off Fattig Creek Road to dispersed residences in the project area. Principal views of the project area would be from Fattig Creek Road and the scattered private residences in the project area.

3.12 Noise

Noise can be characterized as unwanted or unpleasant sound. Noise, as a physical phenomenon, consists of sound pressure variations audible to the ear. Sound level is expressed in decibels (dB), a logarithmic unit borrowed from electrical engineering. The dB is a dimensionless unit related to the logarithm of the ratio of the measured level to a reference level. A derivative measure of dB, the dBA, has been developed to express sound levels in a manner that reflects how people perceive sounds. The U.S Environmental Protection Agency (EPA) has adopted a measure of the effect of noise on people called the day-night average sound level (DNL). EPA has identified a range of yearly DNL sufficient to protect public health and welfare. In this scheme, maintaining an outdoor noise level at or below 55 dBA should insure adequate protection for indoor living. Current noise levels in these areas are generated by wind and traffic on local roads, typical of rural areas.

Meridian collected readings of the noise levels at the PM Mine. Construction and heavy equipment operation noise levels ranged from about 72 to 95 dBA near the preparation facility to an ambient noise level of about 35 to 40 dBA. SPE anticipates that noise levels at the Bull Mountains Mine No. 1 facilities would be comparable. Monitoring of noise levels is not required by the current mine permit.

3.13 Transportation Facilities

The Bull Mountains Mine No. 1 mine facilities are served by U.S. Highway 87 which connects Billings, which is along Interstate 94 and Roundup, which is along U.S. Highway 12. Principal local roads include Fattig Creek Road, which connects U.S. Highway 87 by way of Old Divide Road near the mine facilities to U.S. Highway 12 to the northeast at Delphia. Mine employees travelling to work and other mine-related traffic use these roads. U.S. Highway 87 and Old Divide Road are asphalt, all-weather, two-lane highways maintained by the Montana Department of Transportation, and Fattig Creek Road is an unpaved two lane road maintained by Musselshell County. Several smaller local roads branch off of these main roads. Produced coal is currently delivered to markets by the railroad spur to Broadview. This rail spur will continue to carry traffic as long as the mine is in operation. The level of production from the mine results in three coal trains per day from the mine to Broadview and then on mainline railroads to the eastern United States and possibly to the west coast.

3.14 Hazardous and Solid Waste

The Bull Mountains Mine No. 1 is an underground longwall facility and there will be no surface activities in the coal lease area that would generate any hazardous or solid waste. Solid and liquid waste would continue to be produced at the mine facilities and, as the mine advances, waste materials would result from activities associated with mining the leased coal. Procedures are in place for handling solid and liquid waste produced by mining activities, and these procedures would continue to be used for the lease area.

3.15 Socioeconomics

The social and economic project area includes Musselshell and Yellowstone counties. The majority of mine facilities and the coal lease area are in Musselshell County, but employees also commute to the mine from Yellowstone County. Activities on the public lands in Musselshell and Yellowstone counties have the potential to affect social and economic resources in communities near the project area. Public scoping identified effects to employment, local economy, and tax base as the primary issue related to the development of the proposed project area. Effects to social characteristics were not identified as an issue from public scoping efforts, as coal mining has historically been part of county economies. Many residents of the counties depend on resource extraction-based employment for their livelihood and lifestyle.

3.15.1 Local Economy

The local economy in this portion of rural Musselshell County and adjacent portions of Yellowstone County is dominated by mine and ranching-related employment. Closer to Billings in Yellowstone County, an increasing number of individuals are employed in the Billings area. This rural area and Roundup are significantly affected by employment levels at the mine, whether by direct employment or other mine-related businesses and services.

From 1995 to 2008, approximately $125,000,000 has been spent on the Bull Mountains Mine No. 1 project. That number includes over $30,000,000 that has been applied to the purchase of property in Musselshell County from individuals, which in turn has generated millions of dollars of tax revenue for the state and county.

3.15.2 Population

Population in Musselshell County from 1980 to 1990 dropped from 4,428 to 4,106. Most of the decrease in county population occurred in Roundup. By 2000, the population had rebounded to 4,497 and it remained roughly at that same level through 2007. In the 1980s, the population in Yellowstone County was growing, and the proportion of the population that lived in urban areas (Billings) was growing even more rapidly. From 1980 to 1990 the county population grew from 108,035 to 113,419, a 5 percent increase. In that same period, the population of the Billings area increased from 66,842 to 81,151, a 21 percent increase. Not only was the population of the county increasing, but much of the rural population was moving into urbanized areas. By 2000 the county population had increased to 129,352, and it continued to increase, reaching 141,022 in 2007. Through 2007, Yellowstone County showed a continued population growth rate of about 1.3 percent annually and continued urbanization. These trends in population roughly parallel trends in employment as discussed in the Employment Section below. In the 1980s, Musselshell County had a sharp drop in mining-related employment, reflected by less extreme drops in other sectors. In the same period, Yellowstone County also showed a drop in mining-related employment, but showed strong rises in retail trade, finance and real estate, and service sectors, predominantly in the urban areas in and around Billings.

3.15.3 Employment

The Bull Mountains Mine No. 1 surface facility complex is in the south central portion of Musselshell County. Rural Musselshell County, Roundup, and other communities in the county contribute to the labor force of the Bull Mountains Mine. The PM Surface Mine was in operation on a small scale as a surface mine from 1973 through 1993. Consequently, the mine was a minor contributor to the employment statistics over that period. In 1993, the Bull Mountains Mine No. 1 was issued a permit for underground operations. The mine was closed from 1994 through 1995, resumed operation briefly in 1996 and 1997, and closed again until resuming operation in 2003 under new ownership. Mining operations have been expanding since 2003 to full levels of production.

Based on the data presented in the Bull Mountains Mine No. 1 FEIS (MDSL 1992), employment in Musselshell County was dropping in the late 1980s and was dominated by ranching-related jobs. The overall employment figures for Musselshell County given in that FEIS show a 5 percent drop in employment from 1980 to 1989 (1,944 and 1,850). The corresponding labor force statistics (**Table 3.15-1**) show an 8 percent drop in employment over the same period, and a 3 percent drop in the labor force. In 1989, mining accounted for 6 percent of the employment in the county and farm-related employment accounted for 18 percent. Department of Labor and Industry figures for the years 2000 and 2007 (MDLI 2008) show employment in the county rebounding and dropping slightly again. Annual employment in 2000 was 1,969 with a 6.1 percent unemployment rate, and in 2007 had dropped to 1,924 with a 4.8 percent unemployment rate. Information on employment by sector indicates that employment in mining had risen to 8 percent of employment in the county, while ranching-related employment had dropped to only 3 percent. The Bull Mountains Mine No. 1 resumed operation in 2003 and contributed to the proportional increase in employment in the mining sector.

Table 3.15-1 Labor Force Statistics, Montana, Musselshell and Yellowstone Counties, 1990, 2000, and 2007

State of Montana or County/Category	1990[1]	2000[2]	2007[2]
Montana			
Labor Force	402,000	468,865	501,348
Employed Persons	379,000	446,552	485,615
Unemployed Persons	23,000	22,313	15,734
Unemployment Rate	5.7	4.8	3.1
Musselshell County			
Labor Force	1,696	2,096	2,021
Employed Persons	1,564	1,969	1,924
Unemployed Persons	132	127	97
Unemployment Rate	7.8	6.1	4.8
Yellowstone County			
Labor Force	64,473	71,487	81,464
Employed Persons	61,395	68,572	79,532
Unemployed Persons	3,078	2,915	1,932
Unemployment Rate	4.8	4.1	2.4

[1] From MDSL 1992

[2] From MDLI 2008

The southern portions of the project area are in Yellowstone County, and Yellowstone County contributes to the labor force of the Bull Mountains Mine No. 1. Based on the data presented in the Bull Mountains Mine No. 1 FEIS (MDSL 1992), employment in Yellowstone County was rising in the 1980s. The overall employment figures for Yellowstone County show a 14 percent increase in employment from 1980 to 1989 (60,286 to 68,964). The corresponding labor force statistics show an 11 percent increase in employment over the same period, and 11 percent increase in the labor force. In 1989, mining accounted for less than 1 percent of the employment in the county and farm-related employment accounted for approximately 2 percent. Department of Labor and Industry figures for the years 2000 and 2007 (MDLI 2008) show employment in the county continuing to rise. Annual employment in 2000 was 68,572 with a 4.1 percent unemployment rate, and in 2007 had risen to 79,532 with a 2.4 percent unemployment rate. In 2007, farming and mining related employment together accounted for less than 1 percent of the employment in the county. In 1989, employment sectors that tend to cluster in urban areas including retail trade, finance and real estate, services, and government accounted for 72 percent of the employment in Yellowstone County. The greatest growth in Yellowstone County in the 1980s was in services.

Current operations at Bull Mountains Mine No. 1 provide employment for approximately 200 workers. In 2007, mining employment was 51 in Musselshell County, and 366 in Yellowstone County, for a total of 417 workers (BLM 2009); however, this employment number does not reflect recent hires made by the mine. The mine recently expanded the operations workforce by 50 workers, of which 20 percent were estimated to have migrated into the counties from other regions. The effects to social and economic conditions in the counties from the additional 10 workers and their families would be very small. The relatively small number of in-migrating workers did not cause a discernible effect to permanent and temporary housing stock, or to community and municipal services.

The county mining employment includes oil and gas operations as well as other non-coal mining jobs. Employment in coal mining operations is not available for the counties, as disclosure of this data violates state and federal confidentiality criteria. The majority of mining employees in Yellowstone County are employed in the oil and gas industry, so it is likely that current mining employment for both counties utilizes most, if not all, of the available mining labor force in the counties; however, in the event that non-specialized mining jobs become available, workers employed in other sectors would likely shift to mining jobs that pay high wages relative to other employment sectors. The 200 workers at Bull Mountains Mine No. 1 include management and other support staff as well as workers employed for mining activities.

3.15.4 Housing

Year-round housing in Musselshell County, including the project area, increased from 1,997 to 2,183 from 1980 to 1990, an average increase of 0.9 percent annually. However, over the same period the vacancy rate rose substantially. Year-round housing units include both occupied units (households) and vacant units. Housing construction may reflect an anticipated increase in population, but does not mean that population is actually increasing. By 2007, the total number of households in the county was only 1,895, and the vacancy rate of year-round housing was still high.

In Yellowstone County, year-round housing increased from 42,689 in 1980 to 48,781 in 1990, and average increase of 1.1 percent annually. Like Musselshell County, there was an increase in vacant housing, but the increase was not nearly as great. By 2007, the total number of households in the county was 57,305. Over this period, new housing has not increased as rapidly as the population and the housing and rental markets have become increasingly active.

3.15.5 Local Government Facilities and Services

Public services, which are typically provided by local governments (cities, counties, and special service districts), include police and fire protection, emergency medical services, schools, public housing, parks and recreation facilities, water supply, sewage and solid waste disposal, libraries, and roads and other transportation facilities. There are no public housing facilities, public parks and recreational areas, or public transportation facilities in the project area. Tax revenues generally fund public services, although there may be other sources of revenue such as user or franchise fees. The tax base of the county or community is often a key factor in the level of the public services.

The federal rents and royalties would be determined following the decision to lease the coal. The estimated royalties would be 8 percent of the revenue realized from sale of the federal coal. The estimated amount and distribution of these royalties would be determined at a later date, however, a percentage is returned to state and local agencies.

Property taxes have traditionally been the most important source of funding for Musselshell County, accounting for nearly two-thirds of annual revenues. Property taxes are based on taxable valuation of the county, which has not varied greatly over the last few decades. In Yellowstone County, property taxes are only about half of all revenues.

Taxes in Musselshell County contribute to the maintenance of county roads, such as Fattig Creek Road and Old Divide Road, while U.S. Highway 87 is maintained by the Montana Department of Transportation. Prior to 1988, school funding was entirely the responsibility of the local school district and was limited by the county property taxes, but in 1988 the state legislature shifted the funding of general fund budgets from local districts to state and county equalization.

Law enforcement in the project area is provided by the Montana Highway Patrol, and the Musselshell and Yellowstone County Sheriff's departments. The Highway Patrol concentrates on traffic patrol and traffic-related incidents, primarily along U.S. Highway 87. The sheriff's departments concentrate on criminal activities in their respective counties. The Musselshell County Sheriff's Department is consolidated with Roundup city law enforcement. The joint department is understaffed and their facilities are antiquated and inadequate. The Yellowstone County Sheriff's Department is also understaffed. Currently, all rural fire departments are volunteer organizations. The Musselshell County Rural and Roundup Fire Department has been maintaining an adequate number of volunteers and firefighting equipment for existing demand. The Bull Mountains Volunteers was organized in 1988 to provide initial response fire protection in the project areas. Fire-fighting equipment is limited and the volunteers rely on county support for more serious incidents.

The Musselshell County Ambulance Service in Roundup is a volunteer organization that serves the county. The organization has maintained an adequate volunteer staff, but their equipment is aging. There is a single 17-bed county hospital in Roundup with limited medical facilities and two larger hospitals, both 280-bed facilities, in Billings.

The project area does not currently have public water supplies or wastewater treatment. Residential solid waste collection and disposal in Musselshell County are provided by the Musselshell County Refuse District. Refuse is picked up and hauled to the Roundup transfer station and then hauled by a private contractor to the Billings landfill. Solid and liquid wastes produced at the Bull Mountains Mine No. 1 surface facilities complex are handled by the mine and private contractors. Some of the non-hazardous materials make their way to the Billings landfill, and procedures are in-place at the mine for the handling and disposal of these wastes.

3.15.6 Social Environment

The social characteristics of the project area counties are strongly tied to traditional natural resource-based industries, such as agriculture and extractive industries. Area residents recognize the importance of public lands in providing a natural resource base for economic activities, as well as supporting a particular way of life.

Local values of rural residents in the BLM Billings Resource Area (now Field Office) are described in the Billings Resource Area Final EIS (BLM 1983). Residents value the rural character of the region, specifically wide open rural landscapes, naturalness, fresh air, and solitude. Residents of the Billings area exhibit more diversity of lifestyles and interest, contributing to a wide range of values and attitudes. Residents expressed support for the leasing and development of coal, if the coal is needed and developed in a careful manner with reclamation. Some individuals expressed opposition to coal development because of possible impacts to the environment and the agrarian way of life.

3.16 Environmental Justice

Environmental justice issues are concerned with actions that unequally impact a given segment of society as a result of physical location, perception, design, noise, or other factors. EO 12898 (59 FR 7629) requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low income populations. The provisions apply fully to effects on tribal lands, treaty rights, trust responsibilities, and the health and environment of Native American communities.

Communities within Musselshell and Yellowstone counties, entities within the area, and individuals with ties to the area may all have concerns about the presence of an active coal mine in the Bull Mountains. Environmental justice issues are primarily associated with impacts on the natural and physical environment, and also with social and economic impacts. Environmental justice concerns may include Native American access to cultural and religious sites if the sites are on tribal lands or if treaty rights have granted access to specific locations. The potential issue of access to cultural and religious sites is also addressed in the Cultural Resources Section. The Bull Mountains Mine No. 1 is outside the reservations, does not include any Indian Trust Assets, and does not contain any locations specifically named in tribal treaties.

The Crow Indian Reservation is southeast of Billings in Big Horn and Yellowstone counties about 40 miles south of the coal lease area. The Northern Cheyenne Indian Reservation is east of the Crow Indian Reservation in Big Horn and Rosebud counties. Both Big Horn and Rosebud counties have substantial Native American populations. Over 9,000 Native Americans live on the two reservations and additional individuals with varying levels of affiliation with the tribes live in surrounding areas.

The project area is located in Census Tract 1, Census Block Group 3, Musselshell County, and Census Tract 15, Census Block Group 1, Yellowstone County. In the 2000, census the populations of these block groups were predominantly white - 95.9 percent in both Musselshell County and Yellowstone County (U.S. Census Bureau 2008). Minority households were predominantly American Indian in Musselshell County (2.4 percent). Most of the non-white households in Yellowstone County are listed as more than one race or other (3.4 percent). No Asian or African American households were listed in either block group. Year 2000 income data at the census tract level shows that 12.7 percent of families in Musselshell County, Census Tract 1 and 9.4 percent of families in Yellowstone County, Census Tract 15 were below poverty level. The project area does not contain any communities or areas characterized by minority or low income populations that may be affected by mining activities.

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4.0 ENVIRONMENTAL CONSEQUENCES

This chapter discusses the potential physical, biological, cultural and socioeconomic effects of the alternatives described in **Chapter 2**. This chapter is organized by alternative and then by the affected resource in the same order as they are described in **Chapter 3**. Cumulative impacts are also discussed in this chapter. Under the No Action Alternative, the federal coal lease area would not be approved for leasing. Currently approved mining operations would continue until mining reaches the federal coal lease areas. The Proposed Action would recommend a leasing process and the underground mine would continue its operations in the LOM area in accordance with the approved mine plan. Access to the coal lease areas and the private and state coal reserves to the south and east of the coal lease areas would allow mining to continue for approximately seven additional years.

4.1 Effects from No Action

Under the No Action Alternative, federal coal leasing of the proposed lease area would not occur. Consequently, mining would not occur in these identified lease tracts. The existing surface facilities and underground mine plan (no surface facilities or surface disturbance are proposed for the lease area) would continue until mining reaches the westernmost federal lease area in Section 8. Under the current mine plan, without access through the federal lease tracts, mining in the private and state coal south and east of the federal lease area could not occur. Given the relative locations of the lease tracts, there is no modification to the design of the longwall mining plan that would be economically feasible to mine these private and state reserves. Under the No Action Alternative, the current Life of Mine Plan (**Figure 2.1-1**) would be reduced by approximately seven years. Two areas of potential effects are considered in this analysis, the surface overlying the federal coal lease tracts and the existing mine permit area.

4.1.1 Topography and Physiography

Under the No Action Alternative, coal leasing would not occur and there would be no mining of the coal in the federal lease area. This alternative would have no effect on topography and physiography within the proposed lease area as a result of mining and related subsidence.

The No Action Alternative would continue ongoing permitted effects of the existing mine. This would include minor lowering of topography in the subsided areas within the current permit area.

4.1.2 Geology, Mineral Resources, and Paleontology

Under the No Action Alternative, mining would not occur under the lease area, and there would be no effects on local geology, mineral resources, or paleontological resources of the lease area. Not mining the coal reserves within and south of the federal lease areas under the current mine plan would leave these reserves uneconomical to mine in the future resulting in loss of coal royalties. Early closure of the mine would leave approximately 133 million tons of coal un-mined, including 61.4 million tons of federal coal and 71.6 million tons of private and state coal.

Mining would continue in the current mine permit area until mining operations reach the federal lease area. Effects to geology and paleontology would be similar to the Proposed Action, but would be restricted to the current mine permit area.

4.1.3 Air Quality

Under the No Action Alternative, there would be no emissions produced within the federal coal lease area. Permitted emissions from the operations at the surface facilities complex would continue until mining reaches the federal coal lease area and would then end. Air quality would meet existing permit requirements and all state and federal standards.

4.1.4 Water Resources

Under the No Action Alternative, mining would not occur in the federal lease area, and there would be no subsidence-related effects to water resources in the lease area. Mining would continue in the current mine permit area until mining operations reach the federal lease area. Effects to water resources could result from subsidence over mined areas within the current mine permit area. Existing permitted conditions at the mine surface facilities would continue.

4.1.5 Soils

Under the No Action Alternative, mining would not occur in the federal lease area, and there would be no subsidence-related effects to soils in the lease area. Mining would continue in the mine permit area until mining operations reach the coal lease area. Existing surface facilities would continue to operate. There would be no expansion or substantial modification to the surface facilities that could result in additional effects to soils.

4.1.6 Vegetation

Under the No Action Alternative, mining would not occur in the federal lease area, and there would be no subsidence-related effects to vegetation or wetlands in the lease area. Mining and operation of the existing permitted mine surface facilities would continue until mining operations reach the coal lease area. There would be no expansion or substantial modification to the surface facilities that could result in additional effects to vegetation.

4.1.7 Wildlife

Under the No Action Alternative, mining would not occur in the federal lease area, and there would be no subsidence-related effects to wildlife in these lease areas. Mining would continue in the current mine permit area until mining operations reach the federal coal lease area. There could be negligible localized changes in habitat over mined areas from soil erosion from subsidence. There would be no additional changes to habitat at the surface facilities.

4.1.8 Threatened, Endangered, and Special Status Species

Under the No Action Alternative, mining would not occur in the federal lease area, and there would be no subsidence-related effects to threatened, endangered or special status species in these coal lease areas. Mining and operation of the mine surface facilities would continue in the current mine permit area until mining operations reach the federal coal lease area. During this continued operation, there would be no changes to habitat at the surface facilities and no effects to threatened, endangered or special status species.

4.1.9 Ownership and Use of Land

Under the No Action Alternative, mining would not occur in the federal lease area, and there would be no subsidence-related effects to land use in the lease area. Mining would continue in the mine permit area until mining operations reach the coal lease area. Subsidence over longwall mined areas may result in localized slope instability, rock toppling, and alteration of topography at the interface between mined and un-mined areas on or adjacent to the federal lease area. Slope instability could temporarily constrain land use in specific areas. There would be no long-term effects on ownership and use of land.

4.1.10 Cultural Resources

Under the No Action Alternative, mining would not occur in the federal lease area, and there would be no subsidence-related effects to cultural resources on federal lands.

No Native American concerns have been identified in the portion of the mine permit area that would be mined under the No Action Alternative.

4.1.11 Visual Resources

Under the No Action Alternative, mining would not occur in the federal lease area, and there would be no subsidence-related effects to visual resources in the lease area. Mining and operation of the mine surface facilities would continue in the current mine permit area until mining operations reach the federal coal lease area.

4.1.12 Noise

Under the No Action Alternative, mining would not occur in the federal lease area, and there would be no effects to noise in the lease area. Mining would continue in the mine permit area and permitted operation of the surface facilities would continue until mining operations reach the coal lease area.

4.1.13 Transportation Facilities

Under the No Action Alternative, mining would not occur in the federal lease area, and there would be no effects to transportation facilities in the lease area. Mining would continue at current rates until the private coal reserves are depleted which would reduce the mine life by approximately seven years. This would reduce train traffic of coal shipments and associated workforce vehicle traffic on U.S. Highway 87.

4.1.14 Hazardous and Solid Waste

Under the No Action Alternative, mining would not occur in the federal lease area, and there would be no direct or indirect effects of hazardous and solid wastes in the lease area. Mining would continue in the mine permit area and permitted operation of the surface facilities would continue until mining operations reach the coal lease area. Solid and liquid wastes would continue to be produced at the mine facilities until mining depletes the private coal reserves currently permitted.

4.1.15 Socioeconomics

Under the No Action Alternative, the areas of federal coal would not be leased and currently permitted mining operations would cease when private coal reserves are depleted. If this coal is not leased and subsequently mined, it would not be available for residential and industrial uses and State of Montana revenues would be reduced while the federal coal would not be mined. Furthermore, if the federal coal reserves are not leased there would be no federal rents and royalties. Based on the estimated annual production of up to 10 million tons clean coal that would occur under the Proposed Action, and the 2007 annual average open sales price of $11.79 per short ton of coal produced in Montana (Energy Information Administration 2009), selection of the No Action Alternative could result in the loss of a potential $24 million in annual tax revenues to the state. Consequently, revenue from rents, royalties, and severance and proceeds taxes would not be available to the federal, state, and local government programs and services. In addition, there would be the loss of operating expenditures for supplies and equipment to businesses in the counties. The No Action Alternative would generally have no effect on existing public utilities and services.

The Bull Mountains Mine No. 1 contributes to local employment and the general economy. In 2007, for Musselshell County as a whole, mining-related employment accounted for more than 8 percent of total employment. Once mining operations for the current permitted activities are completed, the current 200 employees would lose employment at the mine, which would increase unemployment levels, and reduce the circulation of payroll dollars through the local economies. There would be losses in revenues from taxes paid by SPE and its employees, and by secondary businesses and their employees, resulting in a decrease in the revenues of the affected counties. Musselshell County government tax-based revenues from mining operations would be negatively affected if the Bull Mountains Mine No. 1 is not producing once current mining activities are depleted. Subsequently, Musselshell County's ability to fund certain utilities and services could be jeopardized. The losses to Yellowstone County would occur primarily from a reduction in taxes paid by SPE employees and the loss of secondary business revenues; however, these losses would be small relative to the size of the Yellowstone County economy. In addition, increased unemployment may increase the use of state unemployment programs and increase the use of county and state social programs.

The projected loss of employment could lead to negative effects on overall stability of communities in the affected counties. Although many current SPE employees could be hired at other mining projects in the region, including ongoing gas development, a substantial number would become unemployed and might leave the area to seek other employment, resulting in a slight reduction in the overall county population. Fluctuations in employment would not provide for a stable community environment.

The federal rents and royalties would be determined following the decision to lease the coal. The estimated royalties would be 8 percent of the revenue realized from sale of the federal coal. The estimated amount and distribution of these royalties would be determined at a later date. The federal royalties would also contribute to the county and community revenue.

The total coal tax burden for coal production in Montana is approximately 14 percent of gross revenues, or approximately 20.2 percent of the contract sales price (Montana Department of Revenue 2009). Based on the estimated annual production of up to 3,419,000 tons clean coal and the 2007 annual average open sales price of $11.79 per short ton of coal produced in Montana (Energy Information Administration 2009), the proposed project could contribute a potential $24 million in annual tax revenues to the state. The actual annual taxes that would be paid would vary according to several factors, including the actual annual production and the open sales price per ton of coal.

4.1.16 Environmental Justice

Under the No Action Alternative, mining would not occur in the federal lease area, and there would be no effects to environmental justice in the lease area.

4.2 Effects from Proposed Action

The Proposed Action includes five lease tracts totaling 2,679.76 acres as described in **Chapter 2**. The Proposed Action would entail leasing the federal coal within the lease area and underground mining of the Mammoth coal seam. The federal coal is included in portions of ten longwall panels that would be mined in the LOM area over a seven year period that also includes the private and state coal reserves south and east of the lease area. These private and state coal reserves would be uneconomical to mine under the current mine plan without accessing the federal coal reserves. The current layout of the Life of Mine Plan has been established within the existing geologic environment to reduce overall environmental impact, protect environmental resources where possible, and promote mine ventilation and safety for mine workers. No longwall mining would occur in areas of less than 200 feet of overburden cover to protect surface resources from potential subsidence damage. The Proposed Action would also include the continued operation of the existing permitted surface facilities during the mining operations. There are no plans for surface facilities or other mine features in the lease area and there would be no direct effects to the surface. Indirect effects would include or result from subsidence over the mined areas. Other than the indirect effects of subsidence in the coal lease area, the primary effects of coal leasing would be to continue mining operations for an additional seven years while the LOM area is mined.

4.2.1 Topography and Physiography

Under the Proposed Action, there would be no surface facilities in the federal coal lease area. Mining would continue under the current mine plan and permit until operations reach the federal lease area. Indirect effects on topography would include subsidence over the mined areas. In general, subsidence would be uniform over broad areas. Effects of subsidence could occur on steep slopes and along rock outcrops where localized slope failure and rock toppling may occur.

