United States Department of the Interior
Office of Surface Mining Reclamation and Enforcement

Bull Mountains Mine No. 1
Federal Mining Plan Modification
Environmental Assessment

Musselshell County and Yellowstone County, Montana

Federal Coal Lease MTM 97988
March 13, 2018

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1.0 PURPOSE AND NEED

1.1 Introduction

Signal Peak Energy, LLC (SPE) owns and operates the Bull Mountains Mine No.1 underground coal mine (Mine) located in the Bull Mountains of south central Montana (**Appendix A, Figure 1.0-1**). The Mine is located in Musselshell and Yellowstone counties between the Musselshell and Yellowstone rivers, approximately 30 miles north of Billings and 20 miles southeast of Roundup, Montana. The vast majority of coal is mined using the longwall method, the remaining development coal is mined using the room-and-pillar method. All coal is washed to improve coal quality and shipped from an onsite rail car loading facility (tipple).

On March 19, 2008, SPE filed an application with the Bureau of Land Management (BLM) to lease approximately 2,679.76 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 (LBA) regulations (43 CFR § 3425.1) and the Energy Policy Act of 2005 (**Appendix A, Figure 1.0-2**). BLM processed the lease application in accordance with regulations found at 43 CFR Subpart 3425 for LBA. The Environmental Assessment (EA) titled Bull Mountains Mine No. 1, Federal Coal Lease MTM 97988, Musselshell County, Montana, EA No. DOI-BLM-MT-C010-2009-0010-EA (BLM 2011), hereafter "BLM Coal Lease EA", was prepared to satisfy BLM's requirements under the National Environmental Policy Act (NEPA). The US Department of the Interior (DOI), Office of Surface Mining Reclamation and Enforcement (OSMRE) served as a cooperating agency for the BLM Coal Lease EA. The BLM Coal Lease EA evaluated the application as it would be processed under the following Federal authorities:

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

Both the BLM Coal Lease EA and this Federal Mining Plan Modification EA incorporate prior analyses including the Bull Mountains Exchange Final Environmental Impact Statement (EIS) (BLM 1990) and the Bull Mountains Mine No. 1 EIS (MDSL 1992), which analyzed the effects of proposed mining and connected actions.

The BLM Coal Lease EA analyzed potential impacts associated with leasing five tracts of Federal coal totaling 2,679.76 acres that would allow the Mine to continue producing coal instead of ceasing production as recoverable private coal reserves are exhausted. The BLM Coal Lease EA addressed two alternatives, the No Action Alternative and the Proposed Action. Under the No Action Alternative, current and future mining activities approved by the Montana Department of Environmental Quality (MDEQ) would continue on private lands and appropriate mitigation measures would be implemented to reduce or mitigate effects of mining on the environment. Under the Proposed Action, the subject Federal coal would be mined according to the Life of

Mine (LOM) plan and the same mitigation measures that apply to the No Action Alternative would be applied to the lease areas.

On April 15, 2011, based upon a review of the BLM Coal Lease EA, BLM's Billings Field Office issued a Finding of No Significant Impact (FONSI) of implementing the proposed leasing action. The FONSI was based on the information contained in the BLM Coal Leasing EA and consideration of the Council on Environmental Quality's (CEQ) criteria for significance (40 CFR § 1508.27). The BLM determined 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 was not required.

The State of Montana has a Federally-approved coal regulatory program (hereafter "Montana State program") administered by MDEQ. The Mine permit (C1993017) was approved by MDEQ in 1993 in accordance with the Montana Strip and Underground Mine Reclamation Act (MSUMRA). Mining and reclamation methods specified in the permit are consistent with requirements of SMCRA (30 USC, Chapter 25) and the implementing Federal regulations (30 CFR Chapter VII) as required by the Montana cooperative agreement with OSMRE (30 CFR § 926.30).

On October 4, 2012, MDEQ approved SPE's application for Amendment 2 to the Mine permit to include a portion of the Federal coal lease area and adjacent private lands and coal. On August 2, 2013, the DOI's Assistant Secretary, Lands and Mineral Management (ASLM) signed a mining plan approval document authorizing mining of 140 acres of Federal coal lands within the Amendment 2 boundary as described below (see **Appendix A, Figure 1.0-2** inset detail).

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

Sec. 8, SW¼ SW¼ and portions* of SE¼ SW¼, N½ SW¼, SW¼ NW¼, and SW¼ SE¼, Containing 140 acres more or less.

**portions include areas south and west of the Amendment 2 State permit boundary.*

On October 5, 2012, SPE submitted a Permit Application Package (PAP) for Mine permit Amendment 3 to include the remainder of proposed future mining. MDEQ reviewed the permit application under the Montana State program, the Federal lands program (30 CFR Chapter VII, Subchapter D), and the Montana cooperative agreement (30 CFR § 926.30). Pursuant to the Montana State program and the cooperative agreement, MDEQ approved the permit application for Amendment 3 on October 18, 2013. The current State-approved Mine permit boundary (**Appendix A, Figure 1.0-2**) includes the LOM area previously analyzed in the BLM Coal Lease EA, including the existing 140-acre mining plan and the proposed mining plan modification. The permit boundaries of Amendment 2 and Amendment 3 referred to in this EA and shown in figures reflect the permit boundary both before and after Amendment 3 approval. All lands within the Mine permit boundary (including Amendment 2 and Amendment 3) are collectively referred to as the "permit area".

On November 22, 2013, SPE submitted a mining plan modification for Federal Lease MTM 97988 that would allow coal development and mining operations at the Bull Mountains Mine No. 1 in the remaining Federal coal lands as described in the Amendment 3 PAP. Federal coal lands included in lease MTM 97988 and proposed for mining, but not included in the existing mining plan, are identified below:

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

Sec. 4, lot 1 , S½NE¼, SE¼NW¼, and S½;	479.76 acres
Sec. 8, NE¼, NE¼NW¼, S½NW¼, and S½;	460.00 acres
Sec. 10, W½NE¼, SE¼ NE¼, NW¼, and S½	600.00 acres
Sec. 14, SW ¼ NE ¼, NW ¼ and S ½;	520.00 acres
Sec. 22, W½ and SE¼.	480.00 acres
	Total 2,539.76 acres

OSMRE prepared the 2015 Mining Plan Modification EA analyzing potential impacts associated with the proposed mining plan modification. A FONSI was signed on January 27, 2015. OSMRE prepared a mining plan decision document (MPDD), and the ASLM approved the mining plan modification on February 24, 2015. SPE continued mining in accordance with the Mine permit and approved mining plan modification and crossed the Amendment 2 boundary into the Amendment 3 area in approximately May 2015 in association with the East Mains development (see **Appendix A, Figure 1.0-2** inset).

On August 14, 2017, the District Court for the District of Montana identified deficiencies in OSMRE's NEPA analysis, vacated and set aside the 2015 Mining Plan Modification EA, and remanded the matter back to OSMRE for further action (*see Montana Environmental Information Center v. U.S. Office of Surface Mining et al.,* Case 9:15-cv-00106-DVM (D. Mont. Aug. 14, 2017)). The court further ordered that mining of the Federal coal within the Amendment 3 permit area be enjoined pending compliance with NEPA. Subsequent orders dated October 31, 2017 and November 3, 2017 (*see* Case 9:15-CV-00106-DWM, ECF Nos. 99 and 103) allow limited development work displacing and storing no more than 170,000 tons of Federal coal in Section 8. That coal must be stockpiled and stored at the Mine and cannot be sold or shipped pending compliance with NEPA.

This EA has been prepared to address the August 14, 2017 ruling and satisfy OSMRE's responsibilities under NEPA. In complying with those responsibilities, OSMRE does not reevaluate potential impacts previously analyzed as part of the BLM Coal Lease EA, which included analysis of all Federal coal lands identified in the proposed mining plan modification. Rather, this EA considers potential changes to the extent or nature of those impacts, based on the current Mine permit approved by the Montana State program, and new information specific to this action. Because the BLM Coal Lease EA thoroughly described the environmental setting of the Mine's LOM area (now the "permit area" or all lands within the "permit boundary") and mining operations, it is incorporated by reference in this EA. The BLM Coal Lease EA is available at the following link.

https://www.wrcc.osmre.gov/initiatives/bullMountainsMine.shtm#documents.

This EA was prepared in accordance with the requirements of NEPA and the CEQ regulations implementing NEPA. OSMRE is the lead Federal agency responsible for development of this EA because it makes a recommendation to the ASLM about whether the proposed mining plan modification should be approved, disapproved, or approved with conditions. As such, this EA follows OSMRE's 516 DM 13, which is the DOI manual guiding OSMRE's implementation of the NEPA process. The BLM is a cooperator in preparation of this EA and has provided technical review and assistance in the analysis.

1.2 Regulatory Framework and Necessary Authorizations

OSMRE is responsible for reviewing plans to operate and reclaim a coal mine on lands containing leased Federal coal and is the lead agency for this EA. Pursuant to 30 CFR Part 746, OSMRE prepares and submits to the Secretary of the Interior a MPDD recommending approval, disapproval or conditional approval of the proposed mining plan modification. Pursuant to 30 CFR § 746.13, the recommendation is based, at a minimum, upon:

- The PAP, including BLM's resource recovery and protection plan (R2P2);
- Information prepared in compliance with NEPA, including this EA;
- Documentation assuring compliance with the applicable requirements of Federal laws, regulations and executive orders (EOs) other than SMCRA;
- Comments and recommendations or concurrence of other Federal agencies and the public;
- Findings and recommendations of the BLM with respect to the R2P2, Federal lease requirements, and the MLA;
- Findings and recommendations of MDEQ with respect to the PAP and the Montana State program; and
- The findings and recommendations of OSMRE with respect to the additional requirements of 30 CFR Chapter VII, Subchapter D.

In a memorandum dated September 13, 2013, the BLM found that maximum economic recovery of the Federal coal would be achieved by mining as described in the PAP and recommended approval of the R2P2.

Upon review of OSMRE's recommendation and supporting documentation, including this EA, the Secretary of the Interior will make a decision on the MPDD approving, approving with conditions or denying the mining plan modification. Such approval would supplement the August 2, 2013 mining plan approved for the Mine.

1.3 Purpose and Need

The purpose of the action is established by MLA and the implementing Federal regulations, which require evaluation of the PAP before SPE may take any action on the Federal leasehold that might cause a significant disturbance of the environment, which includes conducting underground mining and reclamation operations in the Amendment 3 area of Federal coal lease MTM 97988. OSMRE is the agency responsible for making a recommendation to the ASLM to approve, disapprove, or approve with conditions the proposed mining plan modification. The ASLM will decide whether the mining plan modification is approved, disapproved, or approved with conditions. If approved, the MPDD would allow SPE to conduct coal mining and reclamation operations within the Amendment 3 area of the Federal coal lease and economically recover Federal, State, and private coal reserves through a logical mining unit.

The need for this action is to provide SPE the opportunity to exercise its rights granted by the BLM under Federal coal lease MTM 97988 to access and mine the Federal coal reserves located in the tract and approved by MDEQ as Amendment 3 to the state Mine permit. ASLM approval of the Federal mining plan modification is required to mine Federal coal reserves in the Amendment 3 mining area.

1.4 Issues Identification

While the BLM Coal Lease EA evaluated mining of the same parcels described in the PAP, additional analysis is needed to satisfy NEPA requirements. The August 14, 2017 US District Court ruling determined that OSMRE's 2015 Mining Plan Modification EA was deficient, requiring further analysis of several issues to comply with NEPA. The EA must also evaluate mine permit revisions approved or proposed since the BLM Coal Lease EA was prepared and incorporate the most recent data available to support the analysis.

OSMRE conducted a scoping process from October 20 to November 20, 2017 during which public comments were solicited to identify issues of concern. OSMRE published legal notices in the *Billings Gazette* on October 20, 2017 and the *Roundup Record Tribune* on October 25, 2017. The notices described the project in summary form and informed the public that scoping comments would be accepted until November 20, 2017. Public outreach letters describing the EA and soliciting scoping comments were mailed on October 20, 2017 to State, county, and city governments; adjacent landowners; and other interested parties. OSMRE also sent letters of notification to tribes/tribal representatives via certified letters on October 20, 2017. OSMRE made a project website available that provided project information and comment opportunities available at https://www.wrcc.osmre.gov/initiatives/bullMountainsMine.shtm.