Subsidence over the mined panels would alter the overburden and affect the stability of sandstone outcrops and steeper slopes. The effects of subsidence in the overburden from the proposed longwall mining can be grouped into three zones: the fragmented zone, the fractured zone, and the deformation zone (**Figure 2.1-3**). The fragmented zone is a zone of bedrock which would fracture and collapse. This is expected to occur immediately above the active mining area and extend up to 140 feet into the overburden. The fractured zone is a zone of fracturing and deformation of the bedrock that would begin immediately above the fragmented zone and is expected to extend 400 to 600 feet above the fragmented zone. The deformation zone extends from the fractured zone upward to the surface. The deformation zone would deform without fracturing.

The surface effects of subsidence depend on characteristics of the overburden as well as depth of mining below the surface, height of the coal seam removed, mine layout, and mine direction. It is expected that in areas where the seam height is 8.5 feet, predicted subsidence would be a maximum of 5.95 feet and where the seam height is 13 feet, maximum subsidence would be 9.1 feet. The trough of subsidence would be deepest in the center of the panels, graduating to little or no subsidence at the boundary of coal removal. Along a particular subsidence trough, slope failure and toppling of sandstone rocks that outcrop may occur. Slope instability and failure, rock toppling, and alteration to topography and drainage patterns are most likely to occur where steep slopes, weathered materials, and unstable structural conditions exist. **Figure 4.1-1** shows the areas of steep slopes in the lease area where these effects would be likely to occur. The figure depicts contours of areas where slopes are 25 percent and 50 percent grade. These are areas of continuous steep slopes such as cliffs and bluff edges. Localized rugged terrain and small bedrock outcrops may not show up at this scale. The overall effects from mining-related subsidence would be minor over the short term (one to six months after mining) and negligible over the long term. However, there may be local variations in the effects. In most cases, subsidence-related failures would be an acceleration of the slower natural processes of weathering, erosion, sloughing and toppling.

A monitoring program was implemented at the Bull Mountains Mine No.1 to collect subsidence data. The data is used to verify the accuracy of the predicted subsidence under actual ground conditions and to detect mining-induced effects to surface resources both predicted and unpredicted. In addition, site specific angle of draw, subsidence factor, and tensile strains may be calculated. These results are used to refine the predictive model, which then can be used to estimate the effects of mining in successive longwall panels during the remainder of the mine life.

During mining, waste from coal processing would continue to be deposited in the WDA. This would fill the upper reaches (head-of-hollow) of an ephemeral drainage of Rehder Creek. The resulting topography in this local area would be smoother than the existing topography. The overall nature of the topography and physiography of the area would not change.

4.2.1.1 Mitigation Measures

Effects to topography and physiography include ground disturbance from facility construction and operation, coal and soil stockpiles, the WDA, and subsidence over mined areas. All proposed and anticipated ground disturbance from facility construction and operation, management of coal and soil stockpiles, and management of the WDA has been permitted. The potential effects of waste management at the WDA are discussed below under Hazardous and Solid Waste. Potential ground disturbance from subsidence over mined areas is anticipated, but the exact nature and extent of the disturbance is unknown. The surface over the longwall panel is being monitored as the mine progresses. The information from this monitoring is being used to identify actual subsidence effects and to refine the subsidence model for the real-world conditions of the mine area. The effects of subsidence to topography and physiography may also be associated with effects to other resources such as water, wetlands, soils, vegetation, ownership and use of land, and cultural resources. The mine permit includes a subsidence monitoring plan (SPE 2009 Volume 11 Appendix 901-2) as described below.

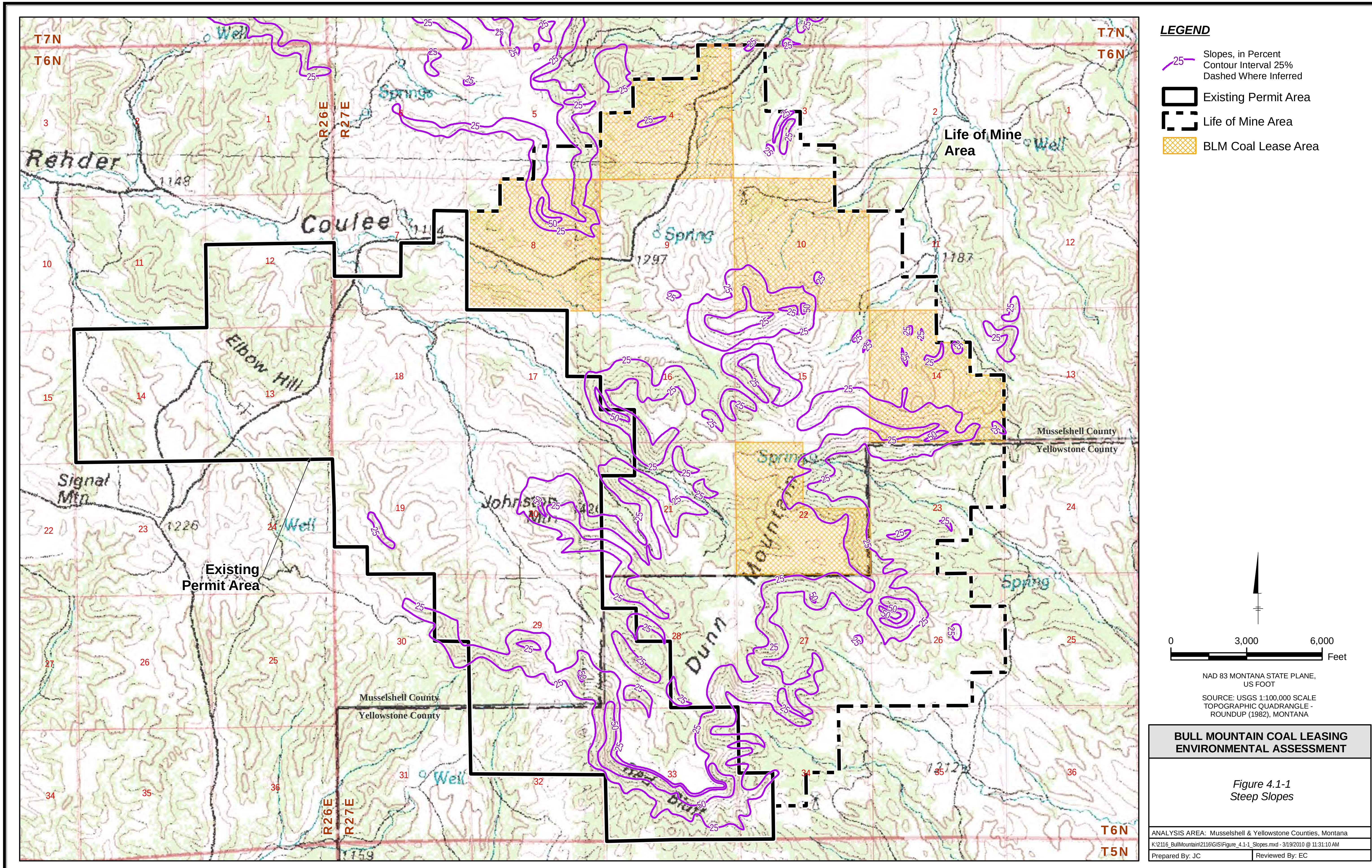

Figure 4.1-1
Steep Slopes

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The subsidence monitoring layout would be arranged in terms of 1000-foot monument spacing along the longitudinal axis of the longwall panels. The monument installations for traverse measurement of the longwall subsidence would be located at the beginning of the panel. This would produce subsidence parameters from the start of longwall operations. Monument spacing would be 50 feet at locations within 250 feet on either side of the panel edge. A second subsidence monitoring traverse would be included at a location with deeper cover and steep slopes. The second traverse monument spacing would be increased to 100 feet since these measurements would be a duplication of the first monument survey traverse. Survey control would be located well outside the area of projected subsidence and these controls would be tied to a known control point (USGS benchmark, section corner, etc.) at the northwest end of the panels and at the southeast end of the panels.

Subsidence in longwall panels is surveyed and results submitted to MDEQ. Pending sufficient subsidence parameters to predict subsidence of subsequent longwall mining, no further monitoring would be required, except for special features or as required by MDEQ. Special features include structures, roads, springs, private wells, drainages and steep slopes, as identified by pre-mine surveys.

Subsidence monitoring would be tied to longwall mining operations. A baseline survey would be conducted three months prior to longwall mining of each panel. This survey would include all monuments and the initial longwall face position. Upon commencement of longwall mining, subsidence survey measurements would be made according to longwall mining advancement. Survey measurements would be made every 1000 feet of longwall advance or once a month, whichever interval is shorter. Full subsidence is expected to be delayed, therefore, monitoring of panels would continue until full subsidence is determined (this may be carried out for as long as 24 months after the mining). Each subsidence survey would include the location of the longwall face and would be tied to known control points.

4.2.2 Geology, Mineral Resources, and Paleontology

The Proposed Action would result in removal of all of the mineable portions of the Mammoth coal seam from the federal lease area by underground longwall mining techniques. SPE anticipates mining about 12 million tons of raw coal per year with operations of four crews working seven days per week.

Indirect effects to the geology, mineral resources, or paleontological resources of the leased area would include subsidence over the mined areas. In general, subsidence would be uniform over broad areas. Strata would subside as a block and retain their internal structure. Except for the removal of the coal bed, the overall nature of the geology, mineral resources, and paleontological resources of the area would not change.

Surface activities and mining operations are unlikely to disrupt important vertebrate or invertebrate fossils, except in the coal seam that would be removed by longwall mining. Collapse features associated with underground mining have the potential to disrupt stratigraphic continuity and data associated with paleontological resources at the surface. However, the low potential for disturbance of resources in conjunction with the limited surface-disrupting activities would minimize the potential impact to paleontological resources that might be in the area of the federal coal.

4.2.2.1 Mitigation Measures

SPE would implement a monitoring program at the Bull Mountains Mine No. 1 to collect subsidence data (see Topography and Physiography). Strata and mineral resources would subside as a unit, and the integrity of geology, mineral resource, and paleontology would not be affected. There may be localized areas of cracking, sloughing of some steep slopes and rock toppling. Indirect damage from slope failure and rock toppling would be repaired by stabilizing areas of failure. This would be conducted on a case by case basis as mechanical treatment of strata may be more damaging than non-treatment.

4.2.3 Air Quality

Under the Proposed Action, potential effects to air quality would continue at the surface facilities, but would not occur in the federal lease area. Acquisition of the federal coal lease would enable mining operations to continue through these portions of the Mammoth coal seam. The observed negligible effects associated with permitted sources would continue for an additional seven years. These effects are expected to be local and would not contribute to the Billings and Laurel nonattainment areas. No changes in mining methods are proposed. Operations at the surface facility complex would be ongoing during the mining operations. The surface facilities complex is currently operating under a valid Montana Air Quality Permit (MAQP No. 3179-04). Mining of the leased coal would contribute to the generation of fugitive dust at the surface facility complex from coal handling, unit train loading, wind erosion of coal and other material stockpiles, and vehicle traffic on unpaved roads and surfaces. The relative location, numbers, and types of most emission sources would not change from current permitted operations.

Other pollutants at the surface facility complex would include exhaust from trucks, maintenance equipment, other motor vehicles, trains, and ventilation emissions from the mine and coal preparation facility. Pollutants from these sources would include carbon monoxide (CO), nitrogen oxides (NO_x), sulfur dioxide (SO_2), particulates, and trace amounts of methane from mine ventilation. These emissions would be within existing levels as allowed under the MAQP and would continue as coal is mined in the LOM area. The 2009 BACT (MAQP #3179-01) concluded that the emissions of the surface facilities would be negligible and that proper operation and maintenance of onsite sources would be adequate to achieve appropriate standards. Some of these pollutants, including methane and nitrous oxides are GHGs that may contribute to climate change. The combined emissions of GHGs from vehicles, equipment, mine ventilation, and coal preparation expressed as CO_2-equivalent would be approximately 2,100 tons (1,905 metric tons) annually. This is well below direct emissions of 25,000 metric tons or more of CO_2-equivalent GHG emissions annually that the CEQ (2010) suggests as a reference point that may be meaningful for quantitative and qualitative assessment of GHG emissions.

4.2.3.1 Mitigation Measures

All mitigation measures included in the existing air quality permit (**Table 3.3-1**) will apply to ongoing operations of the mine. In general, fugitive emissions of particulates from open sources are controlled by preventive or mitigating measures and techniques. Sources of fugitive particulates can be classified in the following four activity classes: wind erosion; coal handling and transfer; reject and waste material handling, transfer, and disposal; and travel on unpaved roads.

Wind erosion affects both storage piles and outdoor material handling and disposal activities. Preventive techniques reduce emissions by reducing the extent of the source, by modifying the process, or by adjusting work practices. Reduction of emissions of fugitive dust or particulate matter from wind erosion and material handling can be accomplished by enclosure, chemical stabilization, or material wetting.

Material handling is broken down into two categories: coal product and reject of waste materials. Coal handling activities include drops to and from conveyors and stockpiles, movement of piles by bulldozer or front-end loader, and movement of material for transport by truck, conveyor or rail. Reject or waste material handling activities include conveyor transfer, bin loading, truck loading and unloading, and material spreading. SPE will minimize the fall distance associated with all material handling activities to the extent feasible. SPE has also developed, implemented, and will maintain good housekeeping practices to keep coal and waste material transfer locations clean.

For particulates generated during coal handling operations onto stockpiles, MDEQ determined that the use of fixed stackers with an underground reclaim system constitutes BACT. In addition, MDEQ determined that the use of enclosures for surface conveyors and incorporating flexible chutes and enclosures at all transfer points for the transport of coal and reject of waste material would constitute BACT. Further, based on similar source determinations, MDEQ determined that the use of fabric filter baghouse pickup points at all surface conveyor material transfer points would constitute BACT. Further, SPE will utilize water or chemical dust suppressant for the purpose of controlling emissions from the movement of materials by bulldozers or front-end loaders. SPE will use watering or chemical dust suppressants, contouring techniques, and soil covering and re-vegetation for controlling particulate emissions from WDA operations.

SPE will take reasonable precautions to limit the fugitive emissions of airborne particulate matter on haul roads, access roads, parking areas, and general plant property. SPE will clean up all spilled material from roadways to further limit potential fugitive emissions. MDEQ determined that the use of water spray or chemical dust suppressant to maintain compliance with the opacity and reasonable precaution limitations would constitute BACT for these sources.

In summary, MDEQ (2009) determined that good housekeeping practices, minimization of fall distance for material transfer operations, the application of moisture throughout the mining process, using stackers with a reclaim system, enclosures for all surface conveyors and conveyor transfer points incorporating fabric filter baghouses or pick-up points, and water spray or chemical dust suppressant to maintain compliance with permitted opacity requirements and reasonable precaution limitations constitutes BACT for these sources.

4.2.3.2 Climate Change

If the federal coal is leased and mined, minor amounts of GHGs would be released to the atmosphere for an additional 7 years. GHG emissions are a concern due to the greenhouse effect. The greenhouse effect is defined as how certain gases in the atmosphere impede the radiation of heat from the earth back into space, trapping heat like the glass in a greenhouse. These gases include carbon dioxide, methane, water vapor, ozone, and nitrous oxide. GHGs are not currently regulated, but there is a consensus in the international community that global climate change is occurring and that it should be addressed in governmental decision making, including policies affected by GHG emissions.

As presented in the GHG Emissions section of Chapter 3, the Bull Mountains Mine No. 1 generated approximately 100 tons of CO_2 from gasoline consumption and 2000 tons CO_2 from diesel fuel consumption in 2008. Current measurements of methane from the mine are at or below detection limits; however, minor amounts of methane may be emitted as the mine progresses.

Although the mine emissions are quantifiable, it is not possible to accurately assess the effects of a given amount of CO_2 emissions, resulting from one activity, on global warming and climate change (CEQ 2010). Given the estimated CO_2 emissions from anthropogenic sources in the United States in 2007, 7,282.4 million metric tons CO_2 equivalent (EPA 2008), it is reasonable to assume that the impact of CO_2-equivalent emissions from annual operation of the Bull Mountains Mine No. 1 on global warming would be negligible.

Black carbon would also be emitted from sources at the mine during the mining of the federal coal. As explained in Chapter 3, it would be possible to control some black carbon at the mine from diesel sources. However, given that the US emits 6.1 percent of the globally-emitted black carbon, it is reasonable to assume that the contribution of black carbon from the continuation of sources related to mining of the federal coal would have a negligible impact on local or regional air quality.

The use of the coal after it is mined is also not determined or analyzed at the time of leasing. However, almost all of the coal that would be mined at the Bull Mountains Mine No. 1 would most likely be used by coal-fired power plants to generate electricity. In recognition of this most likely use, a discussion of emissions and by-products that are generated by transporting and burning coal to produce electricity is included in this assessment. However, these emissions would be the same whether or not the coal burned is from this mine. Additional discussion of the current status of global climate change considerations is included in the Cumulative Impacts section of this chapter.

As discussed in **Chapter 2**, under the No Action Alternative, the completion of the currently approved mine plan would mine the remaining portions of the estimated 34 million tons of recoverable coal reserves in approximately three years at an average annual production rate of up to 12 million tons. Under the Proposed Action, SPE estimates that the life of the mine would be extended by about 7 additional years at an average annual coal production rate of up to 12 million tons.

The mining, processing, and shipping of coal from the Bull Mountains Mine No. 1 would contribute directly to GHG emissions through carbon fuels used in mining and processing including fuel consumed by heavy equipment and stationary machinery, electricity used on site, methane released from mined coal, and rail transport of the coal.

4.2.4 Water Resources

4.2.4.1 Groundwater

Subsidence associated with the proposed underground mining activities is anticipated. A consequence of the subsidence may produce changes to the hydrologic system including:

- Changes in groundwater quality and quantity due to subsidence, mine dewatering, and geochemical processes, and
- Changes in surface water quality and quantity.

To assess potential changes to the overburden, coal, and underburden hydrogeologic units resulting from the proposed mine, factors that were considered include:

- The effects of mining and subsidence on aquifer characteristics, groundwater flow, recharge capacity, springs and the alluvium;
- The cones of depression in the overburden, coal, and underburden caused by groundwater flow into the mine and mine dewatering, and potential changes to groundwater quality caused by chemical processes.

4.2.4.1.1 Hydrologic Model Analysis

The hydrologic impacts were analyzed using a computer code called MODFLOW-SURFACT, a commercially available, industry standard software package capable of modeling complex hydrologic conditions such as those in the project area (Hydrogeologic, Inc. 1996). The program has been subjected to numerous verification and testing exercises and found to perform adequately (EPA 1999).

The procedure for analyzing the hydrologic impacts using groundwater modeling software such as MODFLOW starts with developing the Conceptual Site Model (CSM). The CSM represents the hydrologic and geologic conditions of the project area. The numerical model is constructed to simulate the CSM and then calibrated against observed site conditions. With the CSM and numerical model completed, scenarios representing mining conditions can be modeled, and resulting impacts to groundwater can be determined. Development of this model is only a tool to help us assess what actual impacts could be. The resulting values are not absolute and actual effects may vary from those predicted.

4.2.4.1.2 Developing the Conceptual Site Model Mine Inflow

The project area physiographic setting consists of a circular mesa approximately 10 miles in diameter. The surface terrain is highly variable, ranging from 3,800 to 4,700 feet above mean sea level (amsl). The various strata outcrop along the surface and steep sides of the mesas. Several alternating intervals of sandstone and coal overlie the Mammoth coal, however, for the sake of modeling the Mammoth coal seam, the overlying intervals behave in a homogenous fashion and transmit water at a given rate (regardless of which layer is controlling, the rate to the seam is the same). Therefore, the individual units comprising the overlying material were not considered for this analysis, but have been grouped, and modeled as a single overburden unit.

Three lithologic units have been defined as the upper underburden, Mammoth coal, and overburden. **Table 4.2.4-1** summarizes the hydrogeologic properties of these units. Observed water levels from well monitoring data were used to calibrate the model.

Table 4.2.4-1 Project Area Hydrogeologic Unit Properties

Aquifer parameters	Symbol/Unit	Upper Underburden	Mammoth Coal	Overburden
Conditions		Confined	Semi-confined	Unconfined
Hydraulic Conductivity	K (ft/day)	0.013[1]	0.16[2]	0.018[3]
Saturated Thickness	b (ft)	30[4]	10[5]	Varies[6]
Storage Coefficient	S (unitless)	0.02[7]	0.0004[7]	0.0005[7]

Data Sources from Permit Document (SPE 2009):
1 Table 304(5)-5-4 Aquifer Test Results – Underburden, geometric mean.
2 Table 304(5)-5-3 Aquifer Test Results – Mammoth Coal, geometric mean.
3 Table 304(5)-5-2 Aquifer Test Results – Overburden, geometric mean.
4 Based on upper underburden defined herein.
5 Average thickness of Mammoth coal within study area MAP 322-1.
6 MAP 304(6)-7 – Overburden Potentiometric Surface.
7 Table 304(5)-5-5, arithmetic mean.

In addition to the above parameters, the CSM and numerical model also incorporate:

- The geometry of the Mammoth coal,
- The geometry of the overburden,
- The potentiometric surface of the Mammoth coal
- The potentiometric surface of the overburden, and
- The potentiometric surface of the upper underburden.

The overburden is defined as representing all the zones of material above the Mammoth coal varying from 0 to 800 feet thick within the project area. It is composed of interbedded sandstones, siltstones, shale, claystones, and coals. Although its material composition is variable, for this analysis it is simplified and expressed as an unconfined saturated unit with the properties listed in **Table 4.2.4.1**. Vectorized USGS 7.5-minute quadrangles based on 10-foot contour intervals were input into the model to represent the geometry of the overburden.

The Mammoth coal is defined as the zone of material varying from 8 to 11 feet thick within the project area. It is composed completely of coal exhibiting the hydrogeologic properties identified in **Table 4.2.4-1**. For this analysis, it is expressed as a semi-confined aquifer. Boundary conditions were established where the Mammoth coal outcrops. Although the Mammoth coal does vary in thickness throughout the project area, for this analysis, it was assumed to have a uniform thickness of 10 feet.

The upper underburden is herein defined as the zone extending 30 feet below the base of the Mammoth coal. It is composed of interbedded shale, siltstones, and sandstones. The potentiometric surface for this zone is, on average, 60 feet above the base of the Mammoth coal. The permeability of this zone is extremely low, with a geometric mean hydraulic conductivity of

0.013 feet per day. Beneath the upper underburden, a fourth layer called the lower underburden has been included to represent the base of the mesa and enables groundwater to drain out of the system. The hydraulic properties of the lower underburden are similar to those of the overburden.

In order to develop the numerical model, the following assumptions to the CSM and hydrogeologic parameters were utilized:

- Where a unit would outcrop, a no-flow boundary and a drain would be set to the surface elevation and this would define the groundwater elevation;
- A general head boundary was used to fix the groundwater elevation on the east side of the model where the Mammoth coal outcrops;
- An additional drain was placed along the west side of the model domain within the lower underburden to represent seepage from the mesa to the wash;
- The amount of recharge infiltrating through the overburden was determined by lowering the effective rainfall until the water table in the Mammoth coal matched that which was observed;
- The remaining rainfall is assumed to represent aquifer recharge in the overlying units; and
- A steady-state simulation was used to calibrate the model to groundwater contours. Various parameters included the elevation and conductance of the drains and the effective recharge as described above.

<u>Mine Inflow</u>

The Mammoth coal seam is the targeted zone for mining operations. Under pre-mining conditions, it is one of many pancaked saturated zones that form the Bull Mountains groundwater system. As the coal is removed and underground cavities open up, water seeps into the mine from the roof, floor, and walls. The amount of water seepage increases dramatically as subsidence occurs and the hydrologic conductivity between the mine workings and adjacent saturated zones increases. This infiltration, and subsequent dewatering of the surrounding area, was modeled under transient conditions using MODFLOW-SURFACT. The dewatering was simulated by installing a drain at the bottom of the 10-foot-thick coal layer. To simulate the rubblized nature of the workings, the rubble was assumed to have a high hydrologic conductivity (K=1,000 ft/day) and porosity (75%). The most sensitive parameter in calibrating the drain functionality is the transmittance of the drain. A value of 50 times the horizontal transmissivity for this interval was assumed. Mine inflow was determined by calculating the amount of water that would have to be removed to keep the mine workings dry.

<u>Aquifer Drawdown</u>

Water removed from or allowed to pool in the mine workings originates from adjacent saturated zones. As a result, adjacent aquifers would exhibit reduced volumes of water. This effect is called aquifer dewatering or drawdown. The drawdown is calculated by subtracting the simulated groundwater elevation from the calculated elevation during the calibration phase. The extent of the 1-foot drawdown after 5 and 25 years of mine pooling was then plotted with respect to mine layout. The extent of the drawdown is a balance between the rate of groundwater inflow and the rate of its removal by the mine dewatering system. In this case, the inflow rate is extremely low due to the low hydraulic conductivity of the overburden and Mammoth coal material (0.018 and 0.147 ft/day respectively), resulting in an exceedingly sharp hydraulic boundary.

Mine Pooling

The subsided areas of fragmented roof will function as a highly connected reservoir. The mine pool reservoir will have a high storage, and its transmissivity and yield will increase as the reservoir fills. The mine pool reservoir will be filled by temporary drainage of roof sandstone aquifers above recently subsided longwall panels, by lateral inflow from the coal and overburden, by vertical flow from below, and by vertical recharge from above, which continuously re-saturates the partially-drained roof. As the mine pool rises, lateral inflow and vertical flow from below diminish and eventually become a net outflow. A steady state is reached when the inflow from vertical recharge is approximately the same as the net lateral and vertical outflow from the mine pool reservoir.

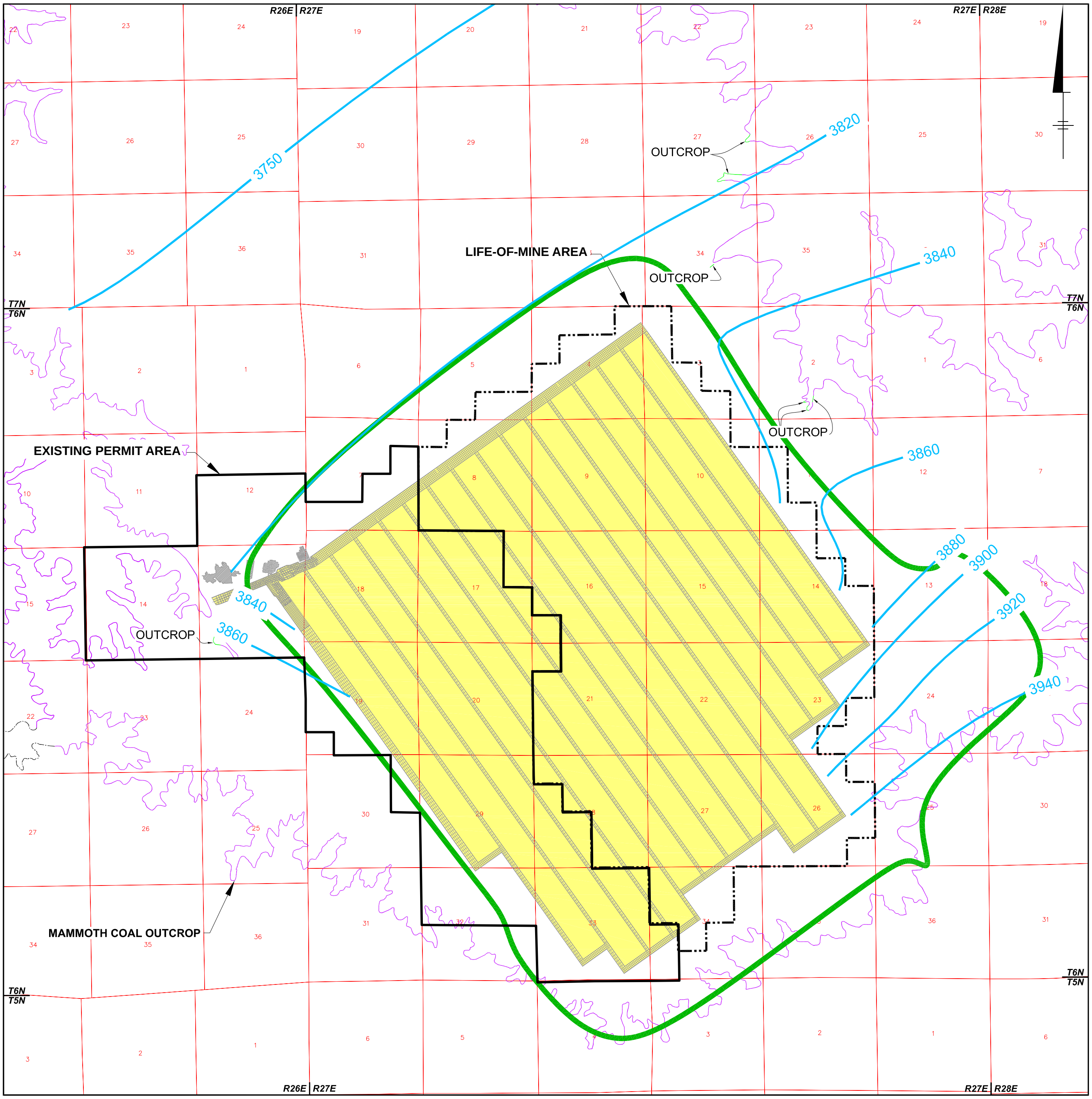
The rate and extent of the mine pool filling depends on four major factors:

1. The rate of vertical recharge (inflow) into the mine,
2. The extent of prior drainage of the fragmented roof zone,
3. The rate of seepage into and out of the mine by lateral flow through the peripheral un-mined coal and overburden, and
4. The rate of seepage into and out of the mine by vertical flow through the floor of the mine.

Model Results

The short-term hydrologic effects on the Mammoth coal aquifer are shown in **Figure 4.2-1**, which indicates the aquifer condition after mining and dewatering of the entire mine area. It represents the conditions immediately following cessation of mining while dewatering continues. The affected environment is defined as the 1-foot drawdown contour (**Figure 4.2-1**), and is interpreted to extend only about 0.5 to 0.75 miles downgradient, but extending to the intersection of the coal seam with the surface in the cross and upgradient direction.

The long-term effects are shown on **Figure 4.2-2** for aquifer drawdown 5 years after dewatering ceases and **Figure 4.2-3** for aquifer drawdown 25 years after dewatering ceases. Equilibrium in the groundwater system of the project area would not be reached within 25 years after mining operations have ceased due to the low rate of effective recharge (~9,000 ft^3/day) compared with the total amount of water being transferred from storage to replace that removed during the mine operating period (2,400,000 ft^3) at the end of the 25-year period. Should subsidence occur, the porosity of the rubble would decrease, therefore decreasing the recovery period. However, the calculations performed here do not account for any subsidence.



LEGEND

- EXISTING PERMIT BOUNDARY
- LIFE-OF-MINE BOUNDARY
- MAMMOTH COAL OUTCROP
- PROJECTED OUTCROP
- OUTCROP
- MINE AREA
- 3900 APPROXIMATE ELEVATION OF THE POTENTIOMETRIC SURFACE IN THE MAMMOTH COAL
- 1-FOOT DRAWDOWN CONTOUR (AREA OF INFLUENCE)

0 3,500 7,000 Feet

NAD 83 MONTANA STATE PLANE, METER

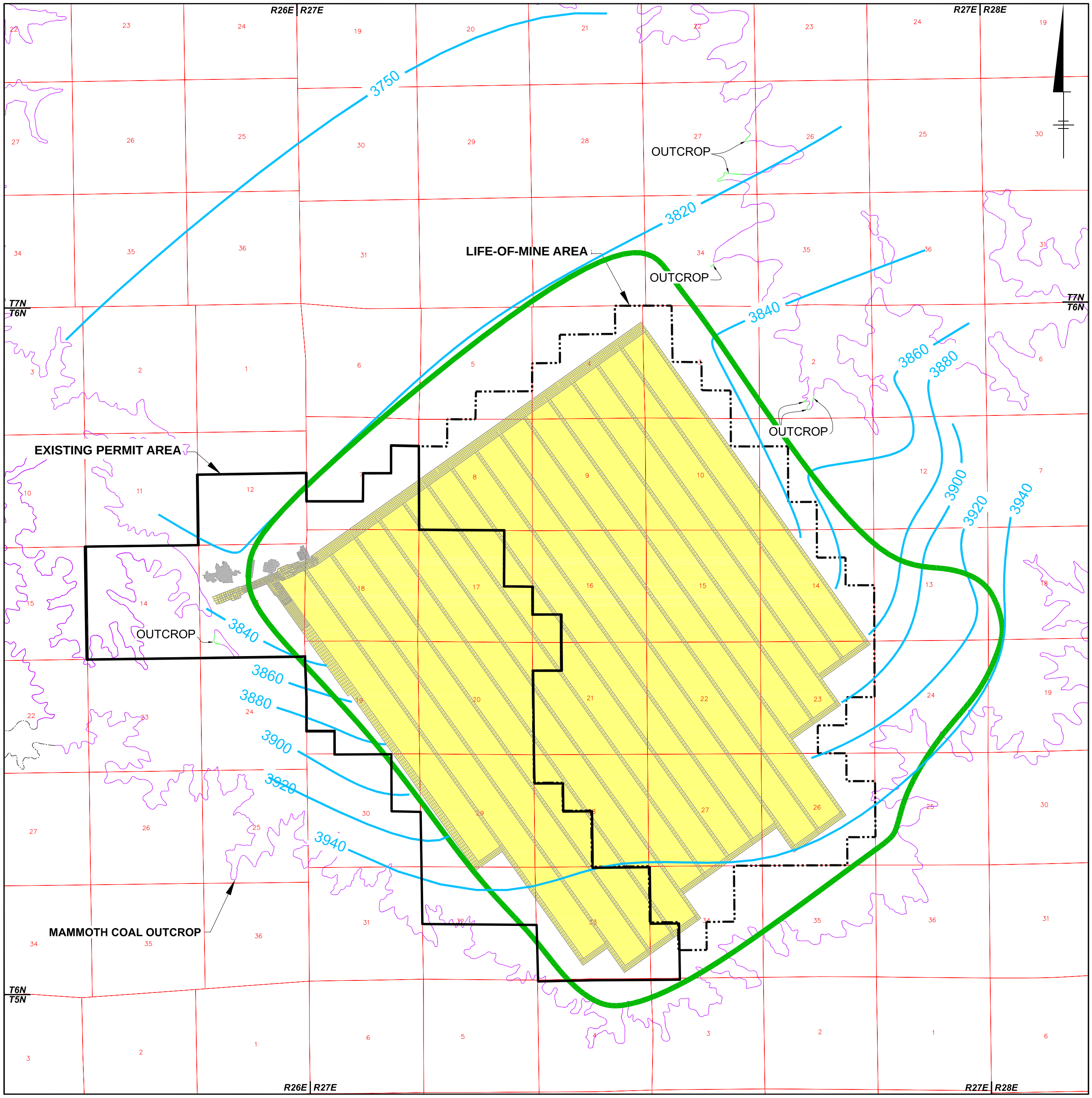
BULL MOUNTAIN COAL LEASING ENVIRONMENTAL ASSESSMENT

Figure 4.2-1
Area of Influence in Mammoth Coal Mining Complete Dewatering Continues

ANALYSIS AREA: Musselshell & Yellowstone Counties, Montana

K:\2116_BullMountain\2116\Images\Illustrator\Figure 4.2-1.AI @ 07/17/2009

Prepared By: JC | Reviewed By: EC



LEGEND

- EXISTING PERMIT BOUNDARY
- LIFE-OF-MINE BOUNDARY
- MAMMOTH COAL OUTCROP
- PROJECTED OUTCROP
- OUTCROP
- MINE AREA
- 3900 APPROXIMATE ELEVATION OF THE POTENTIOMETRIC SURFACE IN THE MAMMOTH COAL
- 1-FOOT DRAWDOWN CONTOUR (AREA OF INFLUENCE)

0 3,500 7,000 Feet

NAD 83 MONTANA STATE PLANE, METER

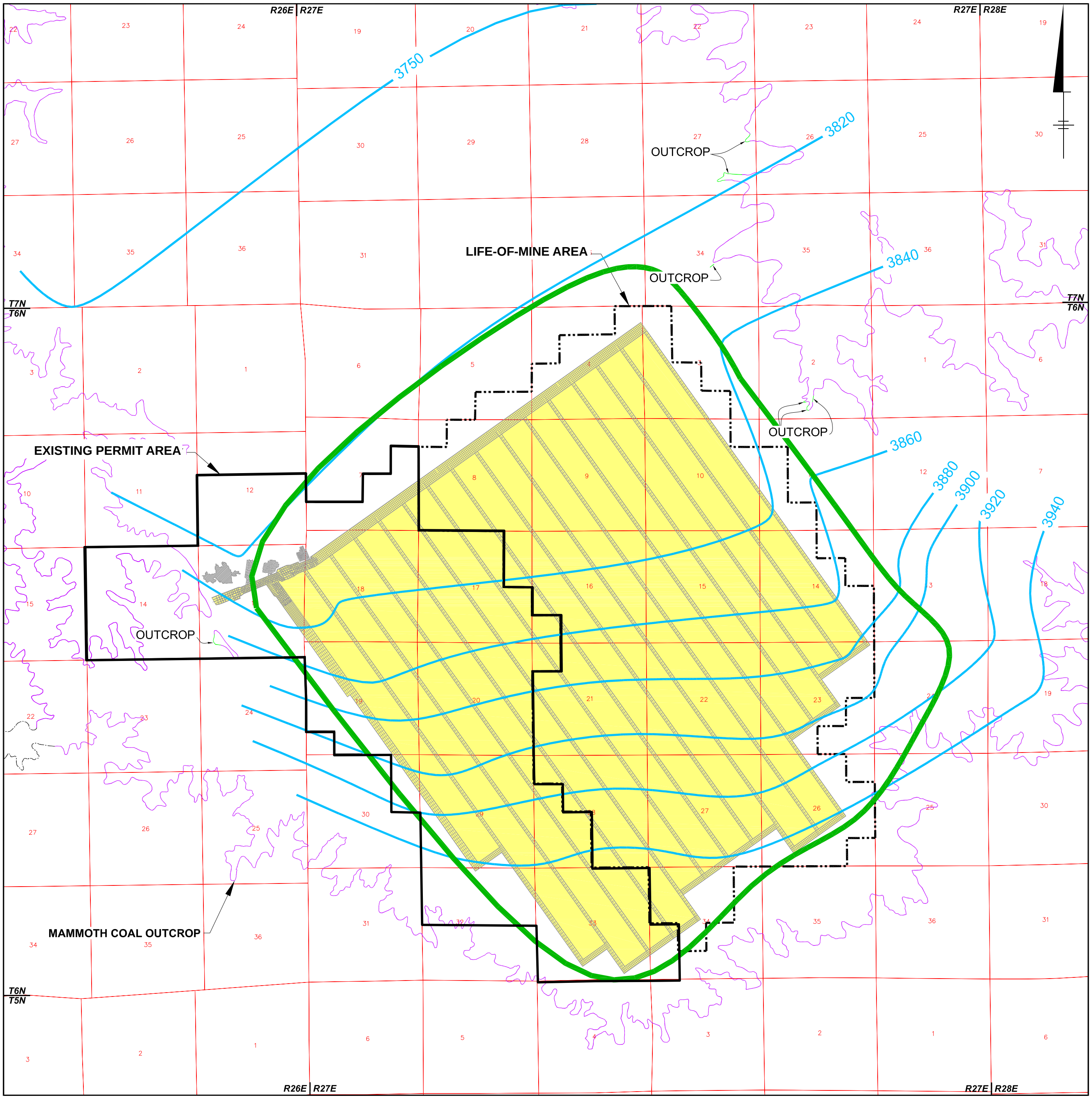
BULL MOUNTAIN COAL LEASING ENVIRONMENTAL ASSESSMENT

Figure 4.2-2
Area of Influence in Mammoth Coal Mining Complete 5-Years after Dewatering Cases

ANALYSIS AREA: Musselshell & Yellowstone Counties, Montana

K:\2116_BullMountain\2116\Images\Illustrator\Figure 4.2-2.AI @ 07/17/2009

Prepared By: JC | Reviewed By: EC



LEGEND

- EXISTING PERMIT BOUNDARY
- LIFE-OF-MINE BOUNDARY
- MAMMOTH COAL OUTCROP
- PROJECTED OUTCROP
- OUTCROP
- MINE AREA
- 3900 — APPROXIMATE ELEVATION OF THE POTENTIOMETRIC SURFACE IN THE MAMMOTH COAL
- 1-FOOT DRAWDOWN CONTOUR (AREA OF INFLUENCE)

0 3,500 7,000 Feet

NAD 83 MONTANA STATE PLANE, METER

BULL MOUNTAIN COAL LEASING ENVIRONMENTAL ASSESSMENT

Figure 4.2-3
Area of Influence in Mammoth Coal Mining Complete 25-Years after Dewatering Cases

ANALYSIS AREA: Musselshell & Yellowstone Counties, Montana

K:\2116_BullMountain\2116\Images\Illustrator\Figure 4.2-3.AI @ 07/17/2009

Prepared By: JC | Reviewed By: EC

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Mine inflow was calculated to be approximately 2.4 acre-feet/acre/year for mined-out areas averaged over the lifetime of the project. In practice, the mining operations would be phased with approximately one panel added each year. The modeling described herein assumes that the entire mine was excavated in year one and the groundwater inflow then continued for the life of the mine. Thus, the estimate of 2.4 acre-feet/acre/year represents the maximum inflow of water expected. This water would accumulate as a mine pool in the mined-out area until the steady state pool is reached. This pool would fill the lower portion of the mined-out area and may extend 3 to 5 feet into the fractured overburden. Of this water, 50 percent originates from the upper underburden, 21 percent from the Mammoth coal, and 29 percent from the overburden.

For the recovery phase, 5 years after dewatering has ceased, 65 percent originates from the upper underburden, 2 percent from the Mammoth coal, and 33 percent from the overburden. Twenty-five years after dewatering has ceases, 95 percent originates from the upper underburden, 2.5 percent originates from the Mammoth coal, and 2.5 percent originates from the overburden.

Model Summary

A fully 3-dimensional groundwater flow model has been developed using MODFLOW-SURFACT to simulate the environmental effects of mining on the local and regional groundwater conditions. The groundwater elevations within the target zone, Mammoth coal, are seen to be determined by the topography and effective recharge.

The results of this analysis indicate that the hydrologic impacts of the mining operations would be limited to the immediate vicinity of the mine workings or the area defined by the boundary of the coal and the ground surface (outcrop) (**Figures 4.2-1** through **4.2-3**). The calculated groundwater extraction rate at the full extent of mining is approximately 2.4 acre-feet/acre/year and represents the maximum inflow of water expected. As of March 2006, the amount of water seepage into the extent of the underground mine workings, approximately 80 acres or 3 percent of the permitted mine plan, is small enough that it requires limited dewatering.

Due to the low hydraulic conductivity of the strata directly below the coal (two to three orders of magnitude less than that of the shallow fractured and weathered bedrock), it is unlikely that the lowering of the potentiometric surface in the underburden (caused by mining) would increase the downward flow from the shallow fractured and weathered bedrock. In groundwater flow systems in which there are contrasts of two orders of magnitude in hydraulic conductivity among adjoining media, flow lines in the unit with the higher hydraulic conductivity tend to parallel the contact (Freeze and Cherry 1979). Groundwater would, therefore, continue to flow in the upper system with only a relatively small loss to the underburden unit. These conditions are expected to be the same after mining in all areas.

Model sensitivity is usually judged by varying the input parameters. However, based on previous modeling and field measurements, it was determined that hydraulic conductivity, porosity, and storage were well characterized. The effect of the storage coefficient was evaluated over two orders of magnitude and shown to have only a small effect. Due to the high contrast in hydraulic conductivity among the zones, the parameters exhibiting the most sensitivity are recharge and the conductance of the drains used to simulate seeps and streams.

4.2.4.2 Hydrologic Impact Due to Subsidence

4.2.4.2.1 The Subsidence Process

The effects of subsidence on the mined area have been predicted in studies conducted by Agapito and Maleki (1989 and 1990). The studies concluded that three different zones of deformation would develop above the mined area as a result of subsidence:

Zone 1: Fragmented Zone - includes the immediate roof and may extend upward to a height approximately equal to 2 to 10 times the mining height. The strata in this zone would fracture and collapse into the mined out area.

Zone 2: Fractured Zone - may extend upward to a height approximately equal to 30 to 50 times the mining height. The strata deform and fracture, but maintain their continuity. Bedding plane separation can occur.

Zone 3: Deformation Zone - extends upward from the top of the fractured zone to the surface. The strata deform without significant fracturing, forming compression zones at the surface near the center of the panel and tension zones at the edges of the panel. Bedding plane separation can occur.

The subsidence front follows a wave form, rather than an abrupt front, so that strata bend rather than shear. Curvature of the subsidence wave is broad, with changes in surface slope of about five degrees, so that deformation is laterally distributed. Further, the inflection plane of the subsidence wave is off vertical by approximately 22 degrees (the angle of draw), and therefore would not coincide with a single vertical joint plane throughout the sandstones. These factors limit the shear strain on individual joints. Some horizontal shear may occur between beds during the passage of the subsidence wave, and thin lenses of disturbed rock with higher permeability may develop, particularly in basal sandstones. High-angle joints would experience initial tension and subsequent compression.

In Zone 1, bulking of the fractured rocks and the caved gob account for the proportion of the mined height that does not transfer to the surface as subsidence. This has been estimated to be about 30 percent of the mining height.

Above Zone 1 (the fragmented zone), shale is expected to buffer fracturing. Shale comprises approximately 25 to 40 percent of the overburden, which favors the distribution of subsidence strain and minimizing vertical hydraulic connection that may fracture, but shale greater than ten feet in thickness may deform without fracturing, accommodating strain on small oblique shears. Shear in shale that do intercept water, particularly below saturated sandstones, should tend to soften and close under overburden loads rather than conduct flow.

The presence of several massive, thick sandstones should concentrate overburden loads on pillars left in the gates at panel margins, and cause the pillars to crush and enhance uniform lowering of strata, particularly at greater overburden thicknesses.

At the surface, over mined areas, tension occurs as subsidence begins, and is followed by compression as the overburden settles. Cracks can open during the tension phase, but most close during the compression phase (usually within two years). The trough mode of the subsidence laterally constrains the deforming strata above Zone 1, and limits the tensional cracking. Above the ultimate mine boundaries, on the edge of the final subsidence trough, there would be a fringe where there is no compression recovery, and tension cracks parallel to the boundaries are expected to heal more slowly. Closing of these cracks is expected due to the soft nature of the sandstones and shale in the project area. Enduring cracks, which are determined to pose a threat to wildlife or livestock or have a detrimental effect on the surface hydrologic system, would be filled or otherwise mitigated, as necessary.

4.2.4.2.2 Changes to the Hydrogeologic System

The hydrogeologic units above and below the mine would be affected to varying degrees by subsidence. The fragmented zone, predicted to extend between 18 and 140 feet above the mined seam (Agapito and Maleki 1990), would have increased hydraulic conductivity, porosity and storage because of bulking. The difference between the mined height and the surface subsidence would be taken up in the gob and the fragmented roof zone. In this case, the zone is predicted to comprise a highly connected pool, which over a ten foot mining height would have a storage capacity of approximately 3 acre feet per acre. This bulking storage has the capacity to gravity drain about 30 feet of sandstone in the fragmented zone, assuming a specific yield of 0.1.

During mining operations, the gob and fragmented zone would intercept and divert vertical flow, interrupting some recharge to the upper underburden, except perhaps in mined areas where water is allowed to accumulate underground. After mining, recharge would begin to re-saturate the gob and fragmented zone until an equilibrium is reached and the portion of recharge to the upper overburden is re-established.

Vertical hydraulic conductivity of a stratiform aquifer system is dominated by the less permeable lithologies, particularly shale, which is less permeable than the associated interbedded sandstones. The capacity of shale in the project area to deform in response to subsidence may be expected to limit changes in overall vertical conductivity in the rocks above the highly fractured Zone 1. Shale thicker than about ten feet that are above the highly fractured subsidence Zone 1 may be expected to show only limited increase in hydraulic conductivity.

An increase in horizontal hydraulic conductivity in a direction parallel to high angle jointing may occur in sandstone bodies. An increase in horizontal conductivity may also occur as a result of some separation and shearing at the base of strata. Volumetric strain should be small compared to the saturated void volume; a new joint with 0.01 inch gap in a cubic foot of sandstone with 10 percent porosity adds only 1 percent storage, although its permeability would be 200 times that of the un-fractured sandstone. Induced jointing may actually increase horizontal flow rates, but is not expected to increase the rate of vertical flow through the overburden as a whole, especially in areas where thick shale maintain continuity and interrupt vertical flow.

Draining of the fragmented overburden into the mine pool is expected to occur at the Bull Mountains Mine No l. This is not considered a loss of water, but rather an accumulation of that water in the most permeable section of the aquifer. Above the fragmented zone, the buffering of deformation and of vertical infiltration of the shale is expected to minimize the impacts to the hydrogeologic systems, such as water level declines.

As water levels decrease in the immediate mine area, some aquifers may shift from semi-confined to unconfined conditions because of partial drainage. Head and storage values are expected to eventually recover in areas where the shale is again effective in re-isolating aquifers from drainage to the mine, and where settling of the subsided overburden heals the fractures, thus causing conductivities to approach pre-mining conditions. However, groundwater may not recover to pre-mining levels in areas where enduring subsidence fractures occur, but may re-establish at lower levels within the overburden. Aquifer response and recovery would be measured by intensive monitoring of springs and wells as specified by the mine permit that requires monitoring and an adaptive management approach to mitigation in the event that unexpected impacts occur.

4.2.4.2.3 Impacts to Groundwater Flow and Recharge

Impacts on groundwater flow and aquifer recharge capacity due to mine subsidence are expected to be limited to the fragmented zone. The shallow bedrock aquifer system is anticipated to be isolated from the drainage to the mine by shale and other low permeability lithologies, especially in areas of greater overburden thickness. The mine would receive some inflow from the underburden, and intercept some recharge to the underburden, but effects on the underburden aquifers should be negligible.

Groundwater flow in the fragmented zone and the Mammoth coal would be directed towards the mine workings during and immediately following mining activities at the site. Flow direction in this narrow zone is not expected to return to pre-mining conditions for several years or more after mining ceases (see groundwater modeling predictions in Section 4.2.4.1.2 above).

In the fractured and deformed overburden, overall flow direction is not expected to be impacted, except perhaps in situations where the overburden is thin or brittle sandstones are the predominant lithology, and where enduring subsidence fractures occur. In the project area, subsidence fracture conductivities are expected to be buffered by thick shale due to their soft nature. Increases in both vertical and horizontal hydraulic conductivities may occur as a result of subsidence. Horizontal hydraulic conductivities are still expected to dominate groundwater flow, because they would continue to be greater than the vertical component because shale is expected to interrupt downward flow along subsidence-induced fractures.

Flow to springs is believed to be controlled by a shallow fractured and weathered bedrock/alluvial system. Subsidence fractures may reach this system in areas of shallow overburden cover, facilitating the diversion of groundwater. Some increased lateral drainage from higher overburden units to some lower springs also may occur temporarily as a result of flow along subsidence fractures. Settling and compression after mining are expected to close most subsidence fractures, thereby returning the groundwater flow direction, including flow to springs to approximately the pre-mining orientation. If, however, flow to the springs is impacted, then SPE is committed to replacing the flow using one of the mitigation methods.

In the project area, recharge should sustain the aquifers and springs which were not permanently impacted, but may take years to replenish drained groundwater. Recharge in the project area has been estimated to be 0.05 feet/year based on infiltration rates determined by the groundwater mass balance analysis.

Local subsidence depressions may remain that could create minor surface ponding or marshy areas during periods of high precipitation. Since precipitation is very low in the region, this is not considered a major or detrimental impact. If the ponds contain sufficient quantities of water, then they may be used opportunistically as a source of replacement water. Recharge may be accentuated in these areas during wet periods and snowmelt events.

The groundwater system that feeds springs is a shallow fractured system controlled by topography. Subsidence fractures may reach this system in areas of shallow cover, where stress can be bridged by sandstone beams in the roof, and subsidence may be more abrupt than the usual smooth wave. Flow can occur on such fractures, but visual observations by King (1980) indicate that settling and compression reclose fractures on which significant shear has occurred.

4.2.4.2.4 Impacts to Springs, Ponds, Wetlands, and Wells

Approximately 141 springs and associated wetlands occur within the project area. All of these springs have been monitored as part of the baseline program. There are 15 springs within the coal lease area and an additional 14 springs within the adjacent area, which directly overlie the proposed mine workings or lie within the subsidence angle of draw (**Table 4.2.4-2**). The probability of individual springs being affected is based on the following:

- Depth to mining from the ground surface;
- The lithology of the rocks between the spring and the Mammoth coal (i.e. percent shale, coal, etc.), if a spring lies within the subsidence areas;
- Percentage of watershed in the mining and subsidence areas; and
- The slope of the spring site (the steeper the slope, the more likely the spring would be impacted).