While many issues may be mentioned during scoping, not all issues raised warrant analysis in an EA. Issues are analyzed in this EA when: 1) an analysis of the issue is necessary to make a reasoned choice between alternatives, 2) the issue is associated with a potentially significant effect, requiring additional analysis, or 3) the issue was specifically identified in the August 14, 2017 US District Court Ruling vacating OSMRE's 2015 Mining Plan Modification EA.

Issues analyzed in this EA include:

- Increased noise and vibration from rail traffic;
- Increased rail traffic effects on rail congestion;
- Coal dust effects on rail safety and the environment (e.g., air, soil, water);
- Potential disproportionate impact of rail transport on environmental justice populations;
- Effects of non-greenhouse gas emissions from coal mining, transport, and combustion;
- Effects of greenhouse gas (GHG) emissions from coal mining, transport, and combustion on climate and resultant climate change effects on all resources, including the economy;
- Impacts of surface facilities and operations such as waste disposal areas (WDAs) and boreholes;
- Future groundwater conditions following subsidence and pooling in the mine "gob";
- Impacts to water quality and water supply for agricultural and domestic uses;
- Impacts to springs, streams, ponds and wetlands;
- Ability to mitigate hydrologic impacts and replace affected water supplies with water of comparable quantity and quality;
- Impacts of subsidence on vegetation, soil, hydrology, and wildlife;
- Reclaimability of subsidence cracks and long-term stability;

- Hazards to people, livestock and wildlife posed by subsidence cracks;
- Effects to local, State, and Federal government, the economy, and local services;
- Aesthetic impacts including subsidence and associated reclamation effects on the landscape and lighting effects on night skies;
- Mine impacts to species listed as threatened or endangered, candidates for listing, or proposed for listing under the Endangered Species Act (ESA), or their habitats;
- Mine impacts to migratory birds, including bald and golden eagles;
- Mine impacts on noxious weed distribution;
- Noise impacts from Mine fan operation; and,
- Dust generation from Mine vehicles and construction operations.

Several of these issues were previously evaluated by the BLM Coal Lease EA and 2015 Mining Plan Modification EA (since vacated), including GHG emissions associated with coal transport and combustion and related climate effects. Socioeconomic impacts, while analyzed previously, have been included for further analysis as part of this EA to address updated conditions.

Impacts of non-greenhouse gas emissions from transport and combustion were not previously analyzed, nor were other issues specific to coal transport by rail, including train noise and vibration, effects of coal dust emissions, rail safety and grade crossing delay and safety. Those previously unanalyzed topics were specifically identified in the August 14, 2017 US District Court Order vacating the 2015 Mining Plan Modification EA, necessitating their consideration in this EA.

While rail transport and combustion are foreseeable and may occur indirectly as a result of Mine operations, US-based rail transportation is outside the jurisdiction of OSMRE and subject to a broad range of rules and regulations set by other Federal and State agencies. As detailed in **Section 3.1**, the Surface Transportation Board (STB) has jurisdiction over railroad rate and service issues, authority to investigate rail service matters of regional and national significance, and rail restructuring transactions. STB regulations preempt State and local laws (e.g., noise ordinances) that would otherwise manage or govern rail transportation. Given their jurisdiction, STB thresholds for environmental analysis are adopted as basis for analysis in this EA for all rail transport related issues associated with coal transport.

Outside of the US, coal transport and combustion activities are governed by the receiving countries and international organizations that similarly implement regulations and/or adopt standards to prevent unacceptable impacts within their jurisdictions.

Comments also identified alternatives to the Project that could be analyzed. These alternatives included: subsurface gas control to reduce GHG emissions, reduced mining levels to avoid impacts to surface features, uses or resources, and alternative land uses that support economic diversification and transition. These alternatives and reasons for dismissing or carrying them forward for analysis are addressed in Chapter 2 (see **Section 2.2.3**).

All comments received have been considered in preparation of this document.

1.5 Crosswalk of Resource Areas

Table 1.4-1 identifies the location of resource areas presented in the BLM Coal Lease EA and lists their location in this EA, where present. Not all resource areas are considered and brought forward for analysis in this EA because OSMRE determined that their effects had been sufficiently documented in the BLM Coal Lease EA and FONSI or that new information would not affect the decision-making process. Information presented in the BLM Coal Lease EA adequately described the affected environment of several resources brought forward for analysis; therefore, those sections of the BLM Coal Lease EA are incorporated by reference into this EA in their entirety and are not reiterated.

Table 1.4-1. Resource areas analyzed.

Resource Area	BLM Coal Lease EA Affected Environment	BLM Coal Lease EA Environmental Consequences	Current EA Not Further Analyzed	Current EA Brought Forward For Analysis	Current EA Affected Environment	Current EA Environmental Consequences
Topography and Physiography	3.1	4.1.1 & 4.2.1	X			
Geology and Minerals	3.2	4.1.2 & 4.2.2	X			
Paleontology	3.2	4.1.2 & 4.2.2		X	3.9	4.9
Air Quality [1]	3.3.1	4.1.3 & 4.2.3		X	3.2	4.2
Climate [1]	3.3.2	4.1.3 & 4.2.3		X	3.3	4.3
Water Resources	3.4	4.1.4 & 4.2.4		X	3.4	4.4
Soils	3.5	4.1.5 & 4.2.5		X	3.5	4.5
Vegetation	3.6	4.1.6 & 4.2.6		X	3.6	4.6
Wildlife	3.7	4.1.7 & 4.2.7		X	3.7	4.7
Threatened or Endangered Species and Special Status Species	3.8	4.1.8 & 4.2.8		X	3.8	4.8
Ownership and Use of Land	3.9	4.1.9 & 4.2.9	X			
Cultural Resources	3.1	4.1.10 & 4.2.10		X	3.9	4.9
Visual Resources	3.11	4.1.11 & 4.2.11		X	3.13	4.13
Noise and Vibration [2]	3.12	4.1.12 & 4.2.12		X	3.10	4.10
Transportation Facilities [3]	3.13	4.1.13 & 4.2.13		X	3.1	4.1
Hazardous and Solid Waste	3.14	4.1.14 & 4.2.14	X			
Socio-Economics	3.15	4.1.15 & 4.2.15		X	3.11	4.11
Environmental Justice [3]	3.16	4.1.16 & 4.2.16		X	3.12	4.12

(1) Current EA addresses coal transport and combustion.
(2) Current EA includes noise and vibration related to rail transportation.
(3) Current EA includes rail transportation.

1.6 Consultation and Coordination

A description of consultation and coordination conducted during preparation of this EA is provided in **Appendix H**. The appendix also includes a list of preparers and contributors and information regarding distribution of the EA.

2.0 PROPOSED ACTION AND ALTERNATIVES

Under NEPA requirements, the agency must evaluate the environmental impacts of a reasonable range of alternatives that meet the project purpose and need. The DOI's NEPA regulations and CEQ's NEPA guidance define reasonable alternatives as those that are "technically and economically practical or feasible and meet the purpose and need of the proposed action" (43 CFR § 46.420).

The Proposed Action and No Action Alternative analyzed in this EA are consistent with the Proposed Action and No Action Alternative analyzed by the BLM Coal Lease EA (2011), but they have been updated to reflect the following factors:

- Onsite mining and related activities conducted since the BLM Coal Lease EA was prepared have changed the existing environmental condition;
- Since the BLM Coal Lease EA was prepared, revisions to the State-approved Mine permit have been approved by MDEQ as proposed by SPE;
- The State-approved Mine permit now includes the entire area previously identified as the unpermitted "Life of Mine" (LOM) in the BLM Coal Lease EA;
- The status of mining has been updated to reflect mining since the BLM Coal Lease EA was prepared, through December 31, 2016;
- The mining schedule is updated to reflect the anticipated mining schedule beginning January 1, 2017; and,
- Information pertaining to coal sales, loadout, transport, and combustion are included.

The Proposed Action and No Action Alternative reflect continuation of existing mining. Descriptions of both alternatives follow the description of the existing conditions (i.e., recent and ongoing Mine activities) in the following sections. Alternatives considered and dismissed are discussed at the end of this chapter. The descriptions herein are consistent with the PAP (SPE 2017a) and are supported by supplemental information provided by SPE (2017b, 2017c, 2018a, 2018b).

2.1 Existing Condition

The BLM Coal Lease EA Section 2.1 presented a thorough description of the existing condition to support the analysis presented therein and is incorporated by reference. The BLM Coal Lease EA is available to the public at:

https://www.wrcc.osmre.gov/initiatives/bullMountainsMine.shtm#documents.

The following updates to the existing condition, including permitted ongoing mining operations, are the most notable since the BLM Coal Lease EA was prepared and are presented to support the analysis in this EA. Unless otherwise noted, this description reflects conditions as of January 1, 2017 and is consistent with the 2016 annual mine report (i.e., report period ending December 31, 2016).

2.1.1 Mining Plan and Mining Operations

Underground mining and reclamation activities have continued at the Mine since the BLM Coal Lease EA was prepared and Federal coal lease MTM 97988 was granted. The current underground mine plan (**Appendix A, Figure 1.0-2**) identifies the area mined through December 31, 2016.[1] As a result of two amendments and several incidental boundary changes, the permit area includes 14,916 acres, which is not substantially different than the LOM area analyzed in the BLM Coal Lease EA. The existing Federal mining plan associated with coal lease MTM 97988 allows mining of 140 acres containing 0.9 million tons (Mt) of Federal coal. As of October 2017, MDEQ holds $15.7 million in a reclamation bond payable to both the State of Montana and the United States.

SPE currently employs 260 people and estimates that 2017 production was approximately 6.2 Mt of saleable coal. In future years, SPE is capable of producing up to 10 million tons per year (Mtpy) of saleable coal, but it is not known if the maximum rate of production will be achieved. All mined tons must be 'washed' in a coal processing facility. Saleable tons (i.e., shipped tons) have consistently represented 70 percent of mined tons (i.e., raw tons). The remaining 30 percent is coal processing waste rock (CPW) that is transferred to the existing waste disposal area (here after WDA #1). While the Montana Air Quality Permit (MAQP #3179-12; MDEQ 2016b) authorizes mining up to 15 Mtpy of raw coal, SPE is only capable of mining 14.3 Mtpy of raw coal, which at the 70 percent recovery, yields 10.0 Mtpy of saleable coal. This production rate has not yet been achieved at the Mine. All royalties are paid based on saleable tons. Total saleable coal production for the past five years is provided in **Table 2.1.1.**

Table 2.1-1. Annual saleable coal production.

Year	Saleable Coal (Millions of Tons)
2012	5.72
2013	7.50
2014	8.03
2015	6.49
2016	5.96
2017	6.2 (estimate)

Source: SPE 2018a

Approximately 109.7 Mt of saleable coal remain in the Mining Plan Area after December 31, 2016. SPE continues to mine using the longwall and room-and-pillar mining methods described in the BLM Coal Lease EA.

2.1.2 Surface Facilities Area

The majority of the surface activities related to underground mining occur within the Surface Facilities Area (**Appendix A, Figure 2.1-1**). The Surface Facilities Area encompasses 553 acres of existing disturbance and includes the mine portals, run of mine (i.e., raw) and clean coal stockpiles, coal processing facilities, coal loadout facility and railroad loop, WDA #1, mine shop and offices, associated surface water control facilities, and other associated facilities.

[1] The most recent annual reporting data available at the time this analysis was prepared reflect conditions through December 31, 2016. Although more recent information was available for some resources, data was not consistently available across aspects of mining. Data current as of December 31, 2016 provide a snapshot for consistent representation of the existing condition.

Waste Disposal Areas

Waste disposal operations are conducted as described in the BLM Coal Lease EA except for minor changes in waste handling. In 2010, SPE revised the State-approved Mine permit and received a beneficial use determination to allow for addition of fly ash (received from Yellowstone Energy) to accelerate drying of the CPW. MDEQ reviewed a chemical analysis of representative fly ash and concluded that the addition of ash to the CPW would not pose a risk to surface water, groundwater, or other environmental conditions. The addition of a dewatering plate press for fine CPW material has substantially reduced the use of fly ash in WDA #1 since those new facilities became operational in 2015.

WDA #1 has a total capacity of 44 Mt. In 2017, MDEQ approved WDA #2 which is permitted to be constructed southeast of WDA #1 and across Fattig Creek Road. WDA #2 would have a capacity of 24.5 Mt. The combined permitted capacity of WDA #1 and WDA #2 would be sufficient to store coal waste from the permitted LOM operations.