Table 4.2.4-2 Springs and Seeps Overlying Areas Potentially Affected By Subsidence in Coal Lease Area

Spring Name, Number	Location (TRS)	Elevation	Flow Range (gpm)	Development	Relative Score*	Value to Ranchers**
14405	6N/27E 8 NESE	4075	Dry – 1.5	None	1	No
14415	6N/27E 8 SESE	4070	dry - 1.5	small pond	3	Yes
14535	6N/27E 8 NESW	4000	dry - 0.5	None	1	No
14555	6N/27E 8 NESW	4070	dry - 0.3	small pond	2	Yes
16135	6N/27E 22 NWSW	4486	1.0 - 18.0	stream channel flow	2	Yes
52275	6N/27E 4 SWSE	3960	Dry -1.5nd	None	1	Yes
52355	6N/27E 4 NESW	4038	dry - 2.0	None	2	Yes
52365	6N/27E 4 NESW	4028	dry	None	1	No
52375	6N/27E 4 SWNE	3950	dry - 0.8	Pond	2	Yes
53525	6N/27E 10 SENW	4040	dry - 0.5	None	2	Yes
53535	6N/27E 10 SENW	4040	seep - 0.3	small pond	2	Yes
53545	6N/27E 10 SENW	4000	dry - 0.1	None	2	Yes
53225	6N/27E 14 NESW	4113	dry - 0.5	None	2	Yes
53245	6N/27E 14 SENW	3980	dry - 0.5	None	2	Yes
71125	6N/27E 22 SENW	4460	seep - 1.0	None	2	Yes
Springs near the lease boundaries (within 1,000 feet)						
Red Fork 14115	6N/27E 16 SESE	4460	seep - 3.3	None	2	Yes
Busse 14325	6N/27E 17 NENE	4095	1.0 - 39.0	two large ponds in	4	Yes

Table 4.2.4-2 Springs and Seeps Overlying Areas Potentially Affected By Subsidence in Coal Lease Area

Spring Name, Number	Location (TRS)	Elevation	Flow Range (gpm)	Development	Relative Score*	Value to Ranchers**
				lease area Section 4		
14655	6N/27E 8 NWNW	4040	seep - 1.0	Pond	2	Yes
16145	6N/27E 21 NESE	4480	0.3 - 3.5	stream channel flow	2	Yes
16165	6N/27E 22 SENE	4440	dry - 1.3	None	3	Yes
16955	6N/27E 18 NENE	3961	dry - 41.8	None	2	Yes
52165	6N/27E 3 SWSW	3980	pond - 3.3	2 small ponds	3	Yes
52455	6N/27E 3 NWNW	3840	15.4 – 46.6	Small Pond	4	Yes
52565	6N/27E 33 SWSE	3960	dry – 0.5	None	1	No
53125	6N/27E 15 SESW	4400	Seep – 1.0	None	2	Yes
53175	6N/27E 15 NENE	4038	pond - 12.0	large pond	3	Yes
53335	6N/27E 13 NWSW	4080	seep - 0.6	None	2	Yes
53575	6N/27E 10 NENE	3890	seep - 0.8	None	2	Yes
71115	6N/27E 22 NWNE	4416	1.3 - 9.0	extensive piping to stock tanks and storage impoundments	4	Yes

nd - no survey or no data
*Relative Score - An average derived from relative values (1 through 4) assigned to 12 qualitative observations and range variables relating to hydrology, aquatic ecology, vegetation, wildlife and use (adapted from MDSL 1992).
**The value to rancher information was obtained from each landowner interviewed in 1992 (SPE 2009 Volume 1C Section 304(5) Appendix 304(5-6) and 304(12) Appendix 304(12)-1). Updated information obtained in 2010 from Charter (2010) and field monitoring observations (SPE 2010).

- To evaluate these factors, a matrix was designed to evaluate each spring in terms of the probability of impact. Qualitative descriptors were used to define in relative terms the potential for impact to springs. Relative scores for each category, based on literature and the understanding of the hydrogeologic system, are defined as follows: Mining the vertical distance between the spring and the Mammoth coal; the relationship of the spring to the mine layout; and the direction of mining relative to topography as the mine moves under the spring were all determined for each spring (**Table 4.2.4-3**). Each of these three categories were evaluated as factors contributing to the probability of spring impact.

Table 4.2.4-3 Mining Score for Spring Impact Probability Matrix

Depth Of Mining			Mine Layout			Direction Of Mining	
<200 Ft.	10	+	Edge of Pillar or on Pillar	1	+	Uphill	1
200 - 300 Ft.	4		Center of Panel	0		Downhill	0
300 - 400 Ft.	3		Outside of Mining	0		Outside of Mining	0
400 - 500 Ft.	2						
500 - 600 Ft.	1						
>600 Outside of Mining	0						

There are no published criteria for developing the Mining Scores. Professional judgement and the literature indicate that the springs most likely to be impacted are close to the mining level, located near or on a pillar, or positioned on a slope that would be undermined in an uphill direction. It is also known that fracturing at the surface is most likely to occur in areas of shallow cover; therefore, the springs located 200 to 400 feet above the mining operation would have a disproportional higher probability of being impacted.

- Hydrology. The conceptual groundwater model, supported by field data, shows that most of the water discharged at a spring originates from recharge to the watershed in which it is located. This water moves downhill by gravity through a thin system of alluvium and shallow fractured bedrock. Therefore, the percentage of the contributing watershed overlying the subsidence areas was calculated for each spring. As described in **Table 4.2.4-4**, springs with greater proportions of their contributing watersheds overlying the active mining area were given higher scores. For example, a spring with 50 to 100 percent of its contributing watershed overlying the active mine was given a score of 5, while a spring with less than 20 percent was given a score of 1.
- Geology. Geophysical logs from boreholes close to each spring were used to determine the percentage of shale, sandstone/siltstone, coal, and unconsolidated surficial material between the spring and the Mammoth coal. It is assumed that a relatively high percentage of shale will reduce the impacts of subsidence on a spring. As shown in **Table 4.2.4-4**, springs underlain by less than 20 percent shale were given a score of 5, while springs underlain by more than 40 percent shale were given a score of 1 and springs beyond the subsidence areas were given a score of 0.
- Topography. Areas of high topographic relief, would affect the size and location of tension cracks and horizontal ground movement. The percent slope map generated by the Office of Surface Mining and USGS topographic maps for the area were used in this analysis. Topography scores on **Table 4.2.4-4** ranged from 5 to zero. Springs with slopes greater than 50 percent were give a score of 5, while springs with slopes less than 5 percent were given a score of one. Springs beyond the subsidence areas were given a score of 0.

Table 4.2.4-4 Scoring Methodologies for Probability Matrix

Hydrology Score: Hydrology (% of watershed in mine area)	
50% - 100%	5
40% - 50%	4
30% - 40%	3
20% - 30%	2
< 20%	1
Beyond mining area	0

* +1 for coal spring

Geology Score: Geology (% of Shale)	
< 20%	4
20% - 30%	3
30% - 40%	2
> 40%	1
Beyond mining area	0

Table 4.2.4-4 Scoring Methodologies for Probability Matrix

Topography Score: Topography (% of slope)	
> 50%	5
25% - 50%	4
10% - 25%	3
5% - 10%	2
< 5%	1
Beyond mining area	0

The scores for each of these factors for the 27 springs in and surrounding the coal lease area are presented in **Table 4.2.4-5**. All potential impact to these springs during the LOM were considered in this evaluation. The scores were added and ranked according to the following probability criteria:

Score	Impact Potential
0 – 2	None
3 – 5	Negligible
6 – 10	Low
11 – 14	Moderate
15 – 21	High

Table 4.2.4-5 Probability of Impact Matrix for Springs in the Coal Lease Area

Spring Number	Mining	Hydrology	Geology	Topography	Total		Probability
14115	1	5	2	2	3	(10)	**L**
14155	1	5	2	2	3	(10)	**L**
14165	3	5	2	2	4	(12)	**M**
14255	2	5	2	2	4	(11)	**M**
14325	4	5	2	1	4	(12)	**M**
14415	3	5	3	1	4	(12)	**M**
14535	5	5	3	1	4	(14)	**M**
14555	4	5	3	1	4	(13)	**M**
16135	0	5	4	1	3	(10)	**L**
16145	1	5	4	2	4	(12)	**M**
16165	1	5	4	3	4	(13)	**M**
16255	1	5	4	1	4	(11)	**M**
16275	1	5	4	2	4	(12)	**M**
16355	3	5	3	1	4	(12)	**M**
17635	2	5	3	4	4	(14)	**M**
17655	2	4	4	1	4	(11)	**M**
52125	3	5	2	1	4	(11)	**M**
52145	5	5	3	1	4	(14)	**M**
52225	3	5	3	1	4	(12)	**M**

Table 4.2.4-5 Probability of Impact Matrix for Springs in the Coal Lease Area

Spring Number	Mining	Hydrology	Geology	Topography	Total		Probability
52235	3	5	3	1	4	(12)	**M**
52255	4	5	3	1	4	(13)	**M**
52455	0	5	1	4	3	(10)	**L**
53115	2	5	3	4	4	(14)	**M**
53125	2	5	3	4	4	(14)	**M**
53125	1	5	3	4	4	(13)	**M**
53145	4	5	4	3	5	(16)	**H**
53155	3	5	4	3	5	(15)	**H**
53175	3	5	4	1	4	(13)	**M**
53225	4	5	3	1	4	(13)	**M**
53245	0	5	1	4	5	(15)	**H**
53525	5	5	2	3	5	(15)	**H**
53535	5	5	2	3	5	(15)	**H**
53545	5	5	3	1	4	(14)	**M**
71115	2	5	3	4	4	(14)	**M**
71125	1	5	3	4	4	(13)	**M**

IMPACTS: N = no Ng = negligible L = low M = moderate H = high
Total scores are in parentheses

This analysis indicates that for the 15 springs within the coal lease area, four springs have a low potential for being impacted by mining, seven have a moderate potential, and four have a high potential. For the 14 springs surrounding the coal lease area, six would have a low potential for impact and eight would have a moderate potential for impact. Further discussion of the logic used to develop the Probability of Impact Scores for these 29 springs is presented in Permit Document (SPE 2009).

Impact scores are considered relative. An impact to a spring could be a change in location, flow quantity, or water quality. For instance, a spring such as 16135 that occurs at a higher elevation (relative to the coal seam) has a low Impact Potential score. In evaluating this spring, a Mining Score of 0 (relatively low) was assigned primarily because of the depth to the seam, however, a Hydrologic Score of 5 was assigned because of the percent of watershed in the mine area. Due to the depth to mining, it is not anticipated that this spring would lose flow. However, there is a chance that the spring could be relocated due to changes to the topography.

For topographically lower located springs, such as 14535 (**Table 4.2.4-5**), the opposite holds true. This spring has a high Mining Score (5) yet a relatively low Topography Score (1). In this case, there is a chance that a change in flow quantity may occur due to the shallow depth to mining, yet the change in topography would have little impact on the spring.

It is still unknown as to what impacts actually would occur to the springs and the actual impacts may be different from those predicted by this analysis. Nonetheless, SPE is committed to mitigate impacts to springs and to mitigate impacts to the associated perennial and intermittent stream reaches.

Although caution must be exercised in applying conclusions drawn from hydrogeologic studies from one mine to another, the results of a study by Pennington et al. (1984) on the effects of longwall mining on overlying aquifers gives additional insight into the possible consequences of mining under springs in the Bull Mountains. As part of that study, the effects of longwall mining on a shallow sourced spring were evaluated. The spring was located between 500 and 600 feet above the longwall panel, a situation similar to that which would occur in the Bull Mountains. The study showed that during pre-mining, active mining, and post-mining conditions spring flow was maintained and was consistently related to precipitation in the study area. It is believed that this also would be the case in the project area where the majority of springs emanate from the shallow fractured bedrock and are recharged locally by precipitation.

Since the Bull Mountains Mine No. l would be an underground operation, surface impacts would be minimal. None of the springs or ponds would be removed by mining. The potential for each spring to be impacted by mining has been evaluated above. Impacts of mining on the existing springs and perennial stream reaches would be identified using SPE's baseline and operational monitoring program. Key monitoring springs and perennial stream reaches would be identified as those within and adjacent to each area of active mining and subsidence. Spring flows for these key monitoring springs would be compared with flows from reference springs located outside the permit area and the influence of subsidence. A change in the relationship between the flows at the key monitoring springs and the reference springs occurring at the time of mining and subsidence would indicate impact to the springs and associated perennial segment.

For water quality, TDS concentrations measured at the key monitoring springs would be compared with TDS measurements from reference springs. A change in the relationship between the TDS at the key monitoring springs and the reference springs occurring at the time of mining and subsidence would indicate impact to the springs and associated perennial segment.

For all potentially impacted springs and perennial stream segments, impacts to the use of these resources would be evaluated by comparing the wildlife, vegetation and livestock use patterns with long term data for the specific site and for the reference or control sites. For the 12 springs surrounding the coal lease area, five would have a low potential for impact and seven would have a moderate potential for impact.

Two private wells, 62710BBB (possible Mammoth coal well) and 62711CCD (possible underburden well), are located within the coal lease area that would be mined. SPE has established mitigation measures approved by MDEQ in the mine permit to replace wells that would be removed or severely impacted with new wells or a comparable water supply. Water rights are protected as stipulated in the permit.

Impacts of mining on existing water supply wells will be identified using SPE's baseline and operational monitoring program. For water quantity, drawdown of water levels in the coal, overburden and underburden would be determined and updated annually. Water supply wells located within the drawdown zone of their respective unit would be identified as potentially impacted. SPE would evaluate measures to mitigate the impacts to water supply such as rehabilitating the well, deepening the well or drilling a new well. SPE is currently using approximately 500 gpm from two permitted Madison Formation wells to supply the coal preparation plant and underground mining equipment. This deep formation is capable of providing this level of sustained use and there are no other water users that rely on Madison Formation water for their uses.

For water quality, TDS concentrations measured in SPE's groundwater monitoring wells in the coal, overburden and underburden would be compared with baseline concentrations to identify possible trends. Groundwater quality within the vicinity of the monitoring well would be identified as potentially impacted if there is a statistically significant increase in the TDS concentrations in four successive samples relative to the TDS concentrations measured during the baseline and operational monitoring periods. A statistical calculation would be utilized to analyze the data. Locations where water quality within the coal, overburden and underburden may be potentially impacted would be mapped and analyzed for statistically significant increases in TDS. Samples would be collected and analyzed for TDS and major ions. If the concentration of TDS or major ions exceed the corresponding use standards, the water quality would be assumed to be impacted and SPE would evaluate measures to mitigate the impacts to water quality such as rehabilitating the well, deepening the well or drilling a new well.

4.2.4.2.5 Impact Downgradient of the Mine

Regional aquifers would not be impacted by mining operations in the coal lease area or LOM area. Hydrogeologic units directly downgradient of the mine would not be directly impacted by subsidence, but may be affected by mine dewatering and associated drawdown within the coal and overburden. In addition, mine subsidence fracturing may enhance drainage into the mine and subsequent drawdown in the hydrogeologic units above the fragmented zone.

The local unit of most concern is the shallow fractured bedrock, which contributes the majority of flow to the springs. Impacts to the shallow fractured bedrock are expected to be temporary as subsidence fractures within the bedrock underlying this unit should heal and water levels should recover. However, in areas where springs have a probability (low, moderate, or high) of being impacted, mitigation measures have been developed to replace springs and augment flow downgradient (SPE 2009).

The only other hydrogeologic unit that could be impacted by subsidence is the alluvium in areas of low overburden cover. The alluvium receives most of its recharge from precipitation and spring discharge. A small portion of the recharge also originates from deeper bedrock discharge. Within the project area, water from the alluvium drains into the bedrock; emerges further downslope as part of the next spring’s discharge; is used, or moves further downslope either as surface flow or alluvial flow; drains back into the shallow bedrock; and so on down the valley. Some portion of the water may stay permanently in the shallow bedrock, while some may not.

Interruption of alluvial groundwater could have a measurable impact on water levels in the alluvium and shallow bedrock downgradient of the subsidence area. However, this would not significantly impact water availability because:

- The alluvium is relatively thin,
- Saturation of the alluvium is discontinuous and where saturated, the depth to water is greater than 8 feet, and
- Surface flow in the streams is ephemeral except immediately downgradient of some springs.

Impacts are expected to be temporary as subsidence fractures within the bedrock underlying the alluvium heal and water levels should recover. However, groundwater may not recover to pre-mine levels in areas where enduring subsidence fractures or bedding plane separation occur.

The Mammoth coal would be the most impacted unit due to its removal and dewatering during mining. Drawdown of pre-mining potentiometric surfaces would have the greatest extent in the Mammoth coal.

Downgradient impacts due to mine dewatering and subsidence would be minimal. A flow net analysis indicates that groundwater discharge from the Mammoth coal to the various drainages is quite small because of the low permeability of this unit and the relatively low hydraulic gradient. Drawdown in the Mammoth coal does not extend very far beyond the mined area. Drawdown within the Mammoth coal would reduce groundwater flow in the coal downgradient of the mine. Steady state discharge rates in the coal are quite low, and most of the inflow to the mine is water depleted from storage in the coal and in the overburden. Inflow from the underburden is also estimated to be quite small.

Water removed from storage in the coal and overburden during mining would be replaced slowly over time as water levels recover in the gob. Impacts following completion of mining would be similar to impacts during mining, but would diminish with time as groundwater levels recover.

4.2.4.2.6 Impacts Due to Mine Dewatering

The Mammoth coal seam is one of many saturated zones that make up the Tongue River Member of the Fort Union Formation, which contains most of the usable water in the project area (Slagle 1986). As a result, mining the Mammoth coal seam would permanently impact the flow of groundwater in the project area during and after mining. The objective of this analysis is to assess potential worst-case, short and long-term hydrologic impacts to the project area as a result of mining.

Although drawdown in the aquifer as a result of mining activities may also impact surface hydrology features such as springs and ponds, the following sections focus on impacts to groundwater. Impacts to and mitigation for springs and ponds are explained above. The impacts modeled and discussed below focus on both the nearby and regional impacts in and around the mining area.

4.2.4.2.7 Groundwater Quality

All of the impacts presented in this analysis are expected to occur as a result of the approved current mining operations, regardless of the decision to lease the federal coal. No significant increased degradation of groundwater quality is anticipated as a result of the proposed leasing activities. The quality of groundwater that does not come in contact with the highly fractured rocks immediately above the mined out area or the gob (mine waste) should not be affected by mining. No significant change in acidity is anticipated to occur in the operational or post-mining groundwater quality in the project and downgradient areas. A general increase in total dissolved solids, sodium and sulfate concentration is anticipated in the groundwater that flows through the gob and the highly fractured zones immediately above the mined out area; however, it is expected that groundwater quality would continue to be suitable for the current and post-mining uses of watering livestock and wildlife. These changes would result primarily from chemical reactions that may occur as the fragmentation and collapse of the overburden expose new mineral surfaces to oxygen and groundwater. Areas affected by these changes currently have elevated levels of TDS, sodium, and sulfate which often exceed drinking water standards. No additional restrictions on water use beyond those presently in place are anticipated. However, regular monitoring of water quality would be maintained. Fragmentation and collapse of the overburden immediately overlying the mined-out area may expose rocks previously existing in a reducing environment to an oxidizing environment, and drain stagnant pores that may be not in equilibrium with mobile water. The oxidizing conditions would exist until after mining is complete, and re-saturation of the collapsed material has occurred. These conditions may result in increased sulfide oxidation, cation exchange, leaching, and weathering, which together with the exposure of stagnant porosity, cause an increase in the concentration of calcium, magnesium, and sodium ions. An increase in mine water acidity, however, generally does not occur as a result of these chemical reactions in the coal mines of the Northern Great Plains, because of the buffering capacity of the alkaline sediments present throughout the project area and because the indigenous sulfide minerals generally occur in a relatively stable chemical form. However, should acid drainage occur, it would be mitigated to acceptable standards.

The fragmenting and fracturing of the overlying strata may result in the interconnection of a number of hydrogeologic units. This interconnection should not have a significant effect on resultant water qualities for two primary reasons. First, the geochemical properties of both the overburden and Mammoth coal groundwater are similar; and secondly, separate overburden water-bearing units generally are not discernible from one another using water quality comparisons. Natural groundwater flow in the Bull Mountains is downward, and in the long term all aquifers are connected. The evolution of chemical change through the vertical section is not so pronounced. Therefore, the geochemistry should not significantly change laterally, over a distance of several hundred feet.

A study that indicates the probable quality of post-mining water was conducted by the Montana Bureau of Mines and Geology (Reiten and Wheaton, 1989; Wheaton and Van Voast, 1989). They conducted a hydrogeologic reconnaissance of abandoned underground coal mines near Roundup, Montana to investigate the potential for beneficial development of the waters contained in these mines. The results of this study indicate that water in the abandoned mines is predominantly sodium-sulfate type with calculated dissolved solids ranging from 1,325 to 5,155 mg/L. Historical water quality data for several mines indicate that dissolved solids, sodium and sulfate concentrations have steadily increased over time while calcium and bicarbonate have decreased. No acidic waters were encountered in any of the mines sampled, and the pH of the water samples ranged from 7.2 to 8.2.

The study suggests dissolution of gypsum, pyrite oxidation, and ion exchange as the most likely geochemical mechanisms contributing to the existing mine water chemistry conditions. It also suggests that mine water quality has developed over a relatively long period of time (some of the mines have been abandoned for over 70 years) and that cyclic dewatering could significantly improve the water quality (Wheaton and Van Voast, 1989).

In general, the MBMG study found that although the quality of the water consistently did not meet the National Secondary Drinking Water Standards for TDS and sulfate, the overall composition generally met the Montana Groundwater Classification standards for agricultural and livestock use. More recent studies (Raisbeck, et al 2008) suggest that several of these samples exceed acceptable levels for livestock use. **Table 4.2.4-6** summarizes water quality analyses collected during the study (Wheaton and Van Voast, 1989). Baseline water quality statistics for Mammoth coal well waters are presented for comparison in **Table 4.2.4-7**. In general, water qualities in the abandoned mines are of similar character and quality to the baseline coal water qualities at the Bull Mountains Mine No. 1.

Given that the water in the mines in the Roundup area has tended to show a general degradation in water quality over time, it is likely that a similar degradation of water quality, such as increased TDS and sulfate, will occur during the operation of the Bull Mountain Mine No. 1. Overall long term effects on groundwater quality will depend to a large extent on the degree of groundwater flow through the collapsed mine workings. Post-mining groundwater quality within the collapsed zone will probably stabilize at a slightly degraded level compared with baseline water quality unless the mine water is periodically pumped or otherwise removed.

In addition to examining existing data on mine water quality, geochemical analyses of selected samples from the overburden materials were run in order to evaluate the potential changes to groundwater quality that may result from mining. Cores and chip samples from five holes drilled in the project area were selected for overburden analyses of a number of parameters. Samples were collected from the first six inches of material overlying the coal seam, the first 10 feet of strata overlying the coal seam, and additional strata selected as representative of the various major overburden lithologies. Most of the samples were collected from overburden Intervals 5, 6, and 7, which are the intervals most likely to fragment and fracture as a result of subsidence. These samples were analyzed for pH, saturation percent, conductivity, calcium, magnesium, sodium, SAR, textural parameters, nitrate as N, boron, molybdenum, and selenium. Anions, such as sulfate, bicarbonate, and chloride were not analyzed. Saturated paste extracts were used to determine the concentration of the calcium, magnesium, and sodium cations.

Post-mining groundwater quality commonly is predicted using overburden saturated paste extract data because, despite certain drawbacks, saturated paste extracts do provide order of magnitude estimates of potential concentrations (McWhorter, 1979).

The saturated paste extract procedure consists of wetting a sample with distilled water until a saturated paste is formed. Saturation is reached when the paste glistens as it reflects light and flows slightly. The resulting solution is extracted and analyzed for chemical constituents of interest. Since the saturation criterion is subjective, the degree of saturation achieved in one sample may be considerably different from that achieved in another. As a result, observed extract concentrations often are not directly comparable (Mednick, 1987).

Van Voast and Thompson (1982) concluded that potential post-mining, groundwater ionic concentrations could be calculated using the results from saturated paste analyses. In their study, cation concentrations were determined by saturated paste analysis. They calculated anion concentrations by assuming chloride content was insignificant; that bicarbonate and sulfate concentrations remained in the same relative proportions as those in the natural groundwater near each mine; and that cation/anion balance was maintained. They calculated dissolved solids concentrations by summing the concentrations of calcium, magnesium, sodium, sulfate, and

Table 4.2.4-6 Water-Quality for Underground Mine Workings[1]

Mine	Location	Date of Sample	pH (Lab)	Specific Conductance (Lab) (Microsiemens per cm 0 25 cm)	Calculated[2] Dissolved Solids (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Bicarbonate (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	Sodium Adsorption Ratio	Laboratory
Republic No. 1	08N25E24AB	12/16/13			793	99.0	41.0	(110)[4]		334.0	359.0	15.0	2.4	Milwaukee Railroad
Republic No. 1	08N25E24AB	04/01/59			1200	120.0	80.0	(170)[4]		323.0	669.0	12.0	2.9	Department of Health
Republic No. 1	08N25E24AB	03/19/75	7.5	1730	1150	112.0	70.0	175.0	4.0	349.0	600.0	23.0	3.3	Department of Health
Republic No. 1	08N25E24AB	09/28/76	7.5		1375	118.0	64.0	250.0	4.0	383.0	750.0	21.0	4.6	Department of Health
Republic No. 1	08N25E24AB	05/08/79	7.5		1620	165.0	96.0	258.0	7.0	439.0	881.0	38.0	3.9	Department of Health
Republic No. 1	08N25E24AB	07/22/82	8.2			167.0		337.0		433.0				Department of Health
Republic No. 1	08N25E24AB	06/10/86	7.6		2125	193.0	118.0	364.0		425.0	1237.0		5.1	Department of Health
Republic No. 1	08N25E24AB	07/14/86	7.2		2530	212.0	117.0	455.0	6.0	538.0	1436.0	24.0	6.2	MBMG
Republic No. 1 (R-147)	08N25E24AB C8	01/05/89	7.8	3000	2535	204.0	121.0	483.0		538.0	1462.0		6.6	Department of Health
Republic No. 2	08N25E36	01/22/10			883	37.0	36.0	(220.0)[4]		415.0	339.0	16.0	6.2	Milwaukee Railroad
Republic No. 2 (R-151)	08N25E36CC AB	07/12/89	7.0	4550[3]	4055	327.0	145.0	792.0	12.0	926.0	2300.0	15.0	9.2	Energy Labs
Roundup 3 East	08N25E25AD	07/30/56	8.0	2010	1340	87.0	46.0	293.0	5.0	347.0	715.0	21.0	6.3	USGS
Roundup 3 (R-153)	08N25E23CA DB	07/10/89	7.0	6430	5155	393.0	277.0	857.0	15.0	1150.0	3010.0	23.0	8.1,	Energy labs
Roundup 3 West	08N25E22	03/12/81	7.5	2200	1590	63.0	39.0	414.0	8.0	483.0	809.0	20.0	10.0	Energy Labs
Jeffrey (R-144)	08N26E180C BC	07/29/86	7.7	1890	1280	86.0	43.0	298.0	4.0	464.0	589.0	27.0	6.6	MBMG
Jeffrey (R-145)	08N26E18DC DC	07/30/86	7.6	1930	1320	88.0	44.0	301.0	4.0	465.0	624.0	29.0	7.4	MBMG
Jeffrey (R-145)	08N26E18DC DC	07/14/89	7.8	1800[3]	1325	76.0	38.0	332.0'	5.0	463.0	615.0	28.0	7.8	Energy Labs
Jeffrey (R-146)	08N26E18CA DA01	12/18/86	7.6	1880	1290	86.0	42.0	301.0	6.0	471.0	592.0	27.0	6.7	MBMG
Prescott (R-154)	08N25E24CA AC	07/10/89	6.9	6260	5090	472.0	204.0	891.0	14.0	953.0	3000.0	27.0	8.6	Energy Labs
R-160	08N26E17DB AC	07/31/89	7.2	2780	2140	111.0	72.0	541.0	7.0	717.0	1030.0	25.0	9.8	Energy Labs

1 Source: Wheaton and Van Voast (1989).
2 Dissolved solids were calculated from the major constituents.
3 SC is field measurement.
4 Na calculated from SAR, Ca, Mg

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Table 4.2.4-7 Mammoth Coal Wells Water Quality Statistics

Parameter	Range Minimum Maximum	Mean	Standard Deviation	Number of Samples	Number of Non-Detects	Number of Sample Points
Spec Cond-Lab6125 C(umhos)	1400.000-3730.000	2272.444	775.319	45	0	10
pH-Lab of 25 C (su)	7.000-9.800	8.069	0.708	45	0	10
Acidity	0.000-0.000	0.000	0.000	45	0	10
Alkalinity as CaC03	299.000-812.000	492.067	109.894	45	0	10
Bicarbonate as HC03	321.000-991.000	571.467	156.867	45	0	10
Carbonate as C03	0.000-131.000	14.289	33.504	45	0	10
N03-NO2 Nitrogen – N	<0.050-2.000	0.125	0.293	45	26	10
Sodium Adsorption Ratio	1.290-43.100	18.720	15.192	45	0	10
Sulfate	251.000-1690.000	798.311	478.468	45	0	10
Total Dissolved Solids	862.000-2970.000	1607.689	678.725	45	0	10
Aluminum	<0.100-1.400	0.147	0.201	45	36	10
Arsenic	<0.005-0.008	0.005	0.000	45	42	10
Barium	<0.100-0.100	0.100	0.000	45	44	10
Boron	<0.100-0.200	0.111	0.032	45	16	10
Cadmium	<0.001-0.003	0.001	0.000	45	40	10
Calcium	3.000-189.000	67.244	65.745	45	0	10
Chloride	6.000-30.000	9.756	4.513	45	0	10
Chromium	<0.020-<0.020	<0.020	0.000	45	45	10
Fluoride	0.110-2.800	0.566	0.507	45	0	10
Iron	<0.030-3.680	0.297	0.715	45	20	10
Lead	<0.010-0.020	0.010	0.001	45	41	10
Magnesium	2.000-146.000	68.978	66.405	45	0	10
Manganese	<0.020-0.380	0.057	0.074	45	15	10
Mercury	<0.001-<0.001	<0.001	0.000	45	45	10
Molybdenum	<0.005-0.036	0.006	0.006	45	40	10
Nickel	<0.030-<0.030	<0.030	0.000	45	45	10
Phosphorus	<0.010-0.110	0.024	0.022	45	19	10
Potassium	3.000-32.000	9.822	7.072	45	0	10
Selenium	<0.005-<0.005	<0.005	0.000	45	45	10
Silver	<0.005-0.006	0.005	0.000	45	44	10
Sodium	85.000-712.000	405.489	201.916	45	0	10
Vanadium	<0.100-<0.100	<0.100	0.000	45	45	10
Zinc	<0.010-1.280	0.215	0.259	45	1	10

Notes: All units are mg/L unless otherwise noted.
ALL samples were collected between 4/89 and 10/91.
Non-detects assigned a value equal to the detection limit in calculation of mean and standard deviation.