Coal storage

In 2014, SPE submitted an application to the MDEQ Coal Program and MDEQ Air Program to expand coal Stockpile 1A east of the Mine office and north of Fattig Creek Road (**Appendix A, Figure 2.1-1,** easternmost coal stockpile). The MAQP (MDEQ 2016b) was revised to address emissions associated with this stockpile in October 2014.

Mine Ventilation Fan

One fan is currently installed in the Surface Facilities Area over the East Mains and just north of Longwall Panel 4. This fan operates continuously to ventilate the underground mine. The fan is installed on a large borehole pad; such pads are discussed in Section 2.1.3.

2.1.3 Other Surface Facilities

Since 2011, SPE has added several facilities not contemplated at the time the BLM Coal Lease EA was prepared. The most notable facilities are identified in this section, all of which are subject to the requirements of the State-approved Mine permit (C1993017) (SPE 2017a) which specifies environmental protection measures and reclamation requirements. A total of 51 acres were disturbed through 2016 in association with these surface facilities outside the Surface Facilities Area.

Air Portal

This supplemental support facility consists of a highwall, pad, and a portal constructed at the south end of Panel 3. This mine entry provides critical ventilation to the underground workings (**Appendix A, Figure 2.1-2**). Although the air portal may be used for infrequent access to the underground mine or delivery of equipment and supplies, it does not serve as a primary entry to the underground mine. Delivery of equipment and supplies through the air portal rarely occurs.

Borehole Pads

Borehole Pads are necessary at various locations above the mine entries to provide surface support to underground operations. In **Appendix A, Figure 2.1-2**, pads are located at end of linear disturbances overlying the underground mine plan area. These facilities consist of one or multiple boreholes (borehole types described below) from the surface into the mine entries. Construction of these pads provides laydown areas for equipment and materials. Typical equipment may include mine pickups, forklift, pumps, trash bins, portable toilets, high pressure air compressors, electrical distribution and related equipment, generators, bulk rock dust bins, pallets of bagged materials, and other necessary support material(s). Surface installations may include semi-permanent (concrete) foundations for high capacity air compressors, electrical sub-stations, storage hoppers and batch systems, fuel storage, and other necessary equipment.

All borehole pads in use for extended time periods have detailed designs in the State-approved mine permit. Terminals and pads are reclaimed when no longer needed.

Boreholes

Three types of boreholes are typically used to support underground workings; (1) emergency breathable air boreholes, (2) utility boreholes, and (3) mitigation boreholes. Each type is described in more detail below (not shown on figures). All boreholes are installed with casing as required to control surface water and groundwater inflow. All boreholes include caps when not actively injecting or supplying materials into underground workings. When the boreholes are no longer needed, SPE abandons each according to applicable regulations and procedures.

- ***Emergency Breathable Air Boreholes*** have been constructed at the direction of the Mine Safety and Health Administration (MSHA) to provide breathable air to underground workings. Breathable air boreholes are typically not required by MSHA when other rescue equipment such as rescue chambers are provided at specific underground locations.
- ***Utility Boreholes*** are constructed to provide surface access to the underground workings. This access may include injection or supply of pumpable cribbing material, rock dust, communications, electricity, neet oil, concrete, compressed air, or other material or equipment essential to on-going operations. Typically, Utility Boreholes are approved as part of the construction of a Borehole Pad.
- ***Mitigation Boreholes*** are constructed to maintain compliance with MSHA ventilation and/or roof control plans, or other site-specific MSHA plans. Mitigation boreholes may be constructed for injection of nitrogen or other inert gas, breathable air or concrete. Mitigation boreholes may also include MSHA-directed boreholes for monitoring underground conditions with testing equipment such as air sampling equipment or thermal cameras. These boreholes typically require a developed pad.

Powerlines

Powerlines are currently installed in the Surface Facilities Area and extend to a borehole pad at the north end of Panel 6 (**Appendix A, Figure 2.1-1**).

Roads

A combination of secondary and tertiary roads are constructed in the Mine permit area (**Appendix A, Figure 2.1-2**). Secondary roads (typically 20-foot lane width) are used for access to mine facilities such as the train loadout, conveyors, substations, well pads, and major borehole pads. SPE salvages and stores in stockpiles a minimum of 6 inches of the first lift soil, where available, during construction of secondary roads outside the Surface Facilities Area (**Appendix**

A, Figure 2.1-1). Tertiary roads (typically 15-foot-wide lane width) are used infrequently in the Surface Facilities Area and for temporary activities elsewhere in the permit area, such as installing boreholes, emergency surface support facilities, or reclamation activities. Tertiary roads outside the Surface Facilities Area are temporary. SPE salvages soil by windrowing or storing a minimum of 6 inches of the first lift soil where available. Dust suppressants (e.g., water) are applied to all active roadways and parking areas to control dust emissions, as necessary.

Borehole pads, boreholes, associated roads and other small surface support facilities are required with the development of longwall panels. Traffic to the general location of these large borehole pads or other surface support facilities normally use secondary roads. Tertiary roads branch off from secondary roads to actual boreholes and surface support facilities. If boreholes can be safely constructed by driving on existing ground, then tertiary roads are not constructed.

As mining of Panel 2 began, ventilation and roof control concerns required unanticipated surface disturbances at the southern end of the Panel. In addition to the normal disturbances associated with subsidence crack repair, borehole pads and large laydown areas were constructed for injection of inert gas into the longwall gob. Since completion of Panel 2, SPE has revised its mine roof control and mine ventilation plans to minimize the likelihood of future disturbances associated with inert gas injections. As a result, Panels 3, 4, and 5 did not require similar surface disturbances. While SPE anticipates no future surface disturbances similar to those that were created at the southern end of Panel 2, a secondary road from Old Divide Road to the southern portion of the permit area (**Appendix A, Figure 2.1-2**, labeled "South Dunn Mtn Access Rd") was permitted to support surface activities related to potential subsidence repair and borehole installations. This road may be extended eastward along the southern portion of the Mining Plan Area if necessary. For purposes of this EA, the road extension is not analyzed because it is not considered reasonably foreseeable and would be subject to additional review by MDEQ if proposed in the future.

2.1.4 Subsidence and Associated Surface Repairs

Within the areas planned for longwall mining, the overburden is greater than 200 feet thick and varies based on the Mammoth coal structure and surface topography (SPE 2017a, Map 304(6)-3). In proposed mining areas of the Federal coal lease, overburden thickness ranges from approximately 200 feet (Sections 4 and 8) to 800 feet (Section 22). Surface monitoring indicates that subsidence is occurring as predicted and described in the State-approved Mine permit and BLM Coal Lease EA. The maximum elevation changes in Longwall Panels 1 through 5 ranged from 8 to 9 feet, with most areas subsiding less than 6 feet. The angle of draw is less than previously estimated and typically does not extend beyond the panel width; reducing the area of subsidence relative to that considered in the BLM Coal Lease EA.

Subsidence features generally include minor surface cracks (typically less than 6 inches in width) that do not require repair, but subsidence features requiring mitigation do occur. Subsidence mitigation efforts completed since longwall mining began in December 2009 are concentrated in areas of steep slopes (surface gradient exceeding 60 percent), in areas over the start or finish of a longwall panel, and in areas of shallow cover. The largest subsidence features to date have occurred at the south ends of Panels 4 and 5 (**Appendix A, Figure 2.1-2**). Features at these locations were not only located over the start line of the longwall panel but also in areas of steep slopes. These features were successfully repaired and reclaimed within 3 months.

While subsidence features were smaller at the south end of Panel 2 (relative to Panels 4 and 5), more surface disturbance was required in association with crack sealing to improve air quality in the underground mine as required by MSHA. The ventilation system has been changed to address mine safety concerns and avoid the need for future crack sealing.

Subsidence repair activities conducted by SPE were necessary on 14 acres of the total 3,533 acres of surface area over the first five longwall panels (see **Table 2.2-1** later in this chapter). Efforts completed to date are compliant with regulations pertaining to subsidence control (i.e., ARM 17.24.911). Over 99 percent[2] of the subsided land area required no mitigation. SPE has also entered into private agreements with landowners about surface access and repair activities.

To date, subsidence features resulting from mining have been reclaimed as necessary to eliminate hazards and restore the pre-mining land use. Where disturbance necessary for repair exceeds the disruption due to the feature, no repairs are made unless the features are inconsistent with State regulations pertaining to subsidence control (ARM 17.24.911). If subsidence features substantially disrupt surface or groundwater hydrologic balance, those impacts are mitigated using methods described in the permit. Similarly, if subsidence features such as cracks concentrate flow and lead to excessive erosion, they are corrected in accordance with the State-approved Mine permit and applicable regulations. Although some minor cracks have been repaired (e.g., overlying Panels 3 and 4), due to the disturbance necessary for repair, minor surface cracks (generally less than 6 inches in width) or cracks on slopes greater than 20 percent are not typically repaired unless directed by MDEQ.

Where repairs are undertaken, the method varies according to the specific feature and specific site condition. In general, topsoil is salvaged and replaced where possible or steps are taken to avoid displacement or loss of topsoil into the crack. Cracks of sufficient width and length up-gradient of a drainage path are repaired to prevent excess loss of topsoil into the crack. Heavy equipment is required for most repairs. The method of repair and type of equipment used are selected to minimize damage to the land caused by access routes, material storage, or incidental activities.

Repair of cracks generally does not begin until mining of the next adjacent panel is complete to ensure full subsidence has occurred and allow time for cracks to revert back to pre-subsidence condition without intrusive repair. Exceptions include situations where repair is needed to facilitate mining or where delaying the repair has the potential to exacerbate erosion or negatively affect water resources. To the extent possible, before extensive surface disruption, MDEQ and SPE conduct a survey of the surface above the panel to be repaired to establish agreement on which features are to be repaired and the methods to be used.

2.1.5 Hydrological Impacts and Mitigation

SPE continues to monitor wells, springs, ponds, and streams to identify potential impacts as described in the State-approved Mine permit (SPE 2017a, Appendices 314-3, 314-4). If water sources are impacted, SPE is required to mitigate those impacts (SPE 2017a, Appendix 313-2). Mitigation may be temporary, interim, or permanent, depending on type of impact. Permanent mitigation, if necessary, could include installation of replacement water sources. In addition to

[2] 14 acres of subsidence repairs divided by 3,533 mined = 0.3%

money bonded for temporary and interim mitigation, the bond also includes a $250,000 "trust fund" (SPE 2017a, Appendix 313-1, page 313-1-42) to cover potential long-term costs associated with maintenance and operation of any necessary water replacement facilities. Although this trust fund is included as part of the bond, the amount would not be "released back to [SPE] upon mine shutdown, but [would] instead perpetually exist for benefit of impacted surface owners(s)". Through December 31, 2017, after eight years of longwall mining, mitigation has only been necessary for one spring. SPE has proposed a site-specific mitigation plan for Spring 17145, which ceased flowing after being undermined in 2013 and again in 2014. The plan is currently under review by MDEQ (hydrology is discussed further in **Section 3.4** and **Appendix E**).

2.1.6 Mining-Related Stipulations and Mitigation Measures

Mitigation measures incorporated as State-approved Mine permit conditions were summarized in the BLM Coal Lease EA (see Section 2.1.3) and further discussed in the context of resource-specific impacts (see **Chapter 4**). Additional coal lease stipulations pertaining to cultural resources, paleontological resources, public land survey monument protection, resource recovery and protection, and multiple mineral development were also presented in the BLM Coal Lease EA (see **Chapter 4**). The mitigation measures and stipulations presented in the BLM Coal Lease EA remain in effect. Mitigation measures necessary to supplement previously identified measures are discussed in association with anticipated impacts in **Chapter 4** of this EA.

2.1.7 Coal Loadout

Coal is loaded on trains owned and operated by BNSF Railway (BNSF) at the mine tipple in the Surface Facilities Area. Trains typically have 125 cars with a total train capacity of 15,250 tons of saleable coal. This equates to approximately 1.1 loaded trains per day for the 5.96 Mt shipped in 2016. Based on the annual production rates (**Table 2.1-1**), average loaded trains per day in the past five years ranged from a low of approximately 1.0 in 2012 to a high of 1.4 in 2014, equating to between 2.0 and 2.8 trains for round-trip travel (empty and full).

As part of the coal loadout process, SPE profiles (i.e., shapes) loaded coal to improve aerodynamics and then applies a biodegradable in-transit dust suppressant agent (i.e., topper agent) to loaded coal cars to reduce coal dust emissions during transport. Profiling and application of the suppressant agent are coal dust mitigation requirements imposed by BNSF (2015a, 2017b) to reduce coal dust emissions. These measures are expected to continue for the LOM.

The tipple and rail loop are within the Mine permit boundary. After loading coal on trains, the coal and rail operations are no longer subject to the control of SPE and are outside of OSMRE's jurisdiction. Rail transport is further discussed in **Section 3.1**.

2.1.8 Coal Destinations

Coal sales are typically spot sales or short-term contracts rather than long-term contracts. Over the last 3 years, and for the foreseeable future, the vast majority of coal was and will be shipped to overseas destinations. Over 96 percent of SPE shipments are expected to be sent overseas, mainly to electric power generation facilities in Japan and the Republic of Korea (ROK). No more than 4 percent of shipped coal is expected to be used domestically. Historic locations for domestic locations are shown in **Table 2.1-2**. Domestic locations for future shipments are unknown at this time, and it would be too speculative to complete any further analysis due to changes in coal market conditions.

Table 2.1-2. Domestic coal sales (tons) between 2012 and 2016.

U.S. Power Plant Destination	2012	2013	2014	2015	2016
FirstEnergy East Lake (Ohio)	207,371	--	--	--	--
FirstEnergy Lake Shore (Ohio)	13,538	--	--	--	--
Valley (Wisconsin)	384,458	--	246,445	--	--
Alma (Wisconsin)	--	30,136	--	--	--
TES Filer City Station (Michigan)	--	--	64,300	155,224	144,402

Source: USEIA2017a

Notes: The U.S. coal data are collected and prepared for release by the Office of Oil, Gas, and Coal Supply Statistics, US Energy Information Administration (USEIA). The data are compiled from the following EIA survey source: Form EIA-923, "Power Plant Operations Report" and the US Department of Labor, Mine Safety and Health Administration, Form 7000-2, "Quarterly Mine Employment and Coal Production Report." Data for the most current time periods typically represent preliminary estimates based on samples collected by the surveys. After the end of a calendar year, the estimates are replaced by actual values from a final data collection, except in the case of missing values. The number of missing values (non-responses) are typically minimal. Normally, all data are final by the fall following the data collection year. For example, data for 2012 should be final by the fall of 2013.

Coal exports to Japan and the ROK are shipped through Westshore Terminal (Westshore), which is part of the Roberts Bank port at Port Metro Vancouver, British Columbia, Canada. After leaving the Mine permit boundary, coal is first hauled southwest along a 30-mile rail spur (Class III short line)[3] (MDT 2017) to Broadview, Montana. At Broadview, the rail joins a Class I railroad[4] (MDT 2017) between the cities of Laurel and Great Falls, Montana and is thereby connected to the railway system with alternative routes that may be used in response to weather, maintenance issues, or other factors (BNSF 2017a). Most coal transported to Westshore is expected to be hauled along BNSF's Main Line[5] (identified as "Main Coal Line" in BNSF 2013), a Class I railroad the nearest segment of which is at Laurel, Montana, approximately 27 miles southwest (33 miles by rail) of Broadview (**Appendix A, Figure 1.0-1**). The Main Line between Laurel and Westshore traverses Montana, Idaho, Washington, and British Columbia (**Appendix A, Figure 2.1-3**). In total, the rail transport route between the Mine and Westshore Terminal is estimated to be 1,390 miles one-way.

At Westshore, coal is loaded onto ocean-going vessels for overseas transport to ports in the ROK and Japan. The average ocean transport distance between Westshore and possible coal ports in the ROK and Japan is estimated to be approximately 5,300 miles (4,600 nautical miles) one-way (MarineTraffic 2017). Specific customers, combustion locations/facilities, and ports used are not known and would be too speculative to analyze further.

2.2 Description of Alternatives

A description of the alternatives analyzed by this EA are included in this section and summarized in **Table 2.2-1**, with reference to the existing condition. Features identified in the description of

[3] Short Line railroads operate over a relative short distance relative to larger, national railroad networks.

[4] The railroad at Broadview is a Class I railroad connecting Great Falls to Laurel, Montana and would be considered a "main line", but, for purposes of this analysis, the term "Main Line" is reserved for the "Main Coal Line".

[5] The Main Line joined at Laurel is a Class I railroad identified as the Main Line for Coal Transport by BNSF (2015).

each alternative are shown on the Mining Plan Map (**Appendix A, Figure 1.0-2),** Facilities Area Map (**Figure 2.1-1),** and Surface Disturbance Map (**Figure 2.1-2**).

2.2.1 No Action Alternative

Under the No Action Alternative, the proposed mining plan modification would not be approved by the ASLM, and 1,725.0 acres of Federal coal lands, 28.5 Mt of saleable Federal coal and 58.3 Mt of saleable private and State coal would not be mined. The mining term would be shortened approximately 9 years relative to the Proposed Action (**Table 2.2-1**).

SPE would continue to mine approximately 2.5 years (from 2017 to mid-2019) to recover the 22.9 Mt of saleable coal remaining within the permit area that is economically recoverable without accessing the additional 1,725.0 acres of Federal coal. Longwall mining would end at the north end of Panel 7; where Panel 7 intersects the southern boundary of Section 8 (**Appendix A, Figure 1.0-2**). Mining rates would vary from year to year but would be up to 10 Mtpy of saleable coal. The presence of Federal coal would prevent completion of mining in Panel 7. At the estimated recovery ratio of 70 percent, 6.9 Mt of CPW would be generated and deposited in WDA #1. The remaining capacity of WDA #1 is adequate to contain all waste generated under the No Action Alternative.

Under the No Action Alternative, SPE would conduct development work in the Federal coal located in Section 8 (**Appendix A, Figure 1.0-2**), as allowed by the October 31, 2017 and November 3, 2017, US District Court Orders (see **Section 1.0)** The amount of Federal coal displaced by the development work in Section 8 would not exceed 170,000 tons, and any Federal coal mined would be stockpiled and stored at the Mine and would be neither sold nor shipped. If the Proposed Action is not implemented as discussed in **Section 2.2.2**, stockpiled coal would likely be put back in the mine during reclamation.

Mining and associated operations under the No Action Alternative would disturb an estimated 73 additional acres in association with surface facilities and subsidence repairs (**Table 2.2-1**). Subsidence features and associated repairs would not be as extensive as those at the end of Panels 4 and 5 and are expected to be similar to Panel 6 because the longwall panel start lines would not be located in areas of steep slopes. Preliminary locations of boreholes and associated pads are within the Mine permit area (as reflected in **Appendix A, Figure 2.1-2**), but the actual locations would depend on site conditions and would be subject to change. Surface disturbances would also be subject to existing access agreements with surface owners.

Final locations of all future boreholes and associated pads and roads would be permitted as a revision to the State-approved Mine permit. Since the Borehole Pads were originally permitted, changes to underground procedures (i.e., pumpable cribs are no longer used) have eliminated the need for the mid-panel large borehole pads and their associated access roads. It is anticipated that future mid-panel pads would not be constructed, but they would remain permitted and bonded so that they may be constructed if needed (SPE 2018a).

New powerlines would originate along existing transmission routes and connect to borehole facilities. SPE anticipates that very few boreholes would require power; therefore, few new powerlines would be constructed. However, a new powerline is anticipated along the north end of the mine panels to provide power to several borehole pads over the mine workings in the East Mains. A new ventilation fan may be constructed on one of these pads and a potential location is shown in **Appendix A, Figure 2.1-2**. Associated powerline locations have not been identified. Any additional powerlines or surface disturbance activities would be subject to review by MDEQ as part of the Mine permit.

Table 2.2-1. Comparative Summary of the Proposed Action and No Action Alternative Relative to the Existing Condition

Condition Evaluated	Units	Existing Condition[1]	Additional[2] Under No Action[3]	Additional[2] Under Proposed Action	Difference
Saleable coal to be mined	Mt[2]		22.9	109.7	86.8
Saleable Federal coal to be mined	Mt[2]		1.7	30.2	28.5
Federal coal lands in the Mining Plan Area	acres		140	2679.76	2539.76
Federal coal lands to be mined	acres		110	1,835	1,725.0
Remaining mining term	years		2.5	11.5	9
Annual Mine Production (maximum)	Mt		10	10	same
Annual Average Coal shipment (maximum)	loaded trains per day		1.8	1.8	same
Surface Facilities Area	acres	553	21	337	316
Air Portals	acres	5	1	1	0
Subsidence Repairs[4]	acres	14	5.6	25.2	19.6
Total Subsidence Area	acres	3,533	1,400	6,296	4,896
Borehole Pads	number	19	15	39	24
	acres	21	17	50.8	33.8
Roads (Outside of Facilities Area)	miles	6.9	7.6	16.5	8.9
	acres[5]	25	28	60	32
Total Disturbance[6]	acres	618	73	474	401

(1) Existing condition as of January 1, 2017. Estimates related to future mining tons and acres do not include a comparison of tons or acres mined to date.

(2) Estimated quantities after January 1, 2017. Saleable tones are 70 percent of mined tons.

(3) Saleable Federal coal to be mined (tons) and Federal coal lands to be mined (acres) under the No Action Alternative do not include mining of raw coal from Section 8 as allowed by the October 31, 2017 US District Court Order as that coal would not be sold under the No Action Alternative.

(4) 14 Acres Repair in first 3,533 Acres Subsidence Area so used 0.004 acres Subsidence Repair per acre of Subsidence Area to estimate.

(5) 25 Acres in first 6.9 miles of road equates to approximately 3.7 acres per mile (nearly 31 ft average width). These values were used to estimate the additional acreages for future roads.

(6) Total disturbance may not precisely match the total of component values due to rounding of acreage values.

Under the No Action Alternative, another air portal with similar function is planned for the south end of Panel 7 (**Appendix A, Figure 2.1-2**) to replace the existing air portal at the south end of Panel 3 (see **Section 2.1.3** above). This new air portal would be constructed in early 2018 following approval by MDEQ. The associated State permit revision materials have been submitted to MDEQ (minor revision 247) and include a revision to the Mine permit boundary to include approximately 20 additional acres. After Panel 6 is mined out in 2018, the existing air portal and associated facilities would be reclaimed in accordance with the Mine permit.

At the conclusion of mining, Mine facilities would be removed and all surface disturbances would be reclaimed in accordance with the Mine permit (SPE 2017a). Reclamation is estimated to take approximately 16 months after the end of mining (SPE 2017a, Figure 313-1).

2.2.2 Proposed Action

The Proposed Action would authorize SPE to continue coal mining on approximately 1,835 acres of Federal coal lands in the Mining Plan Area. Mining would continue for approximately 9 additional years beyond the No Action Alternative (until mid-2028). Relative to the No Action Alternative, an additional 86.8 Mt of saleable coal would be produced, including 28.5 Mt of saleable Federal coal. Mining and associated operations are projected to disturb 401 more acres as compared to the No Action Alternative, associated with surface facilities and subsidence repairs (**Table 2.2-1**). The Proposed Action would not result in an increase in annual production, only an increase in the number of years production would continue within the Mine permit area. In connection with Federal coal mining, SPE would continue to mine adjacent private and State coal. Mining rates would vary from year to year, but would be up to 10 Mtpy of saleable coal and would average approximately 9.6 Mtpy of saleable coal from 2017 to 2028. Although there are no existing sales contracts in place, SPE expects that nearly all coal would continue to be sold to customers in the ROK and Japan.

Waste Disposal

Approximately 32.9 Mt of additional CPW would be generated as a result of the Proposed Action, relative to the No Action Alternative. The additional volume of CPW would require construction of WDA #2 encompassing approximately 287 acres south and east of Fattig Creek Road in the Surface Facilities Area (**Appendix A, Figure 2.1-1**). Although WDA #2 is currently approved in the Mine permit (SPE 2017a), it would only be constructed if the Proposed Action is undertaken.

As approved, WDA #2 would be constructed, operated, and reclaimed in a manner comparable to existing WDA #1. Surface water control facilities would be constructed and soil and other suitable cover materials would be stockpiled before placing CPW. CPW would be transferred from the coal processing facilities via conveyor over Fattig Creek Road where it would be handled in the same manner as WDA #1. Equipment would access WDA #2 from WDA #1 via a private at-grade crossing of Fattig Creek Road. CPW would eventually fill the basin in which WDA #2 is constructed and fly ash (received from Yellowstone Energy) would be used to accelerate drying of the CPW. Dust suppressants would be applied to WDA #2 to control dust emissions, as necessary. At the conclusion of mining, WDA #2 would be covered with stockpiled soil and cover material and associated disturbances would be reclaimed to a combination of grazing land, wildlife habitat, and pastureland consistent with pre-mine land uses.