0.4917 multiplied by the concentration of bicarbonate per liter. They then predicted post-mining groundwater quality by adding both the lognormal mean concentrations of cations from the paste analyses and calculated anions to those concentrations representing natural baseline groundwater conditions.

The same method was used to predict post-mining groundwater quality for the Bull Mountains Mine No. 1 for water flowing through the gob and rubblized zone. The predicted water quality for the current mining activities is the same as that predicted for mining the federal coal lease, however, the mine pool area would be larger. The results of paste extracts from overburden samples from the project area and groundwater analyses from baseline monitoring of Mammoth coal and lower overburden wells were used. **Table 4.2.4-8** summarizes these results. **Table 4.2.4-8** also presents, for comparison, the post-mining concentrations predicted by Thompson (1982) in his study of the Bull Mountains area. Thompson also used saturated paste extracts for his predictions. There is a good correspondence between the ionic concentrations predicted by the current study and the Thompson study (**Table 4.2.4-8**).

The paste extract predictions and the existing data on mine water quality in the Roundup area both suggest that TDS, sodium and sulfate concentrations in the groundwater of the mine workings will increase following mining. The paste extract predictions are reasonably consistent with actual mine water quality measurements in existing mines, although a few of the mines currently show higher TDS, sodium and sulfate.

Both the current mean average coal and overburden water quality and the predicted post-mining water qualities exceed sulfate, sodium, and TDS limits for drinking water. On this basis, post-mining groundwater quality would fall within either the Class II or Class III designation of the state. Under this system, the Class II groundwater would be considered suitable for livestock watering. However, some of the Class II wells may have undesirable concentrations of sulfate. Thompson's (1982) study concludes that "Re-saturation of reclaimed surface-mine spoils or of underground mine workings would occur over a period of years, during and after mining. Because groundwater flow rates are very small, the downgradient migration of the plume of lower-quality water would not affect water users even immediately adjacent to the mine for many years. The quality of water in the migrating plume would be altered somewhat by contact with the undisturbed rocks outside the mined area. The post-mining groundwater would still be suitable for stock watering, but not domestic use."

However, Van Voast and Thompson's (1982) figures for predicted underground-mine spoils water (Table 4.2.4-8) indicate that sulfate concentrations are likely to exceed Montana stock water limits. In addition, more recent studies (Raisbeck, et al 2008) have shown that these limits may be unrealistic and that chronic consumption by livestock of water with sulfate concentrations greater than 1,000 mg/L, while not lethal, reduces feed intake, water intake, growth, and performance. This does not take into account that sulfate or other forms of sulfur may also be consumed in forage and other feedstuff. In ruminants, such as cattle, sulfate is also converted to sulfide which inhibits the bioavailability of trace elements such as zinc and copper. Analyses also indicate that overburden pH is essentially neutral to slightly alkaline and the acid-base potential of the overburden and coal mine waste is not acid-producing.

Table 4.2.4-8 Montana Water Standards and Predicted Post-mining Groundwater Quality

Constituent	Montana Groundwater Limits		Average 2007 Overburden + Mammoth Coal Groundwater[1]			Current Study Predicted Post-mining Groundwater (OB + GW)		Van Voast and Thompson[2] Predicted Underground-Mine Spoils Water	
	Drinking Water (mg/L)	Stock Water (mg/L)	Range (mg/L)	Mean (mg/L)	n[3]	Range (mg/L)	Mean (mg/L)	Range (mg/L)	Mean (mg/L)
pH Units (field)	6.5 - 8.5 [a][s]	-	7.15 - 8.15	7.54	16	**	**	**	**
COMMON ELEMENTS (mg/L)									
TDS	500 [a][s]	5,000	261 - 2585	1325	16	**	2505	1580-6110	3100
Bicarbonate as HCO3	-	-	285 - 918	548	16	**	1050	540-2050	1060
Calcium	-	-	12 - 171	73	16	21-822	120	46-150	83
Chloride	250 [a][s]	1,500	3.0 - 19.5	10.3	16	**	**	**	**
Fluoride	4 [p]	2	0.12 - 5.10	0.81	16	**	**	**	**
Iron	0.3 [a][s]	-	0.19 - 1.41	0.68	8	**	**	**	**
Magnesium	-	2,000	2.5 - 2.04	79	16	11-830	92	33-110	96
Manganese	0.05 [a][s]	-	0.02 - 0.23	0.06	11	**	**	**	**
Potassium	-	-	3 - 10.5	6.8	16	**	**	**	**
Sodium	250 [a]	2,000	9.5 - 740	265	16	22-1400	424	460-1840	920
Sulfate	250 [a][s]	1,500	13 - 1430	606	16	**	913	780-3000	1510
TRACE METALS (µg/L)									
Aluminum	50-200 [a][s]	-	*	250	1	**	**	**	**
Arsenic	10 [p]	50	*	30	1	**	**	**	**
Barium	2,000 [p]	-	100 - 100	100	2	**	**	**	**
Cadmium	5 [p]	10	*	*	0	**	**	**	**
Lead	15 [p]	50	*	*	0	**	**	**	**
Selenium	50 [p]	50	*	*	0	**	**	**	**
Silver	100 [a][s]	-	*	*	0	**	**	**	**
Zinc	5,000 [a][s]	24,000	20 - 250	100	9	**	**	**	**

Notes:

1 Ranges based on data collected January-December 2007.
2 Van Voast and Thompson (1982).
3 Number of wells with detectable levels of this constituent.
- There is currently no standard for this constituent.
[a] This standard is based on aesthetic quality of water (i.e. odor, color, etc.) and is not a health standard.
[p] U.S. Environmental Protection Agency maximum contaminant level or action level: revised October 13, 1999.
[s] U.S. Environmental Protection Agency secondary contaminant level: revised October 13, 1999.
* No detectable quantities were identified for this constituent.
** No future concentrations were calculated for this constituent.

Given that the water in the mines in the Roundup area has shown a general degradation in water quality over time, it is likely that a similar degradation of water quality, such as increased TDS and sulfate, would occur during the operation of the Bull Mountain Mine No. 1. Because the water in the Bull Mountain mine area is used predominantly for livestock watering and because sulfate is a concern for livestock, particular attention should be given to sulfate concentrations in groundwater monitoring. Sources of replacement water may need to be identified promptly to mitigate the effects of elevated sulfate concentrations.

The prediction of post-mining groundwater quality, presented above, specifically considers water flowing through the mined-out areas, the gob, and the rubblized zone. It is anticipated that groundwater flow and quality in the shallow fractured and weathered bedrock, which sources most spring flow, would not be degraded by effects of mining, especially in the topographically higher areas where the ground surface is more than 400 feet above the Mammoth coal.

Water quality of springs decreases in a downgradient direction. The shallow fractured and weathered bedrock has water quality comparable to the springs it sources. Whenever possible, this zone would be tapped using horizontal drains or vertical wells and used to supply water to mitigate losses of spring flow at topographically lower elevations. The water supply system would be designed to simulate the natural distribution of water downgradient from recharge areas. The quality of the replacement water would be comparable to or better than any lost or diminished water resources; therefore, there should be no impact on the wetland vegetation or soils.

Should it be necessary to obtain replacement water from a source other than the shallow bedrock, the underburden would be used. Mining should have little effect on the deeper underburden.

Prior to the installation of monitoring well 62720-03, most water quality and quantity data for the underburden had been obtained from sampling and testing monitoring wells completed in the rocks 30 to 40 feet below the Mammoth coal. This stratigraphic interval is comprised of interbedded siltstones, shale, and thin sandstones; having relatively low K values and poor water quality. To determine whether the underburden could be used as a source of replacement water, SPE investigated deeper stratigraphic intervals. Monitoring well 62720-03 was installed in a 50 foot thick fluvial channel sandstone. Other studies (Flores, 1981; Shurr, 1972; and Woolsey, 1917) and geophysical logs from oil and gas test wells indicate that the lower portion of the underburden is a fluvial channel facies-dominated system, and therefore, these massive sandstones are relatively common. If it is necessary to use the underburden as a source of replacement, then wells would be installed to tap this or other massive fluvial sandstones.

In addition, most of the private wells within the project area were completed in the underburden and are used for livestock watering and domestic purposes. Even without the benefit of the extensive hydrogeologic database, geophysical data, background information, and resources available to SPE, some of these wells were completed in intervals capable of sustaining relatively high yields of comparable quality water.

Concentrations of TDS in underburden water range from 943 to 4520 mg/L with a mean value of 2138 mg/L. Water of this quality, although lower than most spring water quality, still should be adequate for the maintenance of wetlands, and livestock and wildlife watering.

To illustrate this point, quality data for the water sample from well 62720-03 indicate a TDS concentration of 1620 mg/L and an SAR value of 7.71. The concentration of TDS is somewhat lower than the mean concentration of TDS for Litsky Springs (1720 mg/L), and slightly higher than mean TDS concentrations for all springs (1118 mg/L). The TDS value of the water from well 62720-03 is below the limit published in MBMG Form 196 of 2000 mg/L. Therefore, no negative effect to the vegetation or soils is likely to occur as result of using water from well 62720-03 to augment the water supplying the wetlands. Additional management practices should not be necessary as a result of the soluble salt concentration in the replacement water.

The SAR value of the water from well 62720-03 is higher than that noted in the springs (mean value for all springs, 1.62). The measured SAR of water from well 62720-03 is below the MBMG recommended and permissible limit for irrigation water.

If necessary, SPE would apply some simple management practices that can be implemented to minimize negative effects of the slightly higher SAR values for the water associated with well 62720-03. Measures that can be taken include: adding organic matter such as hay, bark, or wood chips to the wetland soils to enhance the organic content; or periodically adding gypsum to the soils or feed water (Overcash and Pal, 1981). These simple processes should eliminate any need for more intensive management practices to prevent build up of salts in the soil profile or the degradation of soil structure. Monitoring the success of mitigated springs would detect whether these additional measures would be required.

However, native wetland plant species in the western United States tolerate relatively high salt levels (Hammer, 1992). Plant species known to be salt-tolerant are dominant in many spring wetlands in the project area. These plant species include cattail, rushes, bulrushes, alkali grass, cordgrass, and salt grass. These plants should not be adversely affected by the slightly higher SAR values (7.71) for water from well 62720-03 falls within the range of values for all springs (0.17 - 13.1). However, this SAR value is higher than the mean value for all springs (1.62), but it is still within the acceptable standards for irrigation waters published in MBMG Form 196 (SAR range of 8 to 18 is crop and soil type specific).

In addition, the high natural organic content would tend to mitigate the adverse effects of waters with slightly high SAR (Camp and Meserve, 1974). Typically, wetlands tend to have soils rich in organic matter. A wetlands area would also indicate that a high leaching condition exists and a steady flow of water through the root zone exists, thereby minimizing any salt buildup.

Irrigation waters with higher SAR values can cause problems in areas where swelling clays are dominant in the soil. Soil types mapped in the area of the wetlands do not include a predominance of swelling clay soils.

4.2.4.2 Surface Water

As the longwall advances the roof is allowed to subside into the mine voids. Subsidence leaves a rubble zone up to 10 times the seam height and a fracture zone extending upwards 30 to 50 times the seam height (combined with the rubble zone). Depth of mining varies from about 200 feet below the lower valley bottoms to over 600 feet below the clinker capped ridges.

Spring water and groundwater that is intercepted by subsidence fractures and drained into mine voids would be collected in underground sumps and, if necessary, pumped to the surface facilities area into a sediment pond. This water would be used for mine operations at the preparation plant or longwall mining equipment. If excess water accumulates, it may be discharged through the provisions of the existing MPDES permit. Once mining passed through an area, water levels may increase in the overburden, alluvial or underburden units, increasing flow at existing springs or streams, or emerge as new or relocated springs or streams, as discussed in the groundwater section above. Changes in water quality are expected within the fractured zone due to water coming into contact with collapsed rubble and fresh mineral surfaces. Increases in TDS are likely to be most evident from water pumped from the mine.

Mitigation plans already exist in the permit document for all springs in the project area, including the federal lease area. The plans include restoring springs, stream reaches, and ponds by opportunistic development of springs where they appear, guzzler emplacements, horizontal wells, vertical wells, pipeline systems, deepening or rehabilitating existing wells, reclamation of stream reaches and function, and water treatment where appropriate or necessary and restoring pre-mine land use (SPE 2009).

4.2.4.2.1 Effects of Mining on Local Geomorphology

Operations at the Bull Mountains Mine No. 1 would consist of underground continuous and longwall mining. The land surface of the area to be mined that might be impacted by subsidence is used primarily for livestock grazing and wildlife habitat. Subsidence effects are not anticipated to cause material damage or diminution of the renewable resources. Surface disturbances would occur to the acreage occupied by the main facilities area and Waste Disposal Area (WDA). Other potential effects on the land surface would occur above the longwall mine subsided areas, including 1) changes to the drainage channels; 2) impacts from general land surface lowering; and 3) surface subsidence cracks.

Longwall panels feature yielding pillar design, promoting uniform subsidence profile and also providing stable mining conditions. This smooth subsidence profile is classified as trough subsidence, and normally a gradual flexure of the surface is observed. It is anticipated that maximum subsidence would be 70 percent of extraction height with an angle of draw of 22.5 degrees. In areas with an average coal height of 8.5 feet, maximum subsidence would be approximately 5.9 feet, and in areas with an average coal height of 11 feet, subsidence would be approximately 7.7 feet (Agapito and Maleki, 1990). A subsidence monitoring program would be implemented to measure the subsidence and to record any mining induced damage to surface resources.

Mine area stream channels may be affected by the surface expression of mine subsidence. The profiles of these drainages may be modified by small ridges held up over barriers, pillars, and mains, and by depressions over the longwall panels. The occurrence of these modifications would be dependent upon the orientation of the drainages to the mine layout. Generally, the mine would only pass under a drainage approximately one time in a year, so the progression of the effects can be monitored, and enduring detrimental effects can be mitigated. These drainages are ephemeral and flow in response to storm events. If it is determined that surface flow is being diverted downward into the mine workings, then culverts or piping would be used to contain this flow and carry it over extraction areas. If ponding occurs in the depressions, then an evaluation would be made to determine whether it may be used opportunistically as an alternative source of replacement water.

Surface fractures may temporarily open up over areas of tensional stresses in the rocks overlying the area of active mining. These cracks would be relatively small and shallow and would heal with time (Agapito and Maleki, 1990). If enduring detrimental impacts to the hydrologic system occur as result of surface fractures, then SPE would implement remedial measures such as filling the fractures, using culverts or pipes to divert flow across them, or some other appropriate mitigation measure.

4.2.4.2.2 Effects on Channel Characteristics and Downstream Users

The mine effects on channel characteristics and downstream users would be negligible as discussed above. The mine effects to downstream use or users would also be negligible. SPE has made a commitment in the existing permit document to protect and replace the water supply of any owner if such supply has been affected by the underground mining operation.

4.2.4.2.3 Effects on Surface Water Quality

No surface facilities would be located on the federal coal lease area. The effects of sediment pond discharges on stream water in the existing mine facilities area would be negligible. All sediment ponds are designed to contain the 10-year/24-hour runoff plus sediment. Due to the low precipitation in the area, pond discharges should be very infrequent. In the event that a sediment pond discharge should occur, sampling, effluent limits, and reporting would comply with the MPDES requirements. Routine maintenance of the ponds would ensure the storage capacity. Where practical, runoff from undisturbed areas would be diverted around the sedimentation ponds in order to decrease the quantity of water to be treated within the ponds. Some undisturbed area waters would enter the ponds, however, and would be treated and discharged under permit requirements.

During the life of the mining operation, ditches and culverts would be employed to handle surface runoff within and around the mine facilities area. All ditches are designed to convey the 10-year/24-hour precipitation event, except those in the WDA, which are designed to convey the 100-year/24-hour precipitation event. All ditches and culverts would be routinely inspected to ensure that accelerated erosion is not occurring at the outfalls. No long term or permanent water quality impacts are anticipated due to the emplacement of these structures.

4.2.4.2.4 Effects of Runoff on Stream Quantity and Quality

No permanent effects to the quantity and quality of stream flow are anticipated from disturbed areas within the mine facilities area. Since this is an underground operation, the total disturbed surface acreage is small. All flow from these disturbed areas would be discharges into sedimentation ponds and would meet approved MPDES discharge criteria prior to discharge into PM Draw. Discharge from mine dewatering would also pass through a sedimentation pond and would meet approved MPDES discharge criteria (see Groundwater section above for predictions of mine water quality) prior to discharge into PM Draw. Reclamation and revegetation of the disturbed areas would prevent detrimental impacts from occurring. All flow is ephemeral in the mine plan area; therefore, flow impacts would be negligible.

4.2.4.3 Mitigation Measures

SPE is committed to mitigating hydrologic impacts caused by mining through the measures approved in the permit, or by alternative measures to be developed in consultation with the MDEQ. Depending on the resource, impact, and mitigation alternatives available, SPE will rehabilitate water resources as appropriate. This might include drilling new wells, piping water from wells or springs to specific locations, development of new springs, repair of stream channels, repair of ponds, or establishment of other water management structures, such as guzzlers (water harvest tanks). To implement these measures, SPE has developed a strategy for mitigation of any short or long-term hydrologic or wetland impacts that occur due to mine development, operation, or reclamation. The mitigation plan will follow a multi-step process that has already been initiated for phases of progression of mining operations. These steps include:

Pre-mining Phase

- Determine water use patterns and demands to be maintained.
- Estimate the time required for potential hydrologic impacts to appear after mining begins.
- Determine mitigation alternatives for impacted sites.
- Obtain MDEQ approval and if necessary, conduct appropriate field surveys of the areas in which mitigation will occur.
- Establish an “enhancement bubble” of mitigation measures in advance of any potential impacts by testing and evaluating alternative materials and measures for repair and restoration of ponds, stream channels, or wells.
- Establish and monitor reclamation targets for hydrology, vegetation, aquatic ecology and land uses.

Operation Phase

- Monitor to determine if impacts have occurred.
- Inspection to define extent of changes.
- Emergency response and temporary mitigation to satisfy current water uses.
- Agree on and complete appropriate mitigation measures.
- Monitor to determine reclamation success.

Post-mining Phase

- Initiate final reclamation and mitigation program.
- Continue maintenance on mitigation measures as required.
- Establish final reclamation standards for all measures completed.

4.2.5 Soils

Mining of the federal lease area would not require any surface facilities or disturbance and would have no direct effect on soils in the lease area. Surface subsidence over the mined areas would also have no indirect effect on the nature or productivity of soils. Steep slope instability and failure, rock toppling, and alteration to topography and drainage patterns resulting from subsidence could lead to localized soil changes on steep slopes and at the bases of slopes. These changes would have negligible effects on productivity. Pre-mining surface drainage patterns would be restored. In general, it would be less damaging to allow soils to heal naturally than to use any mechanical treatment.

4.2.5.1 Mitigation Measures

Subsidence over mined areas may alter surface drainage and accelerate degradation of erosive or unstable soils in limited areas. In consultation with MDEQ, soil salvage, regrading, soil replacement, or seeding may be necessary to maintain existing soils and pre-mine land use. In most areas of subsidence where erosive or unstable soils are not present soil profiles would remain intact and retain their chemical and physical characteristics. Mitigation of surface effects of subsidence to soils would be evaluated on a site-specific basis in consultation with MDEQ.

4.2.6 Vegetation

The Proposed Action would not include any surface ground disturbance or surface features, but would lead to subsidence over the longwall mined areas which may temporarily affect upland and wetland vegetation. There could be short-term indirect effects to vegetation resources resulting from subsidence over the mined areas. There are perennial ponds and stream reaches created by flow from 15 springs on the federal coal lease area and 12 springs located adjacent to the lease area. Changes in spring flow would affect the distribution of these wetland habitats. It is expected that vegetation would naturally re-colonize disturbed areas. Because disturbances would occur subsurface, the further spread of invasive, non-native plants is not expected.

4.2.6.1 Mitigation Measures

Subsidence would result in localized areas of erosion and slope instability or altered surface drainage which could disrupt the distribution of vegetation. Mitigation of altered surface drainage is discussed under water resources. Areas of surface disturbance would be evaluated on a site-specific basis and, if the extent of disturbance warranted, a site-specific repair and mitigation plan would be developed and implemented in consultation with MDEQ.

4.2.7 Wildlife

Wildlife is highly responsive to vegetation distribution because vegetation communities are essentially the habitats for wildlife. The Proposed Action would not have any surface disturbance that would directly affect wildlife. However, the Proposed Action may affect wildlife through its indirect effects on vegetation, though these effects are expected to be minimal. Slight changes in topography, spring flow, and vegetation resulting from subsidence over the longwall would lead to minor local changes in wildlife habitat, but would not change the distribution of habitats or wildlife populations. Effects to wildlife as a result of the operation of the surface facilities complex would not change as a result of the Proposed Action, however, would be extended for an additional 7 years while the federal coal is mined. The operations plan includes measures to replace affected wildlife habitats with similar habitats.

Critical big game habitats and migration corridors are not known to occur in the coal lease area. Thus, any indirect effects to vegetation arising from subsidence would not impact the survivorship and productivity of big game species in the project area. Effects to big game as a result of the operation of existing surface facilities would not change as a result of the Proposed Action.

There is potential for bat roosting habitat to be impacted in the subsidence area. Twelve bat species have been identified in the project area. Many of the bats may use rock outcrop areas for roosting. This habitat may be locally affected in steep slope areas by subsidence and rock toppling over longwall mined areas. However, these species are adaptive and if displaced, would likely move to new roost locations. Subsidence alone is not expected to significantly change the distribution of bat populations.

Subsidence may also minimally affect bat and bird roosts and nests in trees and cliff areas. The average subsidence, estimated to be 7.7 feet, is expected to be uniform across large areas. This may result in rock toppling and damage to some trees where nests may be located. This could cause localized damage to raptor or other migratory bird nests within the subsidence area, and possibly some limited mortality of eggs or young if the subsidence occurred during the breeding season. Birds are adaptive and if displaced would be expected to re-nest in new locations in subsequent years. The only raptor nest identified during surveys within the subsidence area is a great horned owl nest located in Section 9 (adjacent to lease tract in Section 8) as shown in **Figure 3.7-1** (WESTECH 2007, 2008). Other raptor nests were observed near surface facilities, with the nearest being located to the east and approximately 0.13 miles from the existing Fattig Creek Road, as shown on **Figure 3.7-1**. In addition, a sharp-tailed grouse lek location was observed in 2006 to the east of the surface facilities and approximately 0.22 miles east of existing Fattig Creek Road, as shown on **Figure 3.7-1**. These nest and courtship locations would not be further affected by the continued operation of the existing surface facilities (WESTECH 2007, 2008).

Aquatic habitat in the area includes streams, ponds, springs, seeps, and areas associated with wetland communities. The Rehder, Fattig, and Railroad Creek drainages are ephemeral; however, there are perennial ponds and stream reaches created by flow from 15 springs on the federal coal lease area and 12 springs located adjacent to the lease area. Changes in spring flow would affect the distribution of these habitats. Depending on the rate and extent of changes in spring flow, local populations of amphibians and aquatic species may experience local short-term modifications in habitat.

4.2.7.1 Mitigation Measures

Subsidence may result in local changes to surface and groundwater flow and to the distribution of vegetation communities. This would affect the distribution of resources available to wildlife. Mitigation for water resources and vegetation are discussed in those resource sections.

4.2.8 Threatened, Endangered, and Special Status Species

Federally threatened or endangered species, particularly the black-footed ferret and the whooping crane, have not been identified in federal lease areas. They would not be affected by the Proposed Action.

Montana special status species that have been documented during mine-related studies include several raptors, migratory birds, bats, the Great Plains toad, the Northern Leopard frog, and sagebrush lizard. The greater sage-grouse and sagebrush lizard occur exclusively in sagebrush communities, which are sparse in the project area. The remaining birds and bats are mobile or migratory and are unlikely to be affected by local changes in vegetation and drainage resulting from subsidence over the mined areas. The Great Plains toad and Northern Leopard frog are dependent on mesic habitats and would be affected by changes to springs and drainage patterns. Mitigation measures identified to minimize effects or replace spring flow would limit the effects of mining on these species.

4.2.9 Ownership and Use of Land

The proposed lease area is both private and federal surface with federal minerals administered by the BLM. Adjacent land is privately owned. Under the Proposed Action, leasing of the coal for underground longwall mining would not result in surface modifications within the lease area that would limit or change current surface uses. Subsidence over longwall mined areas may result in localized slope instability, rock toppling, and alteration of topography at the interface between mined and un-mined areas. This may slightly alter patterns of use in the short term during subsidence, but would not have a long-term effect on use of the land.