Other Facilities and Disturbances

Relative to the No Action Alternative, an estimated 24 additional borehole pads and 8.9 miles of roads may be constructed (**Appendix A, Figure 2.1-2**), resulting in an estimated 66 acres of additional disturbance.

Preliminary locations of boreholes and associated pads and access roads (**Appendix A, Figure 2.1-2**) are identified in the Mine permit area, but the actual locations would depend on site conditions and surface access agreements and are subject to change. Borehole pad and road locations (**Appendix A, Figure 2.1-2**) are preliminary. Consistent with the No Action Alternative, SPE anticipates that most of the pads and roads would not be necessary under the Proposed Action, potentially resulting in as little as 20 acres of disturbance associated with these features. All future boreholes and associated pads and roads would be permitted as a revision to the State-approved Mine permit.

As mining progresses to the east, a ventilation shaft and fan may be installed at a pad location above the East Mains. A possible fan location is shown in Section 8 on **Figure 2.1-2**, but the actual location may be different. Additional powerlines would likely be required to some of the borehole pads to power ventilation fans, but the locations of those powerlines are not known at this time. New powerlines would originate from existing powerlines and connect to borehole facilities. SPE anticipates that few boreholes would require power; therefore, few new lines would be constructed. However, a new powerline is anticipated along the north end of the mine panels to power a ventilation fan installed on one or two additional large borehole pads over the East Mains. Any additional powerlines or surface disturbance activities would be subject to review by MDEQ.

Relative to the No Action Alternative, approximately 19.6 additional acres are expected to be disturbed in association with subsidence repairs, the majority of which would occur near the panel ends. Subsidence features and associated repairs would not be as extensive as those at the end of Panels 4 and 5 as longwall panel start lines would not be located in areas of steep slopes.

Following mining, reclamation activities would be conducted in accordance with the Mine Permit and would take approximately 16 months (SPE 2017a, Figure 313-1).

2.3 Alternatives Eliminated from Detailed Study

If an alternative is considered during the environmental analysis process, but the agency decides not to analyze the alternative in detail, the agency must identify those alternatives and briefly explain why they were eliminated from detailed analysis (40 C.F.R. § 1502.14). An alternative may be eliminated from detailed analysis if:

- It is ineffective (does not respond to the Purpose and Need for the Proposed Action);
- It is technically or economically infeasible (considering whether implementation of the alternative is likely, given past and current practice and technology);
- It is inconsistent with the basic policy objectives for the management of the area (such as, not in conformance with the BLM's Resource Management Plan);
- Its implementation is remote or speculative;
- It is substantially similar in design to an alternative that is analyzed; and/or,
- It would result in substantially similar impacts to an alternative that is analyzed.

Alternatives specific to this EA that were considered, but that are not analyzed in detail, are discussed below.

2.3.1 Subsurface Gas Control

Public comments received during the scoping period suggested an alternative that requires additional subsurface gas controls and mitigations. OSMRE has not brought forward this alternative for full analysis because methane content is only present at trace levels (near zero). 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. The underground workings in the Mammoth coal seam are monitored for methane to ensure mine safety. While trace readings of methane have been occasionally detected over the past two decades, the methane content has historically been zero (Ochsner 2014).

With historically only trace levels of methane in the coal seam, there is no development of coalbed methane as a marketable commodity in this area, and the Bull Mountains Mine has had no need to develop any methane drainage strategies for mine operations. 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. Based on this information, methane from the mine does not substantially contribute to GHG emissions.

2.3.2 Avoidance of Impacts to Surface Resources, Features, and Uses

Public scoping comments suggested that OSMRE should consider alternatives that would avoid mining under areas that are potentially of high impact to surface resources, features, or uses. MSUMRA (82-4-228, Montana Code Annotated (MCA)) and Montana's regulations (ARM 17.24.1141) contain provisions for designation of land unsuitable for coal mining. No such unsuitable lands are located in the Mine permit area as determined with the State program's approval of the Mine permit (SPE 2017a, Volume 5, Section 1141). Additionally, neither significant or unique scenic and/or geologic features (ARM 17.24.304(c)) nor special, exceptional, critical, or unique characteristics (ARM 17.24.304(d)) are present in the Mine permit area (SPE 2017a, Addendum 1).

The PAP contains an inventory of the Amendment 3 mining area and measures that would be employed to mitigate impacts, including reclamation techniques. Impacts and proposed mitigation measures are evaluated in the BLM Coal Lease EA and this EA, and no impacts were identified that would require mitigation beyond that described in the Mine permit. Mining to date has not caused impacts to surface resources, features, or uses beyond those allowed by the Mine permit and MSUMRA. Therefore, this alternative was not brought forward for analysis because avoidance of certain areas would not reduce environmental impacts less than the Proposed Action.

2.3.3 Alternative Land Uses

Comments were submitted during the public scoping period asking OSMRE to consider alternative uses of the land and industries, besides mining, that would be environmentally and economically more stable and lead to economic diversification and transition in the region. Examples included a focus on renewable/clean energy development/activities, education and training, recreation and tourism, other non-fossil fuel sectors which could support economic diversification and transition. This alternative was eliminated from detailed study because it would be inconsistent with the Purpose and Need for the Proposed Action and its implementation would be too remote and speculative (**Section 1.2**).

3.0 AFFECTED ENVIRONMENT

This chapter discusses the existing conditions of the physical, biological, cultural, and human resources that could be affected by implementation of the Proposed Action and No Action Alternative described in **Chapter 2** as they relate to the approval of the Federal mining plan modification for the Bull Mountains Mine No. 1. Aspects of the affected environment described in this chapter relate to the issues presented in **Chapter 1**. Elements of the environment specified by statute, regulation, EO or the Standards for Public Land Health are described and analyzed in this section except where the BLM Coal Lease EA previously concluded they were not present.

Where baseline information pertaining to the Mine and presented in the BLM Coal Lease EA has not substantively changed it is incorporated by reference; a crosswalk between the BLM Coal Lease EA and this EA is presented in **Table 1.4-1**. More recent information pertaining to the baseline and existing condition at the Mine is presented in this chapter, where available, along with baseline data supporting analysis of coal transport and combustion which occur indirectly as a result of mining. Unless otherwise noted, the baseline condition described in the BLM Coal Lease EA (**Appendix A**) has not substantively changed, no new data are available, or the condition has only been minimally affected as a result of current mining operations and further presentation of information would not affect the decision-making process.

3.1 Transportation & Electrical Transmission

3.1.1 Vehicle Transportation

As discussed in the BLM Coal Lease EA, the Mine is accessed from public roads including US Highway 87, Old Divide Road, and Fattig Creek Road (**Appendix A, Figures 2.1-1** and **2.1-2**). Mine employees travelling to work and other Mine-related traffic use these roads. Portions of the Mine permit area away from public roads are accessed via existing ranch trails and Mine roads (**Appendix A, Figure 2.1-2**). Mine roads recently constructed within the permit boundary are discussed in **Section 2.1.3**.

Level of service (LOS) is a term used to qualitatively describe the operating conditions of a roadway based on factors such as speed, travel time, maneuverability, delay, and safety. LOS is designated with a letter, A to F, with A representing the best operating conditions (free flowing traffic) and F the worst (completely congested) (Highway Capacity Manual *in* San Mateo County 2013, Table 3-1). Highway 87 between Billings and Roundup is a two-lane Principal Arterial highway, which would have a design capacity of 2,800 cars per hour (Highway Capacity Manual *in* San Mateo County 2005, page B-2) and a LOS target grade B (MDT 2016).

The highest annual average daily traffic (AADT) in the past 5 years at two daily count stations nearest to the Mine had rates equating to 120 cars per hour (MDT 2016). This equates to LOS Grade A (San Mateo County 2005, Table B-3); therefore, Highway 87 is judged to meet its target LOS. The Montana Department of Transportation (MDT) redesigned and improved the intersection of Highway 87 and the southern terminus of Old Divide Road in 2015 to address a cluster of accidents at that location. No further upgrades or major maintenance projects are planned on Highway 87 (Nelson 2018).

The AADT on Old Divide Road at the southern US Highway 87 intersection was estimated at 239 vehicles per day in 2016 (MDT 2018), a large portion of which is expected to be Mine-related. Old Divide Road and Fattig Creek Road are classified as local roads and as such are not graded as to LOS. The Musselshell County Road Department judges the roads adequate to meet the traffic demands of residents and Mine employees, although they note that heavy equipment being hauled from Billings to the Mine have impacted the road. In March 2017, the County received a grant from the Montana Federal Lands Access Program to reseal and repave Old Divide Road from the northern to the southern intersection with Highway 87, as well as the segment of Fattig Creek Road from Old Divide Road to the Mine entrance (Kenner 2018).

3.1.2 Electrical Transmission

Electricity is currently supplied to the Mine by existing overhead transmission lines. With the exception of electrical distribution lines in the Surface Facilities Area, most of which is associated with Mine-related facilities, no other electrical transmission lines are present in the Mine permit area. In the Mine vicinity, other distribution lines provide power to local residences and farmsteads, including most of the dwellings shown on **Appendix A, Figure 2.1-2**.

3.1.3 Rail Transportation

Regulatory Environment

Railroads are regulated by two separate Federal agencies, each with their own responsibilities.

- Surface Transportation Board (STB) – STB is an independent adjudicatory and economic-regulatory agency charged by Congress with resolving railroad rate and service disputes and reviewing proposed railroad mergers. STB has jurisdiction over railroad rate and service issues and rail restructuring transactions (e.g., mergers, line sales, line construction, and line abandonments) and also has authority to investigate rail service matters of regional and national significance. STB regulations preempt State and local laws (e.g., noise ordinances) that would otherwise manage or govern rail transportation.
- Federal Railroad Administration (FRA) – As part of the US Department of Transportation (USDOT), FRA formulates and enforces rail safety regulations, administers rail funding, and researches rail improvement strategies and technologies. FRA also facilitates national and regional rail planning to maintain current services and infrastructure and also expand and improve the rail network. For example, the Passenger Rail Investment and Improvement Act of 2008 requires states to develop FRA-accepted State rail plans and encourages State involvement in rail policy, planning, and development. For the most part, all railroad operational procedures are subject to FRA regulations, including highway-railroad crossing signals, train speeds, train horn use, and track condition.

STB and FRA conduct reviews required by NEPA and consider environmental impacts before making final decisions pertaining to actions under their jurisdiction. STB's Office of Environmental Analysis is responsible for directing the environmental review process, conducting independent analysis of all environmental data, and making environmental recommendations to the STB. STB's environmental rules are found at 49 CFR Part 1105. FRA conducts environmental reviews according to FRA's Environmental Procedures (FRA 1999).

In addition to the regulations administered by STB and FRA, railroad activities must comply with other Federal laws pertaining to environmental protection such as the Clean Water Act (CWA) and Clean Air Act (CAA) administered by the Environmental Protection Agency (EPA).

Coal Transport Routes and Rail Traffic

As discussed in **Section 2.1.8**, coal from the Mine is shipped to markets by railroad, beginning with the 30-mile Class III (MDT 2017) short line rail spur connecting the tipple in the Surface Facilities Area to the BNSF railroad at Broadview, Montana (**Appendix A, Figure 2.1-3**). Loaded and empty coal trains travelling to and from the Mine comprise all traffic on the rail spur (e.g., 2.1 trains round trip in 2016).

From Broadview, trains travel a Class I railroad (MDT 2017) to Laurel, Montana where they join the Main Line ("Main Coal Line" in BNSF 2013) at the Mossmain Junction (**Appendix A, Figure 2.1-3**). Train count data reported for a rail crossing (088439S) near Acton, Montana, midway on the Broadview to Laurel (Mossmain) segment, estimated 6 trains per 24-hour period in 2013 (USDOT 2016). Based on the production rates and train size presented in **Section 2.1.7**, round-trip rail traffic associated with the Mine averaged approximately 2.7 trains per day in 2013. This suggests that rail traffic excluding the Mine-related rail traffic was approximately three trains per day in 2013 and that Mine-related traffic in the past five years may comprise approximately half of traffic on that segment.