Kern et al (2002) prepared a study of effects to residential property values from longwall coal mining. The report does not discuss the specifics of particular cases, but general patterns. Nevertheless, these patterns may provide some considerations for the Bull Mountains Mine No.1. In the area of the study in Pennsylvania, longwall mining operations occurred in more rural and remote sections of the counties rather than densely developed areas. Consequently, the subsidence may affect a relatively small number of structures over a large area. There also may be other kinds of property damage not addressed by this report. As discussed in Section 2.1.1.3, the surface effects of subsidence over longwall mining are affected by: the thickness of the overburden; the thickness of the coal seam removed; the type of rock in the overburden; surface topography; the width of the longwall panel; and the location in relation to the center and edges of the longwall panel. On an ideal uniform surface, the greatest structural stress occurs where there is the greatest difference in vertical displacement, horizontal tension, and horizontal compression or displacement. Kern et al (2002) note that subsidence deformation increases significantly as the longwall panel width increases in proportion to the depth of the coal seam. Longwall panels wider than the depth of the coal seam, rather than simplifying the surface effects, result in multiple points of maximum subsidence. Kern et al (2002) found that the value of properties in rural areas was more strongly affected by land use density and access to public infrastructure (roads, sewer and water) than by proximity to longwall mining. In this study, less than 8 percent of the properties located in areas where longwall mining was active filed claims with the coal companies for damage. Some property owners may not have filed claims for damage that occurred because they were not aware of the process or did not consider it worth the effort. Nevertheless, it appears that property damage was generally not extensive or extreme. The study found that, of the properties that filed claims for subsidence damage with the coal companies and also sought tax assessment reductions because of property damage, many returned to or surpassed their previous assessment value. The report also noted instances of road damage in the mining areas reviewed by this study. The authors concluded that with regular maintenance and planning these subsidence effects can be minimized.

Surface structures located within the lease area that may be affected by subsidence include fences, roads, and trails in all sections, water conveyance pipeline for livestock in Section 22, building structures in Section 4, home sites in Section 4, spring developments (including ponds, water tanks, and pipes) in all sections for livestock and wildlife, and wells located in sections 4, 10, 14 and 22. SPE would be required to conduct a pre-mine survey to determine the status of all structures above the mine area, monitor subsidence during and after mining, and immediately repair damage to the structures. SPE would also post a reclamation bond to insure availability of funds to repair damages to identified structures. This bond would not cover construction of structures to be built after mining or subsidence damage to undeveloped rangeland. In addition, Musselshell County would require that SPE repair any damage to Fattig Creek County Road.

4.2.9.1 Mitigation Measures

- SPE would repair damage to existing buildings and structures resulting from subsidence.
- SPE would repair damage to existing infrastructure over mined areas such as roads, fences, communications facilities, and utilities.
- Where there would be known or reasonably anticipated damage to infrastructure or communications facilities, SPE would submit a protection and mitigation plan to MDEQ for approval prior to mining under that area.
- SPE would publish the mining schedule at least six months prior to mining under an individual's land, to provide adequate warning of periods of risk and to minimize the potential risk to humans and livestock.

4.2.10 Cultural Resources

4.2.10.1 Prehistoric and Historic Resources

The federal coal lease area has been surveyed for cultural resources. No resources eligible for the National Register have been documented, however, one site (24ML667) is unevaluated because of the potential for deeply buried cultural deposits. Until this site is evaluated, it should be treated as an eligible site. Cultural resources on steep slopes and in areas of cliffs and rock outcrops may be affected by subsidence movement resulting from underground mining. However, no surface disturbance is proposed for the coal lease area and, to date, no eligible cultural resources have been identified in the LOM area on steep slopes or in areas of cliffs and rock outcrops. If potentially eligible cultural resources are identified that may be affected by mining, site-specific treatment plans will be developed and implemented.

4.2.10.2 Native American Religious and Traditional Concerns

Formal consultation is a government-to-government process that must be completed by the BLM for the federal coal lease area and by the state for a permit to mine the lease area. Formal Native American consultation has been initiated with the Crow and Northern Cheyenne and is ongoing. To date, no concerns have been raised.

During the informal consultation that occurred in the 1990s, no potential TCPs were identified in the proposed lease area (Kooistra-Manning and Deaver 1993).

In general, rock shelters, rock art, large rock features, or burials could be affected by areas of slope failure and rock toppling. However, no similar sites were identified during the 2008/2009 cultural inventory of the proposed lease area. Springs were identified as potentially sensitive resources during the informal consultation in the 1990s and would need to be addressed regarding mitigation if effected by subsidence.

Under the Proposed Action, this disturbance of the quiet zone of the deep earth and disruption of the spirits that dwell in springs cannot be avoided. Native American religious and traditional concerns, if present, could be affected by subsidence above mined areas.

4.2.11 Visual Resources

The Proposed Action would not include any direct surface disturbance or surface facilities in the federal lease area. Mining of the coal seam would result in subsidence over the mined areas which could result in slope instability and failure, rock toppling, and alteration to topography and drainage patterns. In general, this would not affect scenic views from the county road or from residences in the Bull Mountains. This would alter details of the scenery such as local rock features in steep slope areas, but not the overall nature and quality of the scenic and aesthetic values.

4.2.12 Noise

The Proposed Action would not create any surface activity in the federal lease area and there would be no direct effects as a result of underground mining. The Proposed Action would facilitate ongoing mining and would lead to the continuation of current noise levels and effects from the mining operations at the surface facilities complex.

Baseline noise level data were collected from the PM Mine when it was still in operation. Construction and heavy equipment operation noise levels ranged from about 72 to 95 dBA near the preparation facility to an ambient noise level of about 35 to 40 dBA. SPE anticipates that noise levels at the Bull Mountains Mine No. 1 facilities would be comparable during the permitted coal mining operations. During operation of the surface facilities, principal noise sources would be preparation plant equipment, other stationary machinery, ventilation fans, heavy equipment, conveyors and rail cars. Noise levels at the facilities during operation range from 72 to 95 dBA. These noise levels would decrease and reach acceptable outdoor levels of about 40 dBA at the nearest residences about 4,500 feet from the surface facilities. Most residences in the general area are much farther from the surface facilities. However, the rail loop reaches within about 2,100 feet of the nearest residence to the south. It is expected that as many as three coal trains a day would carry coal from the mine to the BNSF Railroad mainline at Broadview. Coal production from the lease area would not increase train traffic noise in local communities, but would extend the transportation of coal by an additional seven years.

4.2.12.1 Mitigation Measures

Noise levels are monitored and kept within state and federal guidelines and standards. Noise control measures include well-maintained heavy equipment and enclosed stationary equipment.

The impacts of noise from the mine surface facilities would affect very few people and would be present only as long as the mine is operating. There would be no change in existing noise levels as a result of currently permitted mining operations. There would be no new noise impacts from leasing the federal coal, however, existing noise from surface facilities would continue for an additional 7 years.

4.2.13 Transportation Facilities

The Proposed Action would not include any surface activities or traffic in the federal lease area that would alter existing transportation infrastructure or facilities or require additional maintenance. No additional demand for transportation of employees to the surface facilities complex would be required. Mining operations, processing, and coal transportation would be extended throughout the period required to mine the additional available coal from the coal lease area. There would be approximately three trains a day carrying coal from the mine. Railroad traffic levels would continue at the existing rate for an additional seven years as a result of the availability of coal from the coal lease area.

4.2.14 Hazardous and Solid Waste

Under the Proposed Action, there would be no surface activities in the federal lease area that would create any known hazardous, solid, or liquid waste. Solid and liquid waste would continue to be produced at the mine facilities and, as the mine advances, these wastes would result from activities associated with mining the leased coal. Continued operation of the surface facilities during mining operations would produce waste material from underground development and from coal processing which would be deposited in the permitted WDA. The use of the WDA for waste material disposal would result in the filling of the upper reaches of the ephemeral side drainage of Rehder Creek.

Procedures are in place for handling solid and liquid waste produced by mining activities, and these procedures would continue to be used. Waste would be produced by daily operation of the facilities and office, operation of machinery and mining. Waste materials would include garbage, non-mineral waste and sewage; lumber and debris; grease, lubricants, paints, and flammable liquids; underground development waste; and coal processing waste.

4.2.14.1 Waste Disposal

Trash and non-mineral waste would be accumulated in commercial dumpsters located in convenient locations around the site. Trash from these dumpsters would be picked up regularly by a licensed commercial trash service for disposal off site. Lumber, garbage, and other debris would be placed in storage containers which would be regularly picked up by an appropriately licensed commercial waste disposal company.

A septic tank and drain-field has been constructed in the mine facilities area to treat sewage and other waste water from potable systems. This system is designed to comply with state and federal regulations. System design capacity complies with state regulations, considering the number of men working and the number of shower and restroom facilities provided.

4.2.14.2 Measures against Acid/Toxic Materials

Storage and final disposal of grease, lubricants, paints, and flammable liquids would be in compliance with MDEQ Rule 17.24.507. Grease, lubricants, paints, and flammable liquids would be stored in steel drums and periodically picked up by, or delivered to, an appropriately licensed and bonded liquid waste disposal company.

4.2.14.3 Disposal of Underground and Coal Processing Waste in the WDA

Underground development waste that cannot be stored underground together with coal processing waste would be disposed of in the WDA (**Figure 2.1-4**). Generally, underground development wastes would represent poor quality coal, shale, claystones, mudstones, and siltstones that are mined to access economic coal zones or to clean up roof falls, maintain floor grades, or to maintain necessary roof heights. If possible, this waste would be stored underground. Otherwise, this material would be conveyed to the WDA and blended with the coal processing waste. Coal processing waste is also made up of shale, claystones, sandstones, mudstones, siltstones and unrecovered coal fines that are removed from mined coal (raw coal) to make it marketable. Since underground development waste would represent less than 10 percent of the WDA material, design details for the WDA are based on the more conservative requirements for coal processing wastes (SPE 2009). No underground development or coal processing wastes from outside the permit area would be disposed of in the WDA without approval from the MDEQ.

Underground development and coal processing waste is being hauled and placed within the permitted area. The WDA is designed to control runoff by diverting surface runoff from undisturbed areas around the fill and directing runoff from disturbed areas in ditches through sediment ponds to achieve discharge requirements in compliance with MDEQ Rules 26.4.631 and 26.4.633. The WDA fill structure would be covered with 4 feet of non-toxic material (including topsoil and sub-soil) and revegetated according to the mine Reclamation Plan when final fill contours are achieved (both during operations and at end of life). For those areas of the WDA which have been enhanced for topographic diversity (knobs and the top and nose of the WDA face at the head of the valley) additional placement of spoil material is planned to further reduce potential erosion problems. The enhanced topographic areas of the WDA would be constructed with the standard 4 feet of non-toxic material (topsoil and sub-soil) with the placement of an additional 6 feet of spoil located between the non-toxic material and the coal fines. Stockpiles would be vegetated to minimize erosion and reclaimed to approximate original contour when the WDA is no longer in operation. The planned post-reclamation land use is rangeland and wildlife habitat. The WDA would not create a public hazard either during construction or after reclamation and would be posted and patrolled to limit public access. Wastes would be well-compacted and covered with non-toxic material to eliminate the possibility of spontaneous combustion.

All vegetation and other organic materials would be removed from the WDA fill area and stockpile areas before topsoil and are removed and stockpiled. No underground development processing wastes would be placed until vegetation, and sub-soil has been removed and diversion ditches and sub-soil or coal topsoil sedimentation ponds are operable. Topsoil and sub-soil would be removed in a progressive fashion in advance of fill construction to minimize exposure to wind and water erosion and disturbed areas would be kept to reasonable minimums. Salvage operations would be conducted periodically as required in advance of the fill construction area. SPE would maintain a buffer zone of sufficient area to avoid contamination of soil by coal processing waste. SPE would provide diversion and collection ditches, riprap and vegetation of disturbed areas to minimize surface erosion.

The WDA would ultimately meet the definition of a head-of-hollow fill. Waste materials would be placed in maximum 2-foot lifts and compacted to at least 90 percent maximum dry density to provide stability and prevent mass movement. Coal wastes would be mixed in the coal preparation as part of the cleaning process, and would be further mixed during transport and spreading at the WDA. Mixed coal waste would be spread in two foot lifts and allowed to air dry, as necessary, prior to compaction.

Analyses of underground development and coal processing wastes were conducted to determine the acid-base potential of the materials to be placed in the WDA (Dollhopf 1989). The study determined that these materials are non-acid forming due to either their low sulfur content and/or lack of framboidal pyrite. The acidity from any pyrite contained in the waste will be neutralized by the inherent inert base chemistry of these massive morphology materials. Based on the results of the analyses, it was concluded that coal refuse will not produce acid upon exposure to water and oxygen. Liberation of metals was tested from TCLP laboratory analysis of the waste material by SPE in December 2009 (SPE 2010) and all parameters were found to be not detected at the reporting limit or within maximum contaminant levels. With the control of surface water run-on and low precipitation of the area, negligible effects to surface and groundwater of the WDA area are expected. To monitor these predictions, SPE will conduct testing of the underground development and coal processing wastes using EPA Test Method 1627: Kinetic Test Method for the Prediction of Mine Drainage Quality (EPA 2009b).

The WDA does not contain any springs, natural or manmade water courses (except ephemeral flow in drainages), or wet-weather seeps.

4.2.15 Socioeconomics

Under the Proposed Action, the mineral rights of the federal coal lease areas would be leased, and operation of the mine would continue at its current level for the proposed mine plan of 12 years. The project would contribute to the maintenance of current socioeconomic conditions in the Bull Mountains area at current levels, and would prolong the duration of employment for current employees. The issuance of this lease adds reserves to an existing mining operation, and would not adversely impact the social or infrastructure systems of the local communities. These local communities are located in a coal mining area where mining activities have sporadically occurred for over 100 years. Without issuance of this lease, employment would not reach the mine's projected sustainable term.

Implementation of the Proposed Action would result in effects to the social and economic structure and community resources of the affected counties over the additional project life of 7 years that would be a continuation of effects from current mine activities. The mine would provide employment for the existing mine workforce of 200 for an additional 7 years. It is not anticipated that the proposed mining activities would require the hiring of additional workers. The extension of the life of mining activities at Bull Mountains Mine No. 1 under the Proposed Action would maintain current mining employment in the affected counties, and provide for the continued payment of local, state, and federal taxes by SPE 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. Counties would continue to receive revenues from taxes, fees, and permits. Continued operation of the mine would contribute to severance taxes imposed on coal production. Severance taxes are paid directly to the State of Montana. Coal Gross Proceeds on coal production support county governments where the mine is located. The proceeds revenue is proportionally distributed to the appropriate taxing jurisdictions in which production occurred based on the total number of mills levied in fiscal year 1990.

Additional personal income would be generated for residents in Musselshell County and the State of Montana by circulation and recirculation of dollars paid out as salaries, business expenditures, and as state and local taxes.

Most additional required construction and operations workforce would be available within the Billings area. The mine recently expanded the operations workforce by 50 workers, of which an estimated 20 percent were estimated to migrate into the counties from other regions, for a total of 200 workers. It is anticipated that effects to social and economic conditions in the counties would be very small. The relatively small number of in-migrating workers is unlikely to affect permanent and temporary housing stock, which is plentiful in Billings.

Because there would be no significant increase in population from in-migration, construction, operation, and maintenance of the proposed project; there would be no increase or decrease in the need for police, fire, medical or other community resources in Musselshell and Yellowstone counties. Similarly, there would be no change in housing requirements.

The Bull Mountains Mine No. 1 project currently generates a monthly payroll in Montana of over $400,000, adding much needed revenue and employment to the local economy (SPE 2009). The monthly contribution would continue an additional 7 years with the approval of the proposed project.

The federal rents and royalties would be determined following the decision to lease the coal. The estimated royalties would be 8 percent of the revenue realized from sale of the federal coal. The estimated amount and distribution of these royalties would be determined at a later date. The federal royalties would also contribute to the county and community revenue.

The total coal tax burden for coal production in Montana is approximately 14 percent of gross revenues, or approximately 20.2 percent of the contract sales price (Montana Department of Revenue 2009). Based on the estimated annual production of up to 10 million tons clean coal and the 2007 annual average open sales price of $11.79 per short ton of coal produced in Montana (Energy Information Administration 2009), the proposed project could contribute a potential $23,816,000 million annually in tax revenues to the state. The actual annual taxes that would be paid would vary according to several factors, including the actual annual production and the open sales price per ton of coal.

The Proposed Action would have minimal effects to the rural character valued by residents of the Billings Field Office area. The apparent naturalness, opportunities for solitude, and other characteristics of the rural landscape would remain unchanged under the Proposed Action; however, effects to these qualities from the sights and sounds of current mining activities would continue for an additional seven years. Existing trends in population growth, energy development, and popularity of recreational opportunities in the region (south-central Montana) would combine to change the area over time, as more people use and enjoy it.

4.2.16 Environmental Justice

The project area is outside the Crow and Northern Cheyenne Indian Reservations, does not include any Indian Trust Assets, and does not contain any locations specifically named in tribal treaties. The mine surface facilities complex is about 35 miles from the nearest reservation lands and operation of the mine would have no direct effects on the natural and physical environment of the reservations. No adverse human health or environmental effects would be expected to fall disproportionately on the reservations or on other minority or low income populations from the Proposed Action.

4.2.17 Short-term Uses and Long-term Productivity

NEPA requires consideration of “the relationship between short-term uses of man’s environment and the maintenance and enhancement of long-term productivity” (40 CFR 1502.16). As declared by the Congress, this includes using all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans (NEPA Section 101). The discussions contained within this environmental consequences chapter provide the analysis and relationships of shorter uses and long-term productivity.

4.2.18 Unavoidable Adverse Effects

For the Proposed Action, subsidence is unavoidable if coal is mined in a productive and economic manner. The Geology Section discusses the affects of subsidence and other resource sections discuss the indirect effects of subsidence.

4.2.19 Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources are those that cannot be regained. In this case, the removal of mined coal is an irreversible commitment of resources. Irretrievable commitments are those that are lost for a period of time. In this case, the localized loss of soil and rock toppling on steep slope as a result of subsidence are likely to be irretrievable.

4.3 Cumulative Impacts Analysis

Cumulative impacts are those impacts that result from incremental effects of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or action undertakes such other actions.

4.3.1 Past and Present Actions

Past and present actions in the general area include past small-scale coal mining, the development of the Bull Mountains Mine No. 1, ranching, recreation, and dispersed rural residential development in the upland divide area north and east of the existing mine between the Rehder and Fattig Creek drainages.

Past coal mining in the area has included the PM Underground and Surface Mine that was acquired by SPE, the Meridian Coal Test Pit, and several historic small underground mines on the coal outcrop of the Mammoth seam. Historic underground mining was by room and pillar methods and there is some limited residual subsidence at these locations. The PM Mine was a surface and underground coal mining operation that the Bull Mountains Mine No. 1 surface facilities were built around. The mine was a small continuous miner operation with six workers that operated intermittently from the 1930s to the early 1970s. The Meridian Coal Test Pit was a surface mine developed by Meridian for marketability testing of the Mammoth seam coal reserves. Approximately 180,000 tons of coal was extracted by open pit techniques in 1989 and 1990. This coal was trucked to the Huntley load-out facility. Peak employment by this mine was about 20 employees.

Historically, the project area has been used for ranching. The area also supports wildlife. The project area includes portions of the lands formerly used by four large ranching operations. Two of those ranches are still active.

4.3.2 Reasonably Foreseeable Action Scenario

Foreseeable future actions in the general project area include additional coal mining to the north of the Bull Mountains Mine No. 1 LOM area, continued ranching activities in the Bull Mountains area, and additional dispersed rural residential development (**Figure 4.3-1**). Future subdivisions on private lands typically increase the demand for access roads and utilities rights-of-way across BLM public lands.

The Mammoth coal seam to the north of the LOM area may be considered for mining as the coal reserves become exhausted at the Bull Mountains Mine No. 1. This is not currently a reasonably foreseeable action. No mine plans are available to assess the potential effects of this mining. While it could be speculated that mining methods would be similar to that of the Bull Mountains Mine No. 1 and the effects would also be similar in nature and magnitude, it is also possible that technology may change prior to mining this area. Development of the Mammoth seam reserves north of the divide could continue mining activities for an additional 10 to 20 years at production levels of 10 to 15 million tons per year.

The ongoing dispersed rural residential development includes portions of sections 4 and 5, north of Rehder Creek accessed by Fattig Creek Road. It is reasonably foreseeable that this residential development may continue to the north and west of Fattig Creek Road. This development would increase human activity in the area affecting local traffic, noise, and wildlife populations.

Ranching operations in the area are expected to continue for the foreseeable future. As economics and the desire to ranch large areas may diminish, future subdivisions may occur, thus, causing an increase in population and human activities in the area. These activities may cause changes in vegetation communities and additional pressure on wildlife populations.

4.3.3 Cumulative Impacts

The potential impacts of continued mining in the Bull Mountains at Bull Mountains Mine No.1 or any other mine that may be developed in the area would incrementally add to cumulative impacts. These impacts individually and in the short-term would be minor. If mining continues to the north of the Bull Mountains Mine No. 1 LOM area, impacts would be similar. If additional residences are built in this area, and if the coal reserves to the north are developed, there would be the potential for subsidence damage to structures over the mined areas. Livestock grazing in the region has been managed for sustained production, which relies on minimizing adverse impacts to the environment. Continued ranching under current management practices would have little or no cumulative impact on resources.

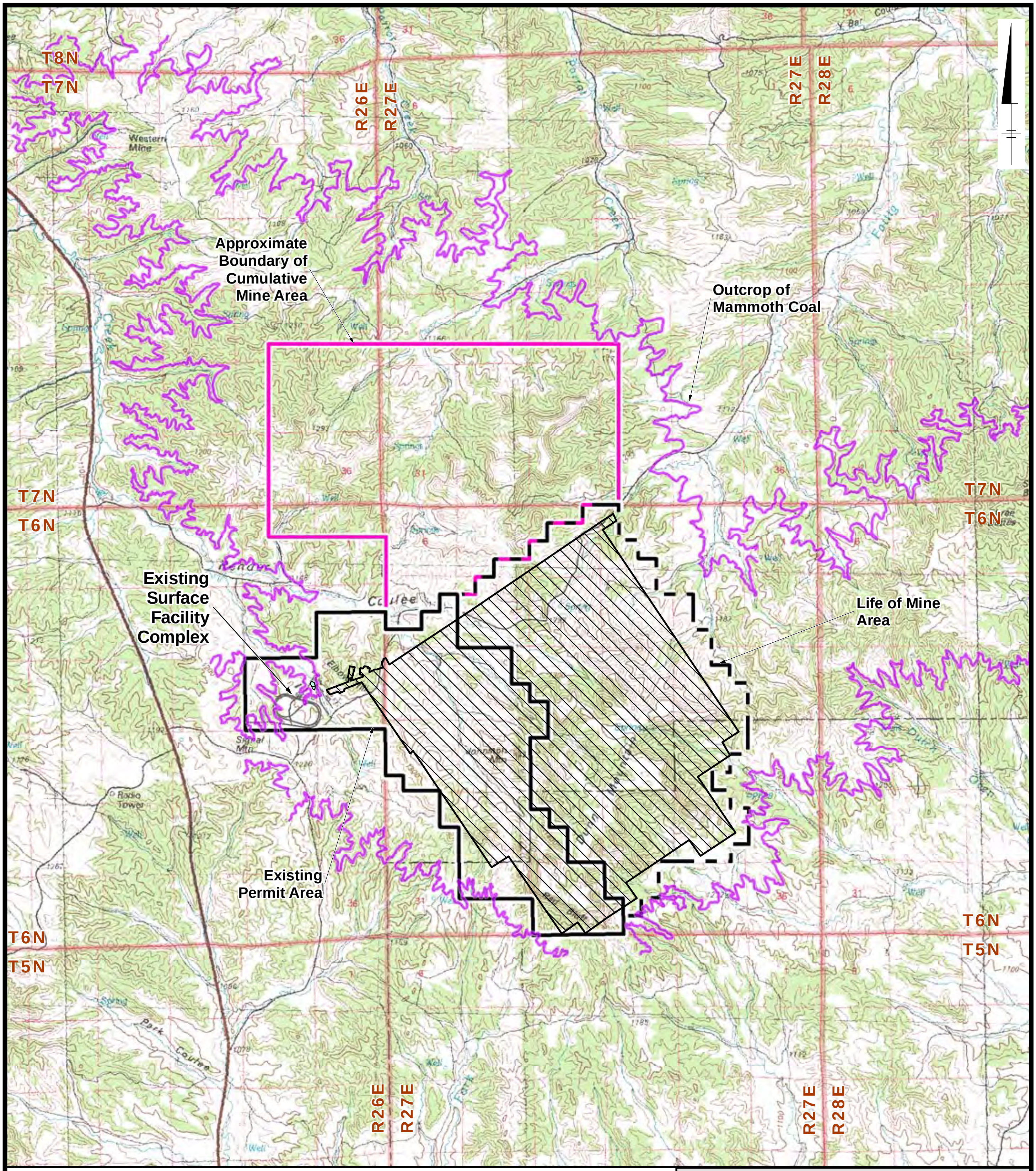
In general, the effects of other underground mining in the Bull Mountains would be cumulative. These would include the surface disturbances at surface facilities that would be reclaimed when the mine is closed and indirect effects of subsidence over the mined areas that may impact water resources. Short-term effects of subsidence may include areas of slope failure and rock toppling, possible disruption of groundwater flow and surface drainage patterns, disruption of vegetation and wildlife, and local disruption of land use. Some of these disruptions may require short-term mitigation measures. Overall, anticipated impacts of underground mining are mitigable, and there are no categories of impacts that are likely to accumulate to a moderate or severe level. The resources would recover after the mining operations are complete.

The cumulative effects of dispersed residential development may be more evident than the cumulative effects of underground coal mining. New roads have been built north of Fattig Creek Road in recent years and scattered residences are being developed. Since the land in sections 4 and 5 at the north end of the Bull Mountains Mine No. 1 LOM area was subdivided in the late 1980s, approximately 25 parcels have been developed. A similar pattern could reasonably be anticipated to the north in other drainage basins.

4.3.3.1 Topography and Physiography

Additional underground mining in the Bull Mountains would have short-term effects on topography and physiography while surface facilities are active. The facilities could include coal storage piles, soil stockpiles, and waste disposal areas that would affect topography and physiography. After mining is complete, these areas would be reclaimed. General pre-mining topography and physiography would be approximated. Cumulative effects would be minor.

Effects of such additional underground mining would also include subsidence over the mined areas. Subsidence would be expected to be relatively uniform over large areas. Short-term effects of subsidence may include slope failure, surface cracking and rock toppling. There may be small areas that would require mitigation to restore surface drainage patterns or to treat the effects of rock toppling, but overall, the effects of subsidence to topography and physiography would be minor.



LEGEND

- Outcrop of Mammoth Coal
- Approximate Boundary of Mined Area
- Existing Permit Area
- Life of Mine Area
- Approximate Boundary of Cumulative Mine Area

0 1 2 Miles

NAD 83 MONTANA STATE PLANE, METER

SOURCE: USGS 1:100,000 SCALE TOPOGRAPHIC QUADRANGLE - ROUNDUP (1982), MONTANA

BULL MOUNTAIN COAL LEASING ENVIRONMENTAL ASSESSMENT

Figure 4.3-1
Cumulative Mine Area

ANALYSIS AREA: Musselshell & Yellowstone Counties, Montana

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Prepared By: JC | Reviewed By: EC

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Dispersed residential development would have localized effects to topography and physiography from construction of buildings, roads and infrastructure. It is expected that this development would remain dispersed and that cumulative effects would be minor.

4.3.3.2 Geology, Mineral Resources, and Paleontology

The cumulative effects of additional underground mining in the Bull Mountains would primarily be removal of large portions of the Mammoth coal seam. Other geologic features, mineral resources and paleontology in the overburden of the coal would subside in place and largely be intact. Cumulative effects to these resources would be minor.

Dispersed residential development would have very localized effects on geology, mineral resources and paleontology. The overall cumulative effects of the development of these subdivisions would be minor.