The Main Line between Laurel and Westshore Terminal traverses Montana, Idaho, Washington and enters British Columbia (**Appendix A, Figure 2.1-3**). Recent baseline traffic (average number of trains per day) estimates of train traffic on the US segments range from 14.5 (2012 estimate for Mossmain Junction to Sandpoint, Idaho [STB 2015a]) trains per day to 70 (2015 estimate for segments in Washington east of Spokane [Cowlitz County and WDOE 2017]) trains per day. The portion of existing rail traffic related to the Mine's coal transport (2.1 trains per day in 2016) is highest from Laurel, Montana to Sandpoint, Idaho. Mine-related rail traffic on that segment is estimated to be less than 15 percent of all rail traffic.

Rail segment utilization, the ratio of demand to available capacity, is a metric related to rail congestion where utilization near or over 100 percent may cause delays. Recent State rail plans report that utilization of Main Line segments in Montana (MDT 2010) and Washington (WSDOT 2014) is less than 100 percent. In Idaho, several segments with an estimated 48 trains per day in 2012 are above their 39 train capacity (ITD 2013). However, according to the Idaho Department of Transportation (2013), despite deficiencies, double-track segments in northern Idaho provide a "comfortable [level of service] under current conditions." Coal from all sources is a substantial portion of statewide rail freight tonnage in all three states: 71 percent in Montana (MDT 2010), 14 percent in Idaho (ITD 2013) and 12 percent in Washington (WSDOT 2014).

Montana, Idaho, and Washington rail plans analyze the current capacity of the lines in each state relative to forecasted conditions extended to 2035 or 2040, which is beyond the estimated Mine life (i.e., 2028 under the Proposed Action). Rail plans project increased rail traffic and utilization on all Main Line segments.

- Montana Main Line utilization will not exceed 100 percent by 2035. (MDT 2010).
- Idaho Main Line utilization in 2040 (ITD 2013):

  - Montana border to Sandpoint (Ponderay) – 90 percent;
  - Sandpoint to the Washington border – 270 percent.
- Washington Main Line utilization in 2035 (WSDOT 2014):
  - Idaho border to Spokane – 150 percent utilization;
  - Spokane to Pasco estimated – 170 percent utilization;
  - Pasco to Vancouver – 140 percent utilization; and,
  - Vancouver to US-Canada Border – most segments near 100 percent utilization.

Rail plans' analyses are based on anticipated freight and passenger rail growth relative to capacity. The volume that can be accommodated depends not only on infrastructure, but also on the railroad's scheduling strategy, use of technology (e.g., signal timing optimization and signal coordination to improve efficiency) and many other business decisions (WSDOT 2014). Projected volumes do not take into account productivity improvements that may be achieved with longer trains, or other strategies continuously explored by railroad operators to improve operations and throughput. "Because capacity is dynamic, it should not be used as a sole measure for decision making" (WSDOT 2014). In Washington and Idaho, it is anticipated the railroads and other infrastructure owners will address key capacity issues by implementing capacity and efficiency improvements (WSDOT 2014, ITD 2013).

Coal Dust Effects on Railroads

Coal dust, a form of particulate matter, originates from loaded coal trains during transit. BNSF has conducted research since 2005 about the impacts of coal dust escaping from loaded coal cars on rail lines in the Powder River Basin (PRB). Results of these studies show that potential deposition of coal dust poses a threat to the stability of the track structure and the operational integrity of its lines in, and close to, the mines in the PRB (BNSF 2017b).

In March 2011, STB confirmed that coal dust is a "particularly harmful contaminant" that can degrade the integrity of railroad ballast, which distributes the load from the rail ties (STB 2011). Coal dust can interfere with the normal drainage of the ballast, causing tracks to be less stable and potentially increasing the risk of train derailments on heavily used rail.

Item 100 of BNSF Price List 6041-B (BNSF 2015a, 2017c) contains BNSF's coal dust mitigation requirements; also known as the Coal Loading Rule. The current Coal Loading Rule has been in effect since October 2011 and requires all shippers loading coal at any Montana or Wyoming mine to take measures to load cars in such a way that ensures coal dust losses in transit are reduced by at least 85 percent compared to cars where no remedial measures have been taken.

The Coal Loading Rule also has a "safe harbor" provision stating that a shipper will be deemed to be in compliance with BNSF's Coal Loading Rule if it loads cars in compliance with BNSF's published Load Profile Template and applies an approved in-transit dust suppressant agent to the loaded cars in the specified manner. Alternatively, the BNSF allows coal shippers to use other methods to reduce dust emissions if the shipper is able to show that its methods reduce emissions of fugitive coal dust by at least 85 percent. In May 2015, the STB issued a decision which affirmed the reasonableness of the Coal Loading Rule and upheld its enforceability (STB 2015b).

3.2 Air Quality

Unless otherwise noted, baseline air quality described herein reflects 2016 conditions, including direct effects from mining and indirect effects of rail transport, seaport handling, ocean transport, and combustion (referred to as "segments") of 5.96 Mt of saleable coal shipped in 2016 (see **Table 2.1-1**). Air quality considerations, baseline conditions, and applicable regulations and jurisdictions differ for each "segment" from mining to combustion. Relevant information is summarized in this section with additional supporting detail provided in **Appendix B**. Estimated emissions from all segments in 2016 are summarized in **Table 3.2-1**. Details regarding information sources and assumptions used to calculate emissions on a 1.0 Mt basis are provided in **Appendix C**.

Table 3.2-1. Total Estimated Emissions from Mining, Transport, and Combustion of 5.96Mt of Saleable Coal in 2016.

Segment	PM10 (tons)	PM2.5 (tons)	NOx (tons)	SOx (tons)	CO (tons)	VOC (tons)	Pb (lbs)	Hg (lbs)	As (lbs)
Mining	236	32	47	16	63	15			
Rail Transport	45	42	1,622	2	386	78			
Seaport Handling	20	4	31	1	9	2			
Ocean Transport	698	642	5,238	4,941	472	202			
Coal Combustion (high range)	890	861	578	2,367	30	4	30	30	26
Coal Combustion (low range)	1,751	1,363	23,095	11,834	373	52	592	182	520

PM10 = particulate matter < 10 microns; PM2.5 = particulate matter <2.5 microns; NOx = nitrogen oxides; SOx = sulfur oxides; CO = carbon monoxide, VOC = volatile organic compounds; Pb = lead; Hg = mercury; As = arsenic.

3.2.1 Mining

Regulatory Setting

Under the CAA, EPA has established concentration levels for common air pollutants judged "necessary, with an adequate margin of safety, to protect the public health" and "necessary to protect the public welfare from any known or anticipated adverse effects" (40 CFR § 50.2(b)). These pollutants, referred to as "criteria pollutants," include: carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone, lead, and particulate matter with aerodynamic diameters less than or equal to 10 microns (PM_{10}) and less than or equal to 2.5 microns ($PM_{2.5}$). Federal concentration thresholds for criteria pollutants; or National Ambient Air Quality Standards (NAAQS), as well as Montana's Ambient Air Quality Standards (MAAQS) are presented in **Appendix B**.

As described in **Appendix B**, Musselshell and Yellowstone Counties, within which the Mine is located, are designated "unclassifiable/attainment" for all criteria pollutants. The Mine does not meet applicability criteria for rules related to Class I areas, including regional haze; the Title V Operating Permit Program; the Prevention of Significant Deterioration New Source Review.

Mine-Related Emissions

Based on information included in SPE's Application for Modification to Air Quality Permit #3179 (SPE 2014a), the Mine's annual PM_{10} emission rate is estimated to be approximately four times greater than the rate for any other criteria pollutant. Approximately 98 percent of mine-related PM_{10} emissions results from fugitive sources, such as haul truck traffic and wind erosion of exposed surfaces, which tend to concentrate air quality impacts locally. Until recently, SPE was required to operate three monitoring stations at two sites (two stations co-located) proximal to the Mine (**Appendix A, Figure 2.1-1**) to measure concentrations of PM_{10}. In February 2017, MDEQ allowed SPE to discontinue this monitoring effort based on the fact that in the preceding seven years none of the monitoring stations measured a PM_{10} MAAQS or NAAQS exceedance attributed to Mine operations (MDEQ 2017a). The Mine is subject to several opacity limits which effectively limit fugitive dust emissions and is subject to the Federal Coal Preparation and Processing Plants New Source Performance Standards (40 CFR Part 60, Subpart Y).

SPE (2014a) estimated the Mine's potential maximum annual emissions of criteria pollutants of concern. **Appendix C** summarizes the results of those estimates and the portion attributed to each 1.0 Mt of saleable coal produced for reference in this analysis. **Table 3.2-1** and **Appendix B** presents estimated annual emissions (tons per year) from Mine operations in 2016, which produced 5.96 Mt of saleable coal.

3.2.2 Rail Transport

Sections 2.1.7 and **3.1** describe the rail transport route considered in this analysis. From the Mine, coal is hauled approximately 1,390 miles (one way) through Montana, Idaho, and Washington to Westshore Terminal at the Port of Vancouver, British Columbia, Canada. Under the CAA, EPA has sole authority to adopt and enforce locomotive emission standards (CARB 2006). Additional details regarding Federal locomotive emission-related standards and other State and local considerations are provided in **Appendix B.**

Baseline criteria air pollutant emission rates for each 1.0 Mt of coal transported by rail between the Mine and Westshore Terminal were estimated using methods described in **Appendix C**. Those estimated emissions were used to estimate the total emissions from transporting 5.96 Mt of saleable coal in 2016 (**Table 3.2-1** and **Appendix B**). Emission rates for each pollutant are estimated in tons per year (2016) as well as average pounds per mile (lbs/mile) over the 2,780 miles trains travel round-trip, with the latter reflecting the transitory and distributed nature of locomotive emissions.

In addition to potential impacts related to rail safety as discussed in **Section 3.1**, coal dust is identified as having potential to affect human health and environmental quality. Particulate emissions (i.e., PM_{10} and $PM_{2.5}$) can affect the heart and lungs and cause serious health effects (EPA 2017a), and trace elements in coal could potentially affect the environment where coal dust deposition occurs. **Appendix B** summarizes existing literature and information pertaining to coal dust emissions, including generation, dispersion, and deposition, as well as human health and ecological concerns.

3.2.3 Seaport Handling

As discussed in **Section 2.1.7**, nearly all coal from the Mine is shipped overseas from Westshore Terminal. Context on the existing regulatory environment and existing conditions associated with Westshore Terminal are provided in **Appendix B**.

In 2013, an air quality study was conducted to evaluate local and regional baseline conditions and potential environmental impacts related to Westshore Terminal's proposed port improvement and expansion project (Westshore Terminal LP 2013). **Appendix C** discusses emissions estimates from that study and presents estimated port-wide criteria pollutant emissions attributed to handling 1.0 Mt of coal based on existing port capacity and emission rates as this reflects the more conservative (i.e., highest) estimated emission rates of the two scenarios (Westshore Terminal LP 2013). These emission rates were used to estimate emissions attributed to transferring 5.96 Mt of coal from the Mine in 2016 (**Table 3.2-1** and **Appendix B**).

3.2.4 Ocean Transport

Appendix B summarizes the existing regulatory structure related to oceanic transport, including relevant regulations contained within the United Nations International Maritime Organization (IMO) International Convention for the Prevention of Pollution from Ships; known as MARPOL 73/78.

Appendix C presents estimated criteria pollutant emissions from ocean transport of 1.0 Mt of coal. Estimates reflect round-trip travel assuming the same emissions in both directions (i.e., emissions occurring over 10,600 miles, in sum, to and from Westshore Terminal and Japan or the ROK). Estimated baseline criteria air pollutant emissions from ocean transport of 5.96 Mt of coal in 2016 are presented in **Table 3.2-1** and **Appendix B.** Emission rates for each pollutant are estimated in total tons as well as lbs/mile, with the latter reflecting the transitory and distributed nature of cargo vessel emissions.

3.2.5 Overseas Combustion

As discussed in **Section 2.1.7**, nearly all coal is sold to power generators in the ROK and Japan. These countries therefore comprise the affected environment for analysis of overseas combustion effects on air quality. **Appendix B** outlines the regulatory framework implemented by each country to maintain or improve air quality by limiting pollutant emissions from industrial and other emitting sources.

Appendix C presents estimated emissions of criteria pollutants and heavy metals hazardous air pollutants (HAPs) (i.e., lead, mercury and arsenic), generated from combusting 1.0 Mt of coal at utility-scale power plants in the ROK and Japan (separately or collectively). Estimated ranges of baseline pollutant emissions from combusting 5.96 Mt of coal in 2016 are presented in **Table 3.2-1** and **Appendix B.**

Effects of most industrial source air pollutants are limited to the immediate area or, at most, the region surrounding the source. However, mercury emissions can also have a global effect. Exposure to mercury threatens human health, with developing fetuses and young children most at risk. Mercury pollution can also harm wildlife and ecosystems (EPA 2017b). Estimated 2010 mercury emissions from the US, Japan and ROK are summarized in **Appendix B**.

3.3 Climate

The Mine's climate is discussed in Section 3.1 of the BLM Coal Lease EA and notable recent precipitation patterns are discussed in **Section 3.4** (Hydrology) of this EA. This section primarily addresses global climate conditions and trends in relation to climate change, previously discussed in Section 3.3.2 of the BLM Coal Lease EA.

3.3.1 Background

Though the terms "global warming" and "climate change" are often used interchangeably, they are two distinct concepts. In general, the causes and effects of climate change can be depicted as a chain of events: GHG emissions and other climate drivers → global warming → climate change → environmental effects. Essentially, GHG emissions and other factors contribute to climate change in the form of global warming, then climate change contributes to environmental effects around the globe.

GHGs & Global Warming

The term "global warming" refers to the gradual increase, observed or projected, in global surface temperature (Intergovernmental Panel on Climate Change, IPCC 2014). Through complex interactions on a global scale, the emissions of GHGs, along with other climate-influencing environmental factors, cause a net warming of the atmosphere. GHGs impede the escape of reflected solar radiation and heat from the Earth's surface back into space, creating a "greenhouse effect".

At the global scale, key GHGs emitted by human activities include CO_2, methane (CH_4), nitrous oxide (N_2O), and fluorinated gasses (F-gasses) (EPA 2018a). Anthropogenic GHG emissions since the pre-industrial era have driven large increases in the atmospheric GHG concentrations. Human activities are responsible for almost all of the increase in GHGs in the atmosphere over the last 150 years (IPCC 2007 in EPA 2018a).

Climate Change

Climate is defined as the average course or condition of the weather at a place usually over a period of years as exhibited by temperature, wind velocity, and precipitation (Merriam-Webster 2014). The US Global Change Research Program (USGCRP 2017) defines climate change as:

> "Changes in average weather conditions that persist over multiple decades or longer. Climate change encompasses both increases and decreases in temperature, as well as shifts in precipitation, changing risk of certain types of severe weather events, and changes to other features of the climate system."

EPA (2016a) notes that warmer temperatures are one of the most direct signs that the climate is changing. Concentrations of heat-trapping GHGs are increasing in the Earth's atmosphere. In response, average temperatures at the Earth's surface are increasing and are expected to continue rising. However, because climate change can shift wind patterns and ocean currents that drive the world's climate system, some areas are warming more than others, while other areas have experienced cooling.

3.3.2 GHG Emissions

Total GHG emissions are expressed as carbon dioxide equivalent (CO_2e) emissions and are calculated based on how long each GHG remains in the atmosphere, on average, and how strongly it absorbs energy (Global Warming Potential, or GWP) (see **Appendix C**). GHGs with a higher GWP absorb more energy per pound than gases with a lower GWP, and thus contribute more to global warming (EPA 2018a).

According to the EPA (2016a), increasing emissions of GHGs due to human activities worldwide have led to a substantial increase in atmospheric concentrations of GHGs. Every country emits GHGs into the atmosphere, meaning the root cause of climate change is truly global in scope. However, some countries produce far more GHGs than others, and several factors—such as economic activity (including the composition and efficiency of the economy), population, income level, land use, and climatic conditions—can influence any given country's emissions levels. Tracking GHG emissions worldwide provides a global context for understanding the US' and other nations' roles in climate change.

Global Emissions

Global anthropogenic GHG emissions totaled approximately 54,000 Mt of CO_2e (Mt-CO_2e) in 2010 (IPCC 2014). Global carbon emissions from fossil fuels comprise the largest source of anthropogenic GHG emissions and have significantly increased since 1900 (EPA 2018a). Since 1970, CO_2 emissions have increased by about 90 percent, with emissions from fossil fuel combustion and industrial processes contributing approximately 78 percent of the total GHG emissions increase from 1970 to 2011. Agriculture, deforestation, and other land-use changes have been identified as the second-largest contributors (IPCC 2014 in EPA 2018a).

US Emissions

EPA (2018a) reports that since 1990, annual US GHG emissions have increased by approximately 4 percent; with annual variations attributable to changes in the economy, the price of fuel, and other factors. In 2015, approximately 7,261 Mt-CO_2e were emitted in the US. Primary sources of those emissions (percent of 2015 total noted) included electricity production (29 percent), transportation (27 percent), industry (21 percent), commercial and residential (12 percent), and agriculture (9 percent).

While activities and land uses can act as a source of GHG emissions, land areas can also act as a sink, absorbing CO_2 from the atmosphere (EPA 2018a). In the US, since 1990, managed forests and other lands have absorbed more CO_2 from the atmosphere than they emit. In 2015, GHG emissions were partly offset by carbon sequestration in forests, trees in urban areas, agricultural soils, landfilled yard trimmings and food scraps, and coastal wetlands, which, in aggregate, offset nearly 12 percent of US emissions (EPA 2017c).

Montana Emissions

In 2007, Montana's estimated anthropogenic GHG emissions and sinks (carbon storage) were estimated for the period from 1990 to 2020 (CCS 2007). In 2005, activities in Montana accounted for approximately 40.7 Mt-CO_2e emissions, less than 1 percent of US emissions estimated over that same year. CCS (2007) projects that Montana's gross GHG emissions will climb to 46.3 Mt-CO_2e by 2020, with transportation projected to be the largest contributor to future emissions growth, followed by emissions associated with fossil fuel production and electricity use.

Mine-Related Emissions

Table 3.3-1 summarizes direct and indirect GHG emissions resulting from all activities related to mining, transporting, and combusting coal from the Mine, most of which are outside the jurisdiction of OSMRE. Over 97 percent of this total estimate is associated with overseas combustion. **Appendix C** describes calculations, data, and additional assumptions underlying estimates for each segment, which are consistent with the assumptions used to calculate non-GHG emissions as discussed in **Section 3.2.**

Table 3.3-1. Estimated GHG Emissions from Mining, Transporting, and Combusting Coal from the Mine in 2016.

Segment	**GHG Emissions ($Mt\text{-}CO_2e$)**
Mining Operations	<0.1
Rail Transport	0.2
Port Operation	<0.1
Ocean Vessel Transport	0.2
Overseas Combustion	12.7
Total GHG Emissions in 2016 (5.96Mt saleable coal)	**13.0**
Total GHG Emissions Per 1.0 Mt of Saleable Coal	**2.2**

3.3.3 Climate Change

Recent findings and predictions regarding climate change and its effects on a global, national and regional (Montana) scale are presented in the following reports: The IPCC report titled *Climate Change 2014: Synthesis Report*, the *Fourth National Climate Assessment* (USGCRP 2017), and *Montana Climate Assessment* (Whitlock et al 2017). Each of these three documents introduced below are hereby incorporated by reference and findings and predictions are summarized in **Appendix D**.

- The IPCC is the leading international body for the assessment of climate change. IPCC's fifth assessment report (IPCC 2014) presents details pertaining to observed climate changes and their causes; future climate changes, risks and impacts; future pathways for adaptation, mitigation and sustainable development; and adaptation and mitigation (http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml).
- As a key part of the *Fourth National Climate Assessment*, the US Global Change Research Program (USGCRP) oversaw production of a report describing the state of science relating to climate change and its physical impacts. USGCRP (2017) concluded that the climate of the US is strongly connected to the changing global climate, and highlights a range of past, current and projected climate changes both in the US and globally to illustrate these conclusions (https://science2017.globalchange.gov/downloads/CSSR2017_FullReport.pdf).
- Regional considerations regarding climate changes in Montana over the period of 1950 to 2015 is presented in the Montana Climate Assessment (Whitlock et al. 2017). Major findings focus on spatial and temporal changes in temperature and precipitation across the State; including a focus on historic trends between 1950 and 2015 and projected changes into the future. The report also focuses on effects on water, forests, and agriculture, which have been, and will continue to be affected by changes in climate (http://montanaclimate.org/).

3.3.4 Applicable Regulations and Policies

As presented in **Section 3.3.2**, over 97 percent of GHG (i.e., CO_2e) emissions related to SPE's mining activities are attributed to overseas combustion. Only mining activity (less than 0.1 percent of GHG emissions) is under the jurisdiction of OSMRE. Regulating combustion and associated emissions would fall to the country in which those activities occur, as discussed below.

In the US, there are no specific regulations or thresholds pertaining to GHG emissions although improvements in mining equipment and locomotive engine efficiency are expected to reduce emissions over time. In Canada, the province of British Columbia charges a carbon tax on gasoline, diesel, and natural gas that has reduced emissions despite population growth and increased economic activity (British Columbia 2018). Canada has also published a regulatory framework for establishing a clean fuels standard, which will include methods to reduce carbon intensity of a range of fuels based on life-cycle emission. A draft regulation based on the framework is expected by the end of 2018 (Canada 2017).

GHG emission rates from ocean transport should decrease over time. In 2011, IMO enacted legally binding energy efficiency requirements requiring ships built after 2012 to limit CO_2 emissions to a design-specific Energy Efficiency Design Index (EEDI) value. EEDIs will be reduced every five years until 2025. Existing ships must prepare and maintain a Ship Energy Efficiency Management Plan based on IMO technology and operating guidelines (IMO 2011).

The ROK and Japan have both submitted Intended Nationally Determined Contribution (INDC) GHG emissions reduction plans for achieving United Nations Framework Convention on Climate Change objectives (Japan 2015 and ROK 2015). The ROK plans to reduce GHG emissions by 37 percent from the "business-as-usual" level by 2030 (ROK 2015). This reduction is in accordance with ROK's Framework Act on Low Carbon, Green Growth which "creates the legislative framework for emissions reduction targets, cap-and-trade, carbon tax, carbon labelling, carbon disclosure, and the expansion of new and renewable energy" (LSE 2018). Japan plans to reduce GHG emissions by 26 percent by 2030 compared to 2013 levels. This goal is supported by Japan's Strategic Energy Plan developed by the Agency for Natural Resources and Energy (JANRE 2014).

In addition, Canada, ROK and Japan are all a party to, and have ratified the Paris Agreement (entered into force in 2016) which requires all Parties to put forward their best efforts through "nationally determined contributions" to respond to the threat of climate change and strengthen these efforts in the years ahead (UNFCC 2018).

3.4 Water Resources

The existing conditions of surface and groundwater resources in the Mine permit area and vicinity are described in this section, with additional detail presented in **Appendix E**. While hydrologic conditions continue to fluctuate in response to variable precipitation patterns, the baseline hydrologic condition in areas unaffected by mining is consistent with that previously presented in Section 3.4 of the BLM Coal Lease EA. Additional details about the hydrologic systems and water uses are presented with other baseline data in the Mine permit (SPE 2017a, Section 304).

As described in **Appendix E**, hydrologic monitoring has continued in accordance with Mine permit requirements; the findings of which are presented in Annual Hydrology Reports (AHRs) submitted to MDEQ. Locations of active hydrologic monitoring stations (SPE 2017a, see Appendix 314-4) are shown in **Appendix A, Figure 3.4-1,** and all stations specifically referenced in this EA or **Appendix E** are labeled. SPE has also prepared updated descriptions of probable hydrologic consequences (PHCs), and new cumulative hydrologic impact assessments (CHIAs) have been prepared by MDEQ. Data (through September 2017) and interpretations most relevant to OSMRE's decision are summarized in this EA.

3.4.1 Groundwater

Geology of the Mine permit area is discussed in the BLM Coal Lease EA (Section 3.2) and a detailed stratigraphic column is presented in the PAP (SPE 2017a, Map 304(6)). Conditions in four hydrogeologic units (alluvium, overburden, Mammoth coal, and underburden) are summarized below and discussed in detail in **Appendix E.** Although a majority of the alluvial monitoring wells are typically dry and there is no evidence that dewatering associated with mining has affected observed changes in water levels in the alluvial deposits in the Mine vicinity for data extending from inception of mining in 2003 into 2017 are generally more responsive to natural climate events as compared to mining activity. Although alluvial wells have exhibited changes in water quality in recent years, most of those changes commenced after a large precipitation event in 2011 and are likely a result of natural processes rather than response to mining activities. Total dissolved solids (TDS) levels have for the most part decreased or stabilized since 2011, with the exception of three alluvial wells located along the main stem of Rehder Creek downgradient of the Mine (**Appendix E, Section 1.1**).