4.3.3.3 Air Quality and GHG Emissions

As discussed in Chapter 1, BLM does not authorize mining by issuing a lease for federal coal, but the impacts of mining the coal are considered in this EA because it is a logical consequence of issuing a lease to an existing mine. The use of the coal after it is mined is not determined at the time of leasing. However, almost all the coal that is currently being mined at the Bull Mountains Mine No. 1 is being utilized by coal-fired power plants to generate electricity for U.S. consumers. A discussion of emissions that are generated when coal is transported and burned to produce electricity is included in the Cumulative Impacts section.

As discussed in Chapter 2, under the currently approved mining plan, which represents the No Action Alternative, SPE anticipates that the Bull Mountains Mine No. 1 would mine its remaining estimated 34 million tons of recoverable coal reserves in three years at an average annual production rate of approximately 12 million tons. Under the Proposed Action, SPE estimates that the life of the mine would be extended by about seven additional years at an average annual coal production rate of approximately 12 million tons.

Section 3.3.2 contains estimates of air and GHG emissions resulting from the specific mine operations at the Bull Mountains Mine No. 1 from current and projected operations under the Proposed Action. Under the No Action Alternative, these emissions would continue for another three years until the federal coal is reached.

Ongoing scientific research has identified the potential impacts of anthropogenic (man-made) GHG emissions and changes in biological carbon sequestration due to land management activities on global climate. Although GHG levels have varied for millennia, recent industrialization and burning of fossil carbon sources have caused CO_2 concentrations to increase. “As with any field of scientific study, there are uncertainties associated with the science of climate change. This does not imply that scientists do not have confidence in many aspects of climate change science. Some aspects of the science are known with virtual certainty, because they are based on well-known physical laws and documents trends (EPA 2008).”

The National Assessment of the Potential Consequences of Climate Variability and Change, an interagency effort initiated by Congress under the Global Change Research Act of 1990, Public Law 101-606, has confirmed that climate change is impacting some natural resources that the

Department of the Interior has the responsibility to manage and protect (DOI 2001). The Synthesis Report, the final part of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), was released in preliminary form on November 17, 2007. The Synthesis Report summarizes the results of the assessment carried out by the three working groups of the IPCC. Observations and projections addressed in the report include:

- "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperature, widespread melting of snow and ice, and rising global average sea level."
- "Observational evidence from all continents and most oceans show that many natural systems are being affected by regional climate changes, particularly temperature increases."

From 1850 to present, historic trend data show an increase of 1°C in global mean temperature. The increase is not linear, and there have been extended periods (decades) where temperature has dropped or stayed constant. This historic warming over that same period has caused sea levels to rise by about 20 cm on average, and has also resulted in changes in climate patterns on land. These changes are not uniform. In some areas near the equator, temperatures have cooled by about 5°C, while closer to the poles, temperatures have risen by equal amounts (Hansen and Lebedeff 1987). In northern latitudes (above 24° N), temperature increases of nearly 1.2°C (2.1°F) have been documented since 1900. Temperature changes can result in shifts of weather patterns (rainfall and winds) which may then affect vegetation and habitat. The importance of temperature change and changes in precipitation in species migration and change is being investigated.

There has been, and continues to be, considerable scientific investigation and discussion as to the causes of the recent historic rise in global mean temperatures, and whether the warming trend will continue. "Several activities contribute to the phenomena of climate change, including emissions of GHGs (especially carbon dioxide and methane) from fossil fuel development, large wildfires and activities using combustion engines; changes to the natural carbon cycle; and changes to radiative forces and reflectivity (albedo). It is important to note that GHGs will have a sustained climatic impact over different temporal scales (EPA 2008)." Three identified possible causes are solar effects, human population growth, and greenhouse gas effects.

Solar variability may play a role in global climate change, though the magnitude of the influence of increased sun activity is not well understood. Physical aspects of the sun, like sunspots and solar radiation output, are known to vary over time. The intensity of energy from the sun has varied through time and has resulted in global temperature variation.

Human population doubled to two billion over the period 1780 to 1930, then doubled again by 1974. The atmospheric concentrations of greenhouse gases have increased as human populations have increased. More land and resources were used to provide for the needs of these populations. As human activities have increased, carbon-based fuels have been used to provide for those additional energy needs. Forests and vegetation were cleared in order to provide for food production and human use.

Carbon dioxide, methane, water vapor, ozone, and nitrous oxide (NO_2) are recognized as greenhouse gases. Through complex interactions on a regional and global scale, these GHG emissions and net losses of biological carbon sinks cause a net warming effect of the atmosphere, primarily by decreasing the amount of heat energy radiated by the earth back into space. Like glass in a greenhouse, these gases trap radiation from the sun and act as an insulator around the Earth, holding in the planet's heat.

According to the IPCC's synthesis report (IPCC. 2007):

- "Global atmospheric concentrations of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) have increased markedly as a result of human activities since 1750 and now far exceed pre-industrial values determined from ice cores spanning many thousands of years."
- "Most of the observed increase in globally-averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations. It is likely there has been significant anthropogenic warming over the past 50 years averaged over each continent (except Antarctica)."
- "There is high agreement and much evidence that with current climate change mitigation policies and related sustainable development practices, global greenhouse gas emission will continue to grow over the next few decades."
- "Continued greenhouse gas emissions at or above current rates would cause further warming and induce many changes in the global climate system during the 21st century that would be very likely to be larger than those observed during the 20th century."
- "There is high confidence, by mid-century, annual river runoff and water availability are projected to increase at high latitudes and in some tropical wet areas and decrease in some dry regions in the mid-latitudes and tropics. There is also high confidence that many semi-arid areas (e.g., Mediterranean basin, western United States, southern Africa and northeast Brazil) will suffer a decrease in water resources due to climate change."
- "Anthropogenic warming and sea level rise would continue for centuries due to the time scales associated with climate processes and feedbacks, even if greenhouse gas concentrations were to be stabilized."
- "Anthropogenic warming and sea level rise could lead to some impacts that are abrupt or irreversible, depending upon the rate and magnitude of the climate change."
- "There is high agreement and much evidence that all stabilization levels assessed can be achieved by deployment of a portfolio of technologies that are either currently available or expected to be commercialized in coming decades, assuming appropriate and effective incentives are in place for their development, acquisition, deployment and diffusion and addressing related barriers."

The National Academy of Sciences has confirmed these findings, but also has indicated there are uncertainties regarding how climate change may affect different regions. Computer model predictions indicate that increases in temperature will not be equally distributed, but are likely to be accentuated at higher latitudes. Warming during the winter months is expected to be greater than during the summer, and increases in daily minimum temperatures is more likely than increases in daily maximum temperatures. Increases in temperatures would increase water vapor in the atmosphere, and reduce soil moisture, increasing generalized drought conditions, while at the same time enhancing heavy storm events. Although large-scale spatial shifts in precipitation distribution may occur, these changes are more uncertain and difficult to predict.

Relatively steep elevation gradients between valley floors and adjacent mountain ranges in the western U.S. produce considerable geographic climate variability. Warm, dry, semi-arid conditions are typical on valley floors; moist and cool conditions are typical in higher parts of mountain ranges. Different plant communities occur within specific elevation zones. There also have been patterns of historic climatic variation in these areas for more than 10,000 years, during which plant communities gradually shift to higher or lower elevations depending on the direction of temperature and precipitation changes (Tausch et. al. 2004).

If global warming trends continue into the foreseeable future, Chambers (2006) indicates that the following changes may be expected to occur in the West:

- The amount and seasonal variability of precipitation will increase over most areas. IPCC (2001) climate model scenarios indicate that by 2100, precipitation will increase about 10 percent in summer, about 30 percent in fall, and 40 percent in winter. Less snowfall will accumulate in higher elevations, more precipitation will occur as rain, and snowmelt will occur earlier in the spring because of higher temperatures.
- Streamflow patterns will change in response to reduced snow pack and increasing precipitation. Peak flow in spring is expected to occur earlier and be of lower magnitude because of snowpack changes. Runoff from greater amounts of winter rainfall will cause higher winter flow. Summer flow will be lower, but with higher variability depending on the severity of storm events.
- Some populations of native plants, invasive species, and pests will expand. Increasing amounts of atmospheric carbon dioxide and precipitation during the growing season will provide favorable growth conditions for native grasses, perennial forbs, woody species, and invasive annuals such as cheatgrass. Insect populations also will likely increase because milder winter temperatures will improve reproduction and survival rates.
- Fire frequency, severity, and extent will increase because of the increased availability of fine fuels (grasses, forbs, and invasives) and accumulation of fuels from previous growing seasons. Higher temperatures will extend the length of fire seasons. Expansion of pinyon-juniper species and increasing tree densities could increase the number of high severity crown fires. Higher rates of insect damage and disease also may increase fuel accumulations.
- Sensitive species and overall biodiversity will be reduced. High-elevation habitats will shrink in area or disappear as lower-elevation plant communities expand. It is probable that some mammalian, avian, and other species that currently inhabit these high-elevation habitats may become extinct. Higher rates of disease and insect damage also may pose threats to other sensitive plant and animal species.

In 2006, transportation sources accounted for approximately 29 percent of total U.S. greenhouse gas emissions (EPA 2008). Transportation is the fastest growing source of U.S. GHGs, accounting for 47 percent of the net increase in total U.S. emissions since 1990 (EPA 2008). Transportation is also the largest end-use source of CO_2, which is the most prevalent GHG (EPA 2008).

Historically, the coal mined in Montana and Wyoming has been used as one of the sources of fuel to generate electricity in power plants located throughout the United States. Coal-fired power plant emissions include carbon dioxide (CO_2), which has been identified as a principal anthropogenic GHG. According to the Energy Information Administration (U.S. Department of Energy 2008):

- CO_2 emissions represent about 84 percent of the total U.S. greenhouse gas emissions.
- Estimated CO_2 emissions in the U.S. totaled 5,934.2 million metric tons in 2006, which was a 1.8 percent decrease from 2005.
- Estimated CO_2 emissions from the electric power sector totaled 2,343.9 million metric tons, or about 39.5 percent of total U.S. energy-related CO_2 emissions in 2006.
- Estimated CO_2 emissions from coal electric power generation in 2005 totaled 1,937.9 million metric tons or about 33 percent of total U.S. energy-related CO_2 emissions in 2006.
- Coal production from Montana/Wyoming represented approximately 42 percent of the coal used for power generation in 2006, which means these coal mines were responsible for about 13.9 percent of the estimated U.S. CO_2 emissions in 2006.

Montana/Wyoming coal is shipped nationwide and is currently being exported to Asia. These mines have sold, and are expected to sell coal into the open coal market. Each mine's ability to sell coal in this market will determine annual production rates at that mine. Historically, the coal buyers have been domestic electric producers, although the coal could be used in other coal applications or could be exported.

Relatively little coal, about two percent, is burned in Montana/Wyoming. In 2005, coal was shipped to 35 states besides Montana/Wyoming. As noted above, coal represented 50.2 percent of the fuel mix used by electric generators nationally in 2004. In the NERC power regions where Montana/Wyoming coal is sold, coal use range from 74.2 percent in the upper Midwest to 15.6 percent in the northeast U.S. (EPA 2007).

There are methods of generating electricity that result in fewer GHG emissions than burning coal, including natural gas, nuclear, hydroelectric, solar, wind, and geothermal resources. However, coal-burning power plants currently supply about 50 percent of the electric power generated in the U.S. The demand for power is increasing in the U.S. and throughout the world. According to a recent report by the North American Electric Reliability Council, peak demand for electricity in the U.S. is expected to double in the next 22 years. Many developing countries, including China and India, are also relying heavily on coal to meet their rapidly increasing power demands as coal is more economical and more available than other sources of electrical generation.

Technologies for producing cleaner, more-efficient, and more reliable power from coal are currently available, although not yet commercially established. These include advanced pulverized coal, circulating fluidized bed, and integrated gasification combined cycle (IGCC) technologies. The FutureGen project proposes to produce electricity by turning coal into gas, remove impurities, extract CO_2 from the waste stream, and then sequester the CO_2 underground. A site in southeastern Illinois was recently selected for the plant, which has a goal of being operational in 2012.

At this time, there is no national policy or law in place that regulates CO_2 emissions. A number of bills were introduced in the U.S. Congress in 2007 related to global climate change. The Lieberman-Warner Climate Security Act, which was introduced in October, 2007 by Senators Joseph I. Lieberman (ID-CT) and John W. Warner (R-VA), would establish a cap-and-trade within the United States. This program would require a 70 percent reduction in greenhouse gas emissions from covered sources, which represents over 80 percent of total U.S. emissions. It was voted out of the Senate Environment and Public Works Committee in December, 2007 (http://www.pewclimate.org, accessed 12/21/2007).

Additionally, in 2007, the U.S. Supreme Court (Massachusetts v. EPA) held that CO_2 qualifies as an air pollutant under the Clean Air Act (CAA) Section 302(g). The case was remanded to EPA to take further action to regulate CO_2 under the CAA unless the EPA determines that CO_2 does not endanger public health or welfare. At this time, EPA has not made that determination.

Federal, state, and local governments are also developing programs and initiatives aimed at reducing energy use and emissions. The 2002 Clear Skies and Global Climate Change Initiative is a voluntary national program to reduce greenhouse gas emissions. There are federal tax incentives for energy efficiency and conservation, and some states have renewable energy and energy efficiency policies. Regional initiatives have been started in the northeast (Northeast Regional Greenhouse Gas Initiative) as well as the Western Climate Initiative in the western states. At this time, it is not possible to predict how all of these programs would be melded into a national regulatory process if one were to be enacted.

A number of U.S. financial and corporate interests have acknowledged that enactment of federal legislation limiting the emissions of CO_2 and other greenhouse gases seems likely (NARUC 2007). There is uncertainty about anticipated CO_2 emission limits and carbon capture/sequestration regulations. This has caused some proponents to cancel or delay their proposed projects that use existing and emerging technologies to produce electricity from coal.

The regulatory mechanisms proposed under the Climate Security Act, as well as the past regulation of other pollutants under the CAA, are imposed at the point when coal is burned and converted to electric energy and by-products like CO_2. Over 95 percent of coal produced in the PRB is sold in an open market where coal is purchased on short term contracts or spot prices based on a coal feed stock that is suitable for each buyer's power generating facility. Coal production at any one mine is not tied in any predictable way over a period of time to any one power plant. Power plant operators attempt to buy coal from suppliers at the most economical prices that meet their needs. PRB coal has competed well in this market due to its low sulfur content. This makes it valuable in lowering sulfur dioxide pollution, as well as competitive mining costs when compared to delivered costs of coal from other coal producing areas.

U.S. coal production increased from 1,029.1 million tons in 1990 to 1,161.4 million tons in 2006, an increase of 12.9 percent. The share of electric power generated by burning coal was consistently around 50 percent during that time frame. Also, the percentage of total U.S. CO_2 emissions related to coal consumption was consistently around 36 percent during that same time frame. The percentage of U.S. CO_2 emissions related to the coal electric power sector increased from about 31 percent in 1990 to about 33 percent in 2006.

As discussed earlier, future coal mining estimates are based on two forecast scenarios for coal production through 2020. In the low scenario, the percentage of coal use for electric generation would stay about the same, assuming that all forms of electric generation would grow at a proportional rate to meet forecast electric demand. In the high scenario, percentage of coal use would also remain about the same, but with Montana/Wyoming coal displacing coal from other domestic coal regions.

If public sentiment results in changed electric demand, or if CO_2 emissions are ultimately regulated, the demand forecast for coal for electric generation could change. The Department of Energy has forecasted that by 2030, the coal share of total energy use will increase from 23 percent in 2006 to 25 percent in 2030, while the share of natural gas will fall from 22 percent to 20 percent, and the liquids share is predicted to fall from 40 percent to 37 percent. The combined share of carbon-neutral renewable and nuclear energy is forecasted to grow from 15 percent in 2006 to 17 percent in 2030.

Taken together, projected growth in the absolute level of primary energy consumption and a shift toward a fuel mix with slightly lower average carbon content will cause projected energy-related emissions of CO_2 to grow by 16 percent from 2006 to 2030. This is slightly lower than the projected 19 percent increase in total energy use. Over the same period, the economy becomes less carbon-intensive, because the 16 percent increase in CO_2 emissions is about one-fifth of the projected increase in GDP (79 percent), and emissions per capita decline by 5 percent.

In the 2008 study, projected energy-related CO_2 emissions grew from 5,890 million metric tons in 2006 to 6,851 million metric tons in 2030. In the Annual Energy Outlook 2008 study, energy-related CO_2 emissions were projected to grow by about 35 percent, to 7,950 million metric tons in 2030. This reflects both a higher projection of overall energy use and, to a lesser extent, a different mix of energy sources**.**

The Annual Energy Outlook 2008 report projected that energy-related emissions of CO_2 would grow by 16 percent from 2006 to 2030. In this projection, the mix of sources for this generation include coal, natural gas, nuclear, liquids (petroleum), hydro-power, and non-hydro renewable (wind, solar, etc.). They forecast that the generation mix by 2030 as compared to 2007 would be:

Source	2007	2030
Coal	51%	58%
Nuclear	21%	19%
Natural Gas	18%	11%
Petroleum	1%	1%
Hydro Power	7%	6%
Renewable	2%	5%

The Electric Power Research Institute (James 2007) attempted to identify a scenario of how the full portfolio of technologies to provide for electric energy would respond if national policy were to require that CO_2 emissions be reduced to 1990 levels. As noted earlier, there is no regulatory structure or CO_2 emission levels or limits that have been set by national policy or law yet. This scenario provides some analysis of the possible effect of regulation as well as decreased demand through energy efficiency at the user end, in transmission, and at the producer end. Under this scenario, the generation mix by 2030 as compared to 2007 would be:

Source	2007	2030
Coal	51%	52%
Nuclear	21%	29%
Natural Gas	18%	5%
Petroleum	1%	0%
Hydro Power	7%	5%
Renewable	2%	9%

This study predicts that national policy that forces a reduction of CO_2 emissions to 1990 levels would promote increased energy efficiency, and the growth of "non-carbon" sources such as nuclear and renewable. Renewable sources include wind and solar, as well as emerging technologies like tidal power and river turbines. Hydropower is limited because most opportunities for hydropower have already been used or require large infrastructure. Carbon-based sources such as coal, gas, and petroleum are reduced as compared to the EIA forecast. Both EIA and EPRI predict increases in electricity cost.

The mines in the Montana/Wyoming region have sold and are anticipated to sell coal in the open coal market. In both EIA market projections and projections that contemplate CO_2 regulation, the coal market supplies half or more of the electric generation mix through 2020. Each mine's ability to sell coal in this market would determine annual production rates at that mine. Historically, the coal buyers have been domestic electricity producers, although the coal could be used in other coal applications or could be exported.

In addition to CO_2 emissions, black carbon would also be emitted from sources at the mine during the mining of the federal coal. As explained in section 3.3.1.4, it would be possible to control some black carbon at the mine from diesel sources. However, given that the US emits 6.1 percent of the globally-emitted black carbon, it is reasonable to assume that the contribution of black carbon from sources related to mining of the federal coal would have a negligible impact on the cumulative local or regional air quality.

Transportation of coal by railroad is a connected action. GHG emissions are generated when rail car engines combust fuel during travel. GHG emissions were estimated by using an EPA guidance document (EPA 2008a) that presents methods to estimate emissions from rail transportation. Due to coal washing and preparation at the mine, approximately 2 million of the 12 million tons of annual coal is removed and a resultant 10 million tons is transported approximately 3000 miles to Ohio annually. Using the EPA calculation and emission factors, and based on ton miles traveled, approximately 5.4 million tons of CO_2 equivalent is calculated. This represents approximately 0.08 percent of the total 2008 US emissions (EIA 2008) of CO_2

equivalent of 7,000 million tons. The contribution of CO_2 equivalent from transportation of coal mined from the federal lease would have an insignificant impact on the cumulative global environment.

Emissions of GHG are also generated when the coal is burned in Ohio. An analysis of potential impacts of burning 10 million tons of coal annually for 7 years has been evaluated. According to the DOE (2007a,b), estimated CO_2 emissions in the US totaled about 6,000 million metric tons in 2006 and estimated CO_2 emissions from electric power generation totaled approximately 2,300 million metric tons.

Annual coal production destined for electricity production from the federal lease would be 10 million tons of clean coal or roughly less than 1 percent of the estimated US total coal consumption of 1,073 million short tons (EIA 2009) in 2009. The emissions from burning coal from the federal lease would be a small percentage of the US total (23 million tons of CO_2 per year). The coal used by the target power plants could be provided by Powder River Basin mines rather than the Bull Mountains Mine No. 1. However, there is an approximate 10 percent increase in the energy value (BTUs per pound) provided from the federal coal considered in this assessment. This energy efficiency would decrease GHG emissions by burning less coal to produce the same amount of electricity.

The method in which the coal is burned would also impact the emissions. Innovative technologies and emission control systems are reducing emissions and increased regulation would likely reduce emissions in the future. The cumulative impact would be negligible and reduced by these measures.

Additionally, because the tons of coal recovered during the mining of the federal lease would remain relatively consistent with the tons of coal currently being mined on an annual basis, it is anticipated that GHG emissions from the mine and related actions such as the transportation and burning of coal during the mining of the federal lease would remain relatively consistent with emissions currently generated by the mine. The contribution to the cumulative impact would remain relatively constant. The level of emissions from the Proposed Action have been quantified, but the state of the science does not allow any given level of emissions to be tied back to a quantifiable effect on climate change.

It is not likely that selection of the No Action Alternative would result in a decrease of U.S. CO_2 emissions attributable to coal-burning power plants in the long term. There are multiple other sources of coal that, while not having the cost, environmental, or safety advantages, could supply the demand for coal beyond the time that the Bull Mountains Mine No. 1 completes recovery of the coal in its existing life of mine plan. Development of dispersed residential subdivisions including houses, roads, infrastructure and residential traffic would also introduce fugitive dust and GHG emissions from vehicles and heat sources from houses.

4.3.3.4 Water Resources

There would be minor cumulative effects on identified water resources from additional mining and rural residential development in the Bull Mountains area. Mining the federal coal lease area by underground mining methods would have limited disturbance on the surface, however, there would be subsidence related impacts to water resources, as identified under the Proposed Action.

Impact projections have been made for the current life of mine area that includes the federal coal lease area under the Proposed Action. Permit requirements would mitigate these potential impacts. Mining that may occur in the area to the north of the current life of mine area would have similar effects on surface water drainages, springs, and aquifers in that area. These effects would be dependent on a site specific mine plan and mitigation measures established under the approved mining permit issued for development.

Residential development would also have additive effects from surface disturbance and use of groundwater for domestic purposes. Uses of water from mining and residential development could affect the quantity and quality available to downstream users in the primary drainages such as Rehder and Fattig creeks.

4.3.3.5 Soils

The cumulative effects of additional underground mining to soils in the Bull Mountains would primarily be the disturbance effects of mine surface facilities. Reclamation after closure of the surface facilities would include replacement of sub-soil and topsoil that had been stockpiled during mining operations. Reclamation would replace soil materials in the areas of disturbance, but recovery of the natural soil structure would require a long period of time. The land over the mined areas would subside in place and largely intact. There would be local areas of slope failure, rock toppling, and restored drainage patterns, but overall effects on soils would be minor.

Dispersed residential development would have localized effects on soils from surface disturbance and erosion potential. The overall cumulative effects of the development of these subdivisions would be minor.

4.3.3.6 Vegetation

Other than minor subsidence effects, additional mining operations to the north of the Bull Mountains Mine No.1 LOM area would not significantly impact vegetation communities. Sustainable grazing is anticipated to continue as practiced, and vegetation communities are not expected to be significantly altered by this practice. There may be local displacement of vegetation communities as a result of continued dispersed residential development. Overall, cumulative effects to vegetation are expected to be minor, and mining operations would negligibly contribute to these effects.

The cumulative effects of additional mining to wetlands in the Bull Mountains would be minimal and would only arise from subsidence effects in the mine area. Continued grazing, if allowed to become environmentally unsustainable, could affect the structure and water quality of those wetlands impacted. Dispersed residential development is expected to continue in the Bull Mountains. This development could remove or alter local wetlands and their present vegetation communities in the area. Federal regulations under section 404 of the Clean Water Act and regulations set by the U.S. Army Corp of Engineers over jurisdictional waters would reduce the potential for developments to remove or impact wetlands in the area.

4.3.3.7 Wildlife

Other than what has already been analyzed, prolonged mining in the Bull Mountains could alter wildlife habitat and population dynamics. Continued sustainable cattle grazing may cause some localized competition for habitat and food resources; however, this is not expected to change from what competition already exists between cattle and wildlife in the area. Dispersed residential development is expected to continue in the Bull Mountains. This development could cause wildlife, sensitive to human activity, to seek habitat outside the area of development. The increased presence of houses, other buildings, fences, roads, and traffic would also alter the movement of big game animals and restrict hunting and other recreational opportunities. Wildlife and their habitats would still be present in the area, but their habits and habitats would likely be altered and populations reduced.

4.3.3.8 Threatened, Endangered, and Special Status Species

There would be negligible cumulative effects on identified threatened, endangered or special status species or habitats from additional mining and rural residential development in the Bull Mountains area. Underground mines would not disturb the surface and any impacts to water resources would be mitigated. Residential development would also have minimal effects from surface disturbance on habitats in the area.

4.3.3.9 Ownership and Use of Land

Additional underground coal mining would not have a long-term cumulative effect on the ownership and use of land in the general area. However, subdividing the land for dispersed residential development would split up land ownership and would remove areas of rangeland from use for livestock grazing. For the foreseeable future, it is expected that livestock grazing would continue to be important in the Bull Mountains area, although portions of the land could be developed for dispersed private residences.

4.3.3.10 Cultural Resources

4.3.3.10.1 Prehistoric and Historic Resources

Few cultural resources have been documented in the Bull Mountains area. Cultural resources on steep slopes and in areas of cliffs and rock outcrops may be affected by subsidence resulting from additional underground mining. The full extent of these effects would not be known unless systematic monitoring of cultural sites occurs. Dispersed residential development would also affect cultural resources. Currently there is no requirement for systematic cultural resource surveys for residential development.

4.3.3.10.2 Native American Religious and Traditional Concerns

Informal Native American consultation was conducted in the early 1990s for the surface facilities complex, the railroad corridor, and selected locations in the Life of Mine area. A result of the informal consultation in the early 1990s with the Crow, Eastern Shoshone, Assiniboine, Gros Ventre, Oglala Sioux, Blackfeet, Flathead, and the Medicine Wheel Alliance, several potential TCPs were identified during data gathering for the surface facilities complex and railroad corridor (Kooistra-Manning and Deaver 1993). Tribal representatives expressed concern that underground mining disturbs the quiet zone of the deep earth and disrupts or destroys elements of the spiritual environment. They expressed particular concern about disruption to springs and the spirits that dwell in these waters. These impacts are currently occurring on private land at the existing mine site.

4.3.3.11 Visual Resources

Mine surface facilities would have minimal short-term effects to the visual character of the natural landscape during mining operations. When mining is complete, the surface facility areas would be reclaimed. In the long-term, these areas would be returned to pre-mining visual landscape. Some small areas may have less topographic diversity than before mining. Dispersed residential development would also affect visual resources. The houses, roads and utility infrastructure would alter the visual character of the landscape. These developments are not regulated in terms of visual impacts.

4.3.3.12 Noise

The principal noise sources related to the additional mining operations of the surface facilities includes the preparation plant, ventilation fans, trucks, conveyors, load-out equipment, and trains. Surface facilities may be located near residences and noise control measures include maintenance of existing equipment and screening to contain or deflect noise. Dispersed residential development would also affect background noise levels by increased human presence in the area.

4.3.3.13 Transportation Facilities

Future mining operations would maintain mine-related infrastructure for traffic. The tax revenue generated from mining and residential development would contribute to maintenance of public roads. The railroad traffic related to mining would not affect other traffic if the current railroad is used.

4.3.3.14 Hazardous and Solid Waste

Additional mining would produce corresponding quantities of hazardous and solid waste. These materials would continue to be managed and controlled under current regulations and BMPs. Cumulative impacts would be kept within state and federal guidelines and would be minor. Development of residential subdivisions would also generate waste materials. It is expected that the private landowners would contract with private waste management specialists and the cumulative effects would be minor.

4.3.3.15 Socioeconomics

The cumulative socioeconomic effects of additional mining would include a constant level of employment and tax revenues during the operation of the mines and the removal of that source of income when the mines are closed. Residential developments would increase the local population and infrastructure in the Bull Mountains.

4.3.3.16 Environmental Justice

The cumulative effects area is outside the Crow and Northern Cheyenne Indian Reservations, does not include any Indian Trust Assets, and does not contain any locations specifically named in tribal treaties. The mine surface facilities complex is about 35 miles from the nearest reservation lands and operation of the mine would have no cumulative effects on the natural and physical environment of the reservations. No adverse human health or environmental effects would be expected to fall disproportionately on the reservations or on other minority or low income populations from the Proposed Action. As a result, there would be no cumulative environmental justice effects from additional mining and rural residential development in the Bull Mountains area.

5.0 CONSULTATION AND COORDINATION

5.1 Consultation and Coordination

A coal tract that is acceptable for further consideration for leasing must be located within an area that has been determined to have coal development potential. Two major coal deposits have been identified in the Billings management area, the Mammoth/Rehder (Mammoth) Coal Bed and the McCleary Coal Bed (BLM 1983). The Bull Mountains Mine No. 1 LOM area is within the southern portion of the Mammoth Coal Bed. This area has been identified as having coal development potential by the BLM.

During preparation of the application for the current state mining permit, non-government consultation was conducted with Native American tribes to identify potential concerns in the mine permit area and along the railroad corridor. Tribal contacts were initiated in October 1990. The following year Metcalf Archaeological Consultants took over coordination with the tribes. In May 1992, Metcalf Archaeological Consultants hired Ethnoscience to complete Native American consultation for the proposed mine. Ethnoscience consulted with representatives of the Crow, Eastern Shoshone, Assiniboine, Gros Ventre, Northern Cheyenne, Oglala Sioux, and the Medicine Wheel Alliance (Kooistra-Manning and Deaver 1993). In July 1992, Ethnoscience sent letters to representatives of the Crow, Northern Cheyenne, Oglala Sioux, Eastern Shoshone, Assiniboine, Blackfeet, Gros Ventre, and Salish tribes, and to the Medicine Wheel Alliance. The letter contained a summary of the proposed mine, maps, and brief descriptions of potentially sensitive sites within and adjacent to the project area. Cultural representatives were invited to make site visits and to comment on the proposed mine and treatment of specific sites. The Northern Cheyenne Cultural Commission and several Crow, Northern Cheyenne, and Eastern Shoshone members of the Medicine Wheel Alliance requested site visits. In addition to the requests for site visits, the Medicine Wheel Alliance expressed concerns over potential impacts to spirits, springs, and archaeological sites in the mine area. Spring sites in the mine area were visited by tribal representatives in October and December of 1992. No subsequent data gathering or non-government consultation has been conducted for the LOM area.

BLM released an announcement of the current federal coal lease application to interested parties on November 19, 2008. Public scoping comments were accepted from November 24 through December 23, 2008. In addition, a public meeting was held in Roundup on December 10, 2008. Representatives of MDEQ and OSM also attended the public meeting. Nine written public comments were received. Six of the comments approved of the mine and three comments expressed concerns about the effects of subsidence. Principal concerns about the mine were potential effects of subsidence to water resources (both surface water and groundwater) and to structures and infrastructure above the mined area.

BLM released the Draft EA on March 16, 2010 to the public for review and comment for a 30 day period beginning on March 29, 2010 ending on April 27, 2010. There was also an opportunity to provide comments on the EA at a public hearing in Billings, Montana at the BLM State Office on April 13, 2010. Five written comments were provided on the Draft EA. Comments that provided changes to the EA are highlighted in this document. Comments that were determined to be out of the scope of this analysis or require a response not included in the EA are discussed in the FONSI/DN.

During the development of this EA, the BLM has discussed the project with the OSM, USFWS, MDEQ, MFWP, and tribal entities. Consultation was initiated by letters sent to the Crow and Northern Cheyenne Tribes in October 2009 and is ongoing.

5.2 Preparers and Contributors

The Agency and SPE personnel that contributed to the development of this EA include the following:

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5.3 Distribution of the EA

This EA will be distributed to individuals who specifically requested a copy of the document and/or commented during scoping. It will also be made available electronically on the BLM website.

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6.0 REFERENCES, ACRONYMS AND ABBREVIATIONS, INDEX

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6.2 Abbreviations and Acronyms

ARM	Administrative Rules of Montana
AUM	Animal Unit Month
AVF	Alluvial valley floor
BACT	Best available control technology
BLM	Bureau of Land Management
BMP	Best management practice
C	Celsius
CAA	Clean Air Act
cfs	cubic feet per second
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
CRP	Conservation Reserve Program
dB	Decibels, a logarithmic unit of sound levels
DNL	Day-night average sound level
DR	Decision Record
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
EPA	U.S Environmental Protection Agency
EPCA	Energy Policy and Conservation Act
ESP	Electrostatic precipitator
ET	Evapotranspiration
fbgs	Feet below ground surface
FCLAA	Federal Coal Leasing Act Amendment
FEIS	Final Environmental Impact Statement
FONSI	Finding of No Significant Impact
GHG	Greenhouse gas
gpm	gallons per minute
ISA	Intangible spiritual attributes
K	Conductivity
LL&E	Louisiana Land and Exploration Company
LOM	Life of mine
$\mu g/m^3$	micrograms per cubic meter
MAQP	Montana Air Quality Permit
MBTA	Migratory Bird Treaty Act
MBMG	Montana Bureau of Mines and Geology

MDEQ	Montana Department of Environmental Quality
MDNRC	Montana Department of Natural Resources and Conservation
MDSL	Montana Department of State Lands
MFWP	Montana Department of Fish, Wildlife and Parks
mg/L	Micrograms per liter
MLA	Mineral Leasing Act
MNHP	Montana Natural Heritage Program
MPDES	Montana Pollutant Discharge Elimination System
N_2O	Nitrous oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NRHP	National Register of Historic Places
NO_x	Nitrous oxides
NRCS	Natural Resource Conservation Service
OSMRE	Office of Surface Mining Reclamation and Enforcement
ppm	Parts per million
PM-10	Fine particulates less than 10 microns
PSD	Federal Prevention of Significant Deterioration Program
RCRA	Resource Conservation and Recovery Act
RMP	Resource Management Plan
ROD	Record of Decision
ROM	Run of mine
SAR	Sodium adsorption ratio
SMCRA	Mining Control and Reclamation Act
SMP	State Mine Permit
SO_2	Sulfur dioxide
SPE	Signal Peak Energy, LLC
TCP	Traditional Cultural Property
TDS	Total dissolved solids
TPH	Tons per hour
TPY	Tons per year
TRS	Township, Range and Section
TSP	Total suspended particulates
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WDA	Waste disposal area

APPENDIX A

BLM SPECIAL COAL LEASE STIPULATIONS, AND BLM COAL LEASE FORM 3400-12

EXHIBIT A

COAL LEASE SPECIAL STIPULATIONS

Sec. 15. SPECIAL STIPULATIONS - In addition to observing the general obligations and standards of performance set out in the current regulations, the lessee shall comply with and be bound by the following stipulations. These stipulations are also imposed upon the lessee's agents and employees. The failure or refusal of any of these persons to comply with these stipulations shall be deemed a failure of the lessee to comply with the terms of the lease. The lessee shall require his agents, contractors and subcontractors involved in activities concerning this lease to include these stipulations in the contracts between and among them. These stipulations may be revised or amended, in writing, by the mutual consent of the lessor and the lessee at any time to adjust to changed conditions or to correct an oversight.

(a) CULTURAL RESOURCES -

(1) Before undertaking any activities that may disturb the surface of the leased lands, the lessee shall conduct a cultural resource intensive field inventory in a manner specified by the Authorized Officer of the BLM (herinafter referred to as the Authorized Officer) on portions of the mine plan area, or exploration plan area, that may be adversely affected by lease-related activities and which were not previously inventoried at such a level of intensity. Cultural resources are defined as a broad, general term meaning any cultural property or any traditional lifeway value, as defined below:

Cultural property: a definite location of past human activity, occupation, or use identifiable through field inventory (survey), historical documentation, or oral evidence. The term includes archaeological, historic, or architectural sites, structure, or places with important public and scientific uses, and may include traditional cultural or religious importance to specified social and/or cultural groups. Cultural properties are concrete, material places, and things that are classified, ranked, and managed through the system of inventory, evaluation, planning, protection, and utilization.

Traditional lifeway value: the quality of being useful in or important to the maintenance of a specified social and/or cultural group's traditional systems of (a) religious belief, (b) cultural practice, or (c) social interaction, not closely identified with definite locations. Another group's shared values are abstract, nonmaterial, ascribed ideas that one cannot know about without being told. Traditional lifeway values are taken into account through public participation during planning and environmental analysis.

The cultural resources inventory shall be conducted by a qualified professional cultural resource specialist; i.e., archaeologist, anthropologist, historian, or historical architect, as appropriate and necessary, and approved by the Authorized Officer (BLM if the surface is privately owned). A report of the inventory and recommendations for protection of any cultural resources identified shall be submitted to the Assistant Director of the Western Support Center of the Office of Surface Mining (hereinafter referred to as the Assistant Director) by the Authorized Officer. Prior to any on-the-ground cultural resource inventory, the selected professional cultural resource specialist shall consult with the BLM, the Northern Cheyenne Cultural Protection Board, and the Crow Historic and Cultural Committee. The purpose of this consultation will be to guide the work to be performed and

EXHIBIT A

COAL LEASE SPECIAL STIPULATIONS

to identify cultural properties or traditional lifeway values within the immediate and surrounding mine plan area. The lessee shall undertake measures, in accordance with instructions from the Assistant Director to protect cultural resources on the leased lands. The lessee shall not commence the surface-disturbing activities until permission to proceed is given by the Assistant Director in consultation with the Authorized Officer.

(2) The lessee shall protect all cultural resource properties within the lease area from lease related activities until the cultural resource mitigation measures can be implemented as part of an approved mining and reclamation plan or exploration plan.

(3) The cost of carrying out the approved site mitigation measures shall be borne by the lessee.

(4) If cultural resources are discovered during operations under this lease, the lessee shall immediately bring them to the attention of the Assistant Director, or the Authorized Officer if the Assistant Director is not available. The lessee shall not disturb such resources except as may be subsequently authorized by the Assistant Director. Within two (2) working days of notification, the Assistant Director will evaluate or have evaluated any cultural resources discovered and will determine if any action may be required to protect or preserve such discoveries. The cost of data recovery for cultural resources discovered during lease operations shall be borne by the surface managing agency unless otherwise specified by the Authorized Officer.

(5) All cultural resources shall remain under the jurisdiction of the United States until ownership is determined under applicable law.

(b) PALEONTOLOGICAL RESOURCES -

If a paleontological resource, either large and conspicuous, and/or of significant scientific value is discovered during construction, the find will be reported to the authorized officer immediately. Construction will be suspended within 250 feet of said find. An evaluation of the paleontological discovery will be made by a BLM approved professional paleontologist within five (5) working days, weather permitting, to determine the appropriate action(s) to prevent the potential loss of any significant paleontological value. Operations within 250 feet of such discovery will not be resumed until written authorization to proceed is issued by the Authorized Officer. The lessee will bear the cost of any required paleontological appraisals, surface collection of fossils, or salvage of any large conspicuous fossils of significant interest discovered during the operation.

(c) PUBLIC LAND SURVEY PROTECTION -

The lessee will protect all survey monuments, witness corners, reference monuments, and bearing trees against destruction, obliteration, or damage during operations on the lease areas. If any monuments, corners or accessories are destroyed, obliterated or damaged by this operation, the lessee will hire an appropriate county surveyor or registered land surveyor to reestablish or restore the monuments, corners, or accessories at the same locations, using surveying procedures in accordance with the "Manual of Surveying Instructions for the Survey of Public Lands of the United States." The survey will be recorded in the appropriate county records, with a copy sent to the authorized officer.

EXHIBIT A

COAL LEASE SPECIAL STIPULATIONS

(d) RESOURCE RECOVERY AND PROTECTION PLAN (R2P2) -

Notwithstanding the approval of a resource recovery and protection plan (R2P2) by the BLM, lessor reserves the right to seek damages against the operator/lessee in the event (i) the operator/lessee fails to achieve maximum economic recovery (MER) [as defined at 43 CFR 3480.0-5.2(21)] of the recoverable coal reserves or (ii) the operator/lessee is determined to have caused a wasting of recoverable coal reserves. Damages shall be measured on the basis of the royalty that would have been payable on the wasted or unrecovered coal.

The parties recognize that under an approved R2P2, conditions may require a modification by the operator/lessee of that plan. In the event a coal bed or portion thereof is not to be mined or is rendered unmineable by the operation, the operator shall submit appropriate justification to obtain approval by the authorized officer to leave such reserves unmined. Upon approval by the authorized officer, such coal beds or portions thereof shall not be subject to damages as described above. Further, nothing in this section shall prevent the operator/lessee from exercising its right to relinquish all or a portion of the lease as authorized by statute and regulation.

In the event the authorized officer determines that the R2P2 as approved will not attain MER as the result of changed conditions, the authorized officer will give proper notice to the operator/lessee as required under applicable regulations. The authorized officer will order a modification if necessary, identifying additional reserves to be mined in order to attain MER. Upon a final administrative or judicial ruling upholding such an ordered modification, any reserves left unmined (wasted) under that plan will be subject to damages as described in the first paragraph under this section.

Subject to the right to appeal hereinafter set forth, payment of the value of the royalty on such unmined recoverable coal reserves shall become due and payable upon determination by the authorized officer that the coal reserves have been rendered unmineable or at such time that the lessee has demonstrated an unwillingness to extract the coal.

The BLM may enforce this provision either by issuing a written decision requiring payment of the MMS demand for such royalties, or by issuing a notice of non-compliance. A decision or notice of non-compliance issued by the lessor that payment is due under this stipulation is appealable as allowed by law.

(e) MULTIPLE MINERAL DEVELOPMENT -

Operations will not be approved which, in the opinion of the authorized officer, would unreasonably interfere with the orderly development and/or production from a valid existing mineral lease issued prior to this one for the same lands.

The BLM realizes that coal mining operations conducted on Federal coal leases issued within producing oil and gas fields may interfere with the economic recovery of oil and gas; just as Federal oil and gas leases issued in a Federal coal lease area may inhibit coal recovery. BLM retains the authority to alter and/or modify the R2P2 for coal operations on those lands covered by Federal mineral leases so as to obtain maximum resource recovery.

Form 3400-12
(September 2010)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

FORM APPROVED
OMB NO. 1004-0073
Expires: June 30, 2013

Serial Number

COAL LEASE

PART 1. LEASE RIGHTS GRANTED

This lease, entered into by and between the UNITED STATES OF AMERICA, hereinafter called lessor, through the Bureau of Land Management (BLM), and *(Name and Address)*

hereinafter called lessee, is effective *(date)* / / , for a period of 20 years and for so long thereafter as coal is produced in commercial quantities from the leased lands, subject to readjustment of lease terms at the end of the 20th lease year and each 10-year period thereafter.

Sec. 1.This lease is issued pursuant and subject to the terms and provisions of the:

☐ The Mineral Leasing Act of 1920, as amended, 30 U.S.C. 181 - 287; or
☐ The Mineral Leasing Act for Acquired Lands, 30 U.S.C. 351 - 359;
and to the regulations and formal orders of the Secretary of the Interior which are now or hereafter in force, when not inconsistent with the express and specific provisions herein.

Sec. 2. Lessor, in consideration of any bonuses, rents, and royalties to be paid, and the conditions and covenants to be observed as herein set forth, hereby grants and leases to lessee the exclusive right and privilege to drill for, mine, extract, remove, or otherwise process and dispose of the coal deposits in, upon, or under the following described lands:

containing acres, more or less, together with the right to construct such works, buildings, plants, structures, equipment and appliances and the right to use such on-lease rights-of-way which may be necessary and convenient in the exercise of the rights and privileges granted, subject to the conditions herein provided.

PART II. TERMS AND CONDITIONS

Sec. 1. (a) RENTAL RATE - Lessee must pay lessor rental annually and in advance for each acre or fraction thereof during the continuance of the lease at the rate of $ for each lease year.

(b) RENTAL CREDITS - Rental will not be credited against either production or advance royalties for any year.

Sec. 2. (a) PRODUCTION ROYALTIES - The royalty will be percent of the value of the coal as set forth in the regulations. Royalties are due to lessor the final day of the month succeeding the calendar month in which the royalty obligation accrues.

(b) ADVANCE ROYALTIES - Upon request by the lessee, the BLM may accept, for a total of not more than 20 years, the payment of advance royalties in lieu of continued operation, consistent with the regulations. The advance royalty will be based on a percent of the value of a minimum number of tons determined in the manner established by the advance royalty regulations in effect at the time the lessee requests approval to pay advance royalties in lieu of continued operation.

Sec. 3. BONDS - Lessee must maintain in the proper office a lease bond in the amount of $. The BLM may require an increase in this amount when additional coverage is determined appropriate.

Sec. 4. DILIGENCE - This lease is subject to the conditions of diligent development and continued operation, except that these conditions are excused when operations under the lease are interrupted by strikes, the elements, or casualties not attributable to the lessee. The lessor, in the public interest, may suspend the condition of continued operation upon payment of advance royalties in accordance with the regulations in existence at the time of the suspension. Lessee's failure to produce coal in commercial quantities at the end of 10 years will terminate the lease. Lessee must submit an operation and reclamation plan for the BLM's approval pursuant to 30 U.S.C. 207(c) prior to conducting any development or mining operations or taking any other action on a leasehold which might cause a significant disturbance of the environment.

The lessor reserves the power to assent to or order the suspension of the terms and conditions of this lease in accordance with, inter alia, Section 39 of the Mineral Leasing Act, 30 U.S.C. 209.

5. LOGICAL MINING UNIT (LMU) - Either upon approval by the lessor of the lessee's application or at the direction of the lessor, this lease will become an LMU or part of an LMU, subject to the provisions set forth in the regulations.

The stipulations established in an LMU approval in effect at the time of LMU approval will supersede the relevant inconsistent terms of this lease so long as the lease remains committed to the LMU. If the LMU of which this lease is a part is dissolved, the lease will then be subject to the lease terms which would have been applied if the lease had not been included in an LMU.

(Continued on page 2)

Sec. 6. DOCUMENTS, EVIDENCE AND INSPECTION - At such times and in such form as lessor may prescribe, lessee must furnish detailed statements showing the amounts and quality of all products removed and sold from the lease, the proceeds therefrom, and the amount used for production purposes or unavoidably lost.

Lessee must keep open at all reasonable times for the inspection by BLM the leased premises and all surface and underground improvements, works, machinery, ore stockpiles, equipment, and all books, accounts, maps, and records relative to operations, surveys, or investigations on or under the leased lands.

Lessee must allow lessor access to and copying of documents reasonably necessary to verify lessee compliance with terms and conditions of the lease.

While this lease remains in effect, information obtained under this section will be closed to inspection by the public in accordance with the Freedom of Information Act (5 U.S.C. 552).

Sec. 7. DAMAGES TO PROPERTY AND CONDUCT OF OPERATIONS - Lessee must comply at its own expense with all reasonable orders of the Secretary, respecting diligent operations, prevention of waste, and protection of other resources.

Lessee must not conduct exploration operations, other than casual use, without an approved exploration plan. All exploration plans prior to the commencement of mining operations within an approved mining permit area must be submitted to the BLM.

Lessee must carry on all operations in accordance with approved methods and practices as provided in the operating regulations, having due regard for the prevention of injury to life, health, or property, and prevention of waste, damage or degradation to any land, air, water, cultural, biological, visual, and other resources, including mineral deposits and formations of mineral deposits not leased hereunder, and to other land uses or users. Lessee must take measures deemed necessary by lessor to accomplish the intent of this lease term. Such measures may include, but are not limited to, modification to proposed siting or design of facilities, timing of operations, and specification of interim and final reclamation procedures. Lessor reserves to itself the right to lease, sell, or otherwise dispose of the surface or other mineral deposits in the lands and the right to continue existing uses and to authorize future uses upon or in the leased lands, including issuing leases for mineral deposits not covered hereunder and approving easements or rights-of-way. Lessor must condition such uses to prevent unnecessary or unreasonable interference with rights of lessee as may be consistent with concepts of multiple use and multiple mineral development.

Sec. 8. PROTECTION OF DIVERSE INTERESTS, AND EQUAL OPPORTUNITY - Lessee must: pay when due all taxes legally assessed and levied under the laws of the State or the United States; accord all employees complete freedom of purchase; pay all wages at least twice each month in lawful money of the United States; maintain a safe working environment in accordance with standard industry practices; restrict the workday to not more than 8 hours in any one day for underground workers, except in emergencies; and take measures necessary to protect the health and safety of the public. No person under the age of 16 years should be employed in any mine below the surface. To the extent that laws of the State in which the lands are situated are more restrictive than the provisions in this paragraph, then the State laws apply.

Lessee will comply with all provisions of Executive Order No. 11246 of September 24, 1965, as amended, and the rules, regulations, and relevant orders of the Secretary of Labor. Neither lessee nor lessee's subcontractors should maintain segregated facilities.

Sec. 9. (a) TRANSFERS -

This lease may be transferred in whole or in part to any person, association or corporation qualified to hold such lease interest.

This lease may be transferred in whole or in part to another public body or to a person who will mine coal on behalf of, and for the use of, the public body or to a person who for the limited purpose of creating a security interest in favor of a lender agrees to be obligated to mine the coal on behalf of the public body.

This lease may only be transferred in whole or in part to another small business qualified under 13 CFR 121.

Transfers of record title, working or royalty interest must be approved in accordance with the regulations.

(b) RELINQUISHMENT - The lessee may relinquish in writing at any time all rights under this lease or any portion thereof as provided in the regulations. Upon lessor's acceptance of the relinquishment, lessee will be relieved of all future obligations under the lease or the relinquished portion thereof, whichever is applicable.

Sec. 10. DELIVERY OF PREMISES, REMOVAL OF MACHINERY, EQUIPMENT, ETC. - At such time as all portions of this lease are returned to lessor, lessee must deliver up to lessor the land leased, underground timbering, and such other supports and structures necessary for the preservation of the mine workings on the leased premises or deposits and place all workings in condition for suspension or abandonment. Within 180 days thereof, lessee must remove from the premises all other structures, machinery, equipment, tools, and materials that it elects to or as required by the BLM. Any such structures, machinery, equipment, tools, and materials remaining on the leased lands beyond 180 days, or approved extension thereof, will become the property of the lessor, but lessee may either remove any or all such property or continue to be liable for the cost of removal and disposal in the amount actually incurred by the lessor. If the surface is owned by third parties, lessor will waive the requirement for removal, provided the third parties do not object to such waiver. Lessee must, prior to the termination of bond liability or at any other time when required and in accordance with all applicable laws and regulations, reclaim all lands the surface of which has been disturbed, dispose of all debris or solid waste, repair the offsite and onsite damage caused by lessee's activity or activities incidental thereto, and reclaim access roads or trails.

Sec. 11. PROCEEDINGS IN CASE OF DEFAULT - If lessee fails to comply with applicable laws, existing regulations, or the terms, conditions and stipulations of this lease, and the noncompliance continues for 30 days after written notice thereof, this lease will be subject to cancellation by the lessor only by judicial proceedings. This provision will not be construed to prevent the exercise by lessor of any other legal and equitable remedy, including waiver of the default. Any such remedy or waiver will not prevent later cancellation for the same default occurring at any other time.

Sec. 12. HEIRS AND SUCCESSORS-IN-INTEREST - Each obligation of this lease will extend to and be binding upon, and every benefit hereof will inure to, the heirs, executors, administrators, successors, or assigns of the respective parties hereto.

Sec. 13. INDEMNIFICATION - Lessee must indemnify and hold harmless the United States from any and all claims arising out of the lessee's activities and operations under this lease.

Sec. 14. SPECIAL STATUTES - This lease is subject to the Clean Water Act (33 U.S.C. 1252 et seq.), the Clean Air Act (42 U.S.C. 4274 et seq.), and to all other applicable laws pertaining to exploration activities, mining operations and reclamation, including the Surface Mining Control and Reclamation Act of 1977 (30 U.S.C. 1201 et seq.).

Sec. 15. SPECIAL STIPULATIONS -

(Continued on page 3)

Sec. 15. SPECIAL STIPULATIONS (Cont'd.) -

THE UNITED STATES OF AMERICA

_______________ (Company or Lessee Name)	By _______________
_______________ (Signature of Lessee)	_______________ (BLM)
_______________ (Title)	_______________ (Title)
_______________ (Date)	_______________ (Date)

Title 18 U.S.C. Section 1001, makes it a crime for any person knowingly and willfully to make to any department or agency of the United States any false, fictitious or fraudulent statements or representations as to any matter within its jurisdiction.

(Continued on page 4)

NOTICES

The Privacy Act and 43 CFR 2.48(d) require that you be furnished with the following information in connection with the information requested by this form.
AUTHORITY: 30 U.S.C. 181 - 287 and 30 U.S.C. 351 - 359 permit collection of the information requested by this form.
PRINCIPAL PURPOSE: The BLM will use the information you provide to process your application and determine if you are eligible to hold a coal lease on public lands.
ROUTINE USES: The BLM will only disclose this information in accordance with the provisions at 43 CFR 2.56(b) and (c).
EFFECT OF NOT PROVIDING INFORMATION: Submission of the requested information is necessary to obtain or retain a benefit. Failure to submit all of the requested information or to complete this form may result in delay or preclude the BLM's acceptance of your application for a coal lease.

The Paperwork Reduction Act requires us to inform you that:
The BLM collects this information to evaluate and authorize proposed exploration and mining operations on public lands.
Submission of the requested information is necessary to obtain or retain a benefit.
You do not have to respond to this or any other Federal agency-sponsored information collection unless it displays a currently valid OMB control number.

BURDEN HOURS STATEMENT: The public reporting burden for this form is estimated to average 25 hours per response when the form is used under the authority of 43 subpart 3422 (Lease Sales), or 800 hours per response when the form is used under the authority of 43 subpart 3430 (Preference Right Leases). The estimated burdens include the time for reviewing instructions, gathering and maintaining data, and completing and reviewing the form. You may submit comments regarding the burden estimate or any other aspect of this form to: U.S. Department of the Interior, Bureau of Land Management (1004-0073), Bureau Information Collection Clearance Officer (WO-630), 1849 C Street, Mail Stop 401 LS, Washington, DC 20240.