Some overburden wells located above or proximal to areas undermined and subsided have shown declines in water levels in response to mining activities, which fractured the overburden interval 5 hydrologic unit, creating a localized mining-related water level depression. There have been increases of conductivity, TDS and sulfate in some overburden wells, but all changes thus far are within MDEQ-7 numeric water quality standards.

Mammoth coal water levels in the vicinity of longwall mining have declined in response to mine dewatering. There have been no exceedances of MDEQ-7 numeric water quality standards for monitored parameters between 2003 and September 2017 (SPE 2017a, Appendix 314-4, Tables 314-4.6 and 314-4.7).

Water levels in upper portions of the underburden (i.e., shallow underburden) have declined in the vicinity of active mining in response to mine dewatering**.** There have been no persistent trends in groundwater quality in the upper underburden at wells within the area mined to date, but there have been observed increases in TDS in some wells outside the area mined. Underburden groundwater classification has remained within the historically observed range for each well.

3.4.2 Springs

Appendix E, Section 1.2 contains a detailed description of observations at springs undermined to date. Spring 17185 showed a brief cessation in flow as longwall mining in Panel 3 passed underneath but commenced flowing at normal rates within two weeks after mining was complete suggesting that strata bounding/underlying this spring "resealed" after subsidence. Observations at spring 17145 indicate that cessation of flow is associated with mining, and SPE has proposed a site-specific mitigation plan that is currently under review by MDEQ. Spring 17275, overlying Panel 4 (**Appendix A, Figure 3.4-1**), showed a possible water quality response to longwall mining. Additional data are needed to evaluate long-term effects to 17145 and 17275. The remaining undermined springs generally continue to exhibit flows within historical (pre-mining) ranges[6]. Based upon water quality data collected to date, there is no evidence of changes in water

[6] Conclusive evaluations cannot be completed for two springs undermined by longwall mining (17165 and 17415) due to the lack of consistent and comparable historical data; therefore, it is possible that mining related impacts have occurred at these two springs (MDEQ 2017b2017, p. 9-7).

quality associated with mining activity at any springs other than 17275. Two new springs that feed ponds (1701S and 1702S, **Appendix A, Figure 3.4-1**) have emerged after longwall mining undermined and subsided the surrounding terrain.

3.4.3 Surface Water

A majority of stream channels situated within the permit boundary are normally dry and flow only in response to substantial rainfall and runoff events, the most notable of which occurred in response to high precipitation in May and June 2011 (Catena and Nicklin 2012). Some intermittent stream reaches dependent upon spring discharges for flow were identified in the baseline monitoring and discussed in the BLM Coal Lease EA. Perennial and intermittent stream reach flows dependent upon spring flow sources may be affected by mining and may require mitigation measures presented in the Mine permit (SPE 2017a, Appendix 313-3). Detailed analysis and establishment of typical numeric baseline streamflow conditions are precluded due to predominantly ephemeral conditions, which in combination with period sampling frequencies also result in high variability in available water quality monitoring data (MDEQ 2016a). Additional details about surface water are presented in **Appendix E**.

3.4.4 Hydrologic Conditions Surrounding the Existing WDA

Monitoring wells downgradient of WDA#1 (BMP052 and BMP033) have exhibited elevated levels of radium and fluoride most likely due to the use of deep Madison well water for coal processing, but concentrations would not cause impacts to downstream surface or groundwater resources as no human health standards have been exceeded (MDEQ 2017b, Section 9.2.3.1). Since construction of WDA #1 and an associated sediment pond, several discharge events have occurred following significant precipitation events or to facilitate pond sediment cleanout in preparation for significant precipitation events. Pond discharge tends to be small in comparison to Rehder Creek's overall flow rate, and there is no evidence that surface disturbance has impacted surface water resources off the permit area (MDEQ 2017b, Section 9.2.3.1).

3.4.5 Waters of the U.S., including Wetlands

Wetlands have not been formally delineated in the Mine permit area. The BLM Coal Lease EA describes wetlands as occurring in association with springs. Historically flowing channel segments and sites exhibiting wetland characteristics have primarily been found in association with monitored springs and ponds and occur on the surface overlying the underground mine plan (existing and proposed mining) (**Appendix A, Figure 3.4-1**). The US Army Corps of Engineers (USACE) has not made an official determination as to whether water courses or wetlands occurring within the permit area are jurisdictional under Section 404 of the CWA. If jurisdictional waters of the US are present, such features would most likely occur along drainage channels and would include connected wetlands.

3.4.6 Spring and Well Impact Mitigation

The Mine permit specifies mitigation measures to be employed in response to observed effects to water resources. SPE has constructed a well for mitigation of Spring 17145, previously used for livestock watering, and has proposed a site-specific mitigation plan that is currently being reviewed by MDEQ. Additional monitoring will be conducted to assess long-term spring effects and the need for permanent mitigation. One stock water well (BMP064) was abandoned before mining and has been replaced by a well in the same aquifer. No other water resources have required mitigation in accordance with permit requirements.

3.5 Soil

Soil conditions in the Mine permit area are presented in Section 3.5 of the BLM Coal Lease EA. A soil survey was completed for the proposed location of WDA #2 and associated facilities since the BLM Coal Lease EA was prepared. No other new soil data was collected since the BLM Coal Lease EA was prepared.

Map units in the WDA #2 survey area are dominated by the Cabba, Macar, Doney, Shambo, and Straw soil series [SPE 2017a, Addendum 15, Section 304(1)(k)]. Salvage depths in the survey area transition from rock outcrops (no salvage) and shallow soils (<20 inches) on ridges, hilltops, and convex slopes to moderately-deep (20-40 inches) and deep (40-60+ inches) soils on lower hillslopes, swales, concave slopes, and valley bottoms.

Due to the limited quantity of topsoil and subsoil available for salvage relative to the four-foot cover requirement, other suitable materials consisting of unconsolidated or weakly consolidated weathered bedrock underlying subsoil were identified and verified as suitable for use as a soil substitute. The soil balance prepared for the WDA #2 footprint (SPE 2017a, Volume 2, Section 313, Table 313-2H), including salvage of topsoil, subsoil, and deeper suitable materials indicated cover materials available for salvage exceeds the volume required to replace four feet of cover on the WDA #2 during reclamation.

3.6 Vegetation

Existing vegetation communities and conditions described in Section 3.6 of the BLM Coal Lease EA are generally unchanged, except where mining activity has resulted in disturbances. 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. A total of 618 acres was disturbed through the end of 2016, a portion of which has been reclaimed. As required by the State-approved Mine permit, SPE (2017a) conducts contemporaneous reclamation after facilities are no longer needed. Reclamation practices include revegetating disturbances with species adapted to the area, compatible with surrounding vegetation communities, and capable of supporting the post-mining land use.

SPE conducts monitoring of hydrophytic vegetation communities along 62 transects at 37 sites associated with spring discharge points, riparian areas, and associated wetlands in the Mine permit area. The purpose of monitoring is to establish a record of site conditions before mining for comparison after mining to assess potential effects. Data collected since the BLM Coal Lease EA was prepared includes annual photographs of fixed transects and periodic semi-quantitative community descriptions (Catena 2011a, 2012a, 2013a, 2014a, 2015a, 2016a, 2017a). Species occurring along these transects include a variety of wetland indicator species as well as other riparian and upland plant species [SPE 2017a, Addendum 13, Section 304(1)(i)(Part 4), 2007 study, Appendix A]. Species composition varies in response to changes in annual precipitation, spring or seep discharge, livestock use, and other factors.

Eight noxious weeds have been identified in the permit area since the BLM Coal Lease EA was prepared, including six State-listed species (spotted knapweed, hound's tongue, Canada thistle, salt cedar, whitetop, leafy spurge) (MDA 2017) and two County-listed species (black henbane and common mullein) (Musselshell County 2018, Yellowstone County 2018). SPE controls noxious weeds on company-owned private surface. SPE also controls noxious weeds on other surface in the permit area where noxious weeds can reasonably be attributed to activities of SPE. Other surface owners are responsible for noxious weed control elsewhere in the Mine permit area. SPE controls noxious weeds with herbicide in accordance with Weed Management Plans approved by the Yellowstone County Weed District and Musselshell County Weed District (SPE 2014b, 2014c).

No other vegetation inventories have been completed at the Mine since the BLM Coal Lease EA was prepared.

3.7 Wildlife

Section 3.7 of the BLM Coal Lease EA presents a comprehensive discussion of wildlife use in the Mine permit area and vicinity as documented during historical Mine baseline studies and subsequent monitoring. Annual wildlife monitoring has been completed each year since the BLM Coal Lease EA was prepared. **Appendix F** presents a list of wildlife species and the year or survey period during which they were recorded in the Mine vicinity. The list also includes species that are expected to occur in the area but have not yet been recorded. As discussed in the BLM Coal Lease EA, many species occurring at the Mine are migratory birds protected under the Migratory Bird Treaty Act (MBTA), including Bald and Golden Eagles, which are also protected under the Bald and Golden Eagle Protection Act (BGEPA).

Annual wildlife monitoring conducted since the BLM Coal Lease EA was prepared (Catena 2011b, 2012b, 2013b, 2014b, 2015b, 2016b, 2017b, 2018) documented raptor nests and sharp-tailed grouse leks in the permit area and vicinity (**Appendix A, Figure 3.7-1**). In April 2017, one confirmed active eagle nest and one probable eagle nest were discovered, as noted below.

<u>Rehder Road Nest:</u>
This nest is outside the permit boundary, approximately 1.6 miles northwest of the Surface Facilities Area. It was used by golden eagles in 2017.

<u>Dunn Mountain Nest:</u>
This nest is on the south side of Dunn Mountain, inside the permit boundary, approximately 0.5 miles northeast of the existing air portal. This nest is not new but was previously unrecorded. The location, size, and materials used for construction suggest that it is a golden eagle nest. It was not used in 2017, but golden eagles were observed in

the nest vicinity in April 2017 and exhibited territorial behavior, suggesting territory occupancy.

Bald eagles typically nest adjacent to large bodies of water (Buehler 2000), which do not occur in the immediate vicinity of the Mine. The nearest reported bald eagle nests are at least 12 miles north of the Mine permit boundary, along the Musselshell River (MTNHP 2013). While bald eagles have been observed during historical monitoring (see **Appendix F**), they are only expected to occur during migration periods or winter months. Considering this, impacts to bald eagles, if any, would not rise to the level of significance and are not further specifically discussed in this EA.

The State-approved Mine permit and associated mining regulations specify mitigation measures for wildlife, including minimization of disturbance, reclamation of habitats and raptor-safe powerline construction. The measures specified in the permit and enforced by MDEQ ensure compliance with MBTA and BGEPA and the ESA (further discussed in **Section 3.8**), thereby reducing potential impacts to those protected wildlife species. The US Fish and Wildlife Service (USFWS) has not issued golden eagle management guidelines. However, SPE will notify the MDEQ and comply with siting recommendations, seasonal restrictions, and distance buffers specified in the 2010 Montana Bald Eagle Management Guidelines: An Addendum to Montana Bald Eagle Management Plan (1994) (MBEWG 2010). In addition, SPE would comply with the Service's May 2007, National Bald Eagle Management Guidelines, which contains additional information on protecting bald eagles from disturbance due to human activity (USFWS 2007).

Approved measures include:

- Minimizing surface disturbing activities (e.g., soil salvage, road and drill pad construction, grubbing, logging) during the April through July time period. If surface disturbing activities are scheduled during the April through July time period, SPE will make the area unsuitable for ground nesting (e.g., mow, blade, etc.) before the nesting period.
- Ensuring searches for raptor nests are conducted before initiating disturbance during raptor nesting season. Searches will be conducted within the proposed disturbance area with an additional 500-foot buffer zone.
- Conducting regular discussions with equipment operators, supervisors, and contractors to maintain awareness for the commitment to minimize surface disturbances, especially during the April through July time period.
- Locating and operating access and haul roads to avoid or minimize impacts to important fish and wildlife species or species protected by State or Federal law.

Montana mining regulations require SPE to report bald or golden eagle roost sites, seasonal concentration area, or breeding territory to MDEQ and USFWS to ensure mining activities do not result in take.

3.8 Threatened, Endangered, and Special Status Species

No confirmed observations of species listed, proposed for listing, or candidates for listing under the ESA have been recorded in the Mine permit area during the historical wildlife surveys. However, the list of historical species observations (**Appendix F**) includes a 2006 acoustic detection of northern myotis (a.k.a. northern long-eared bat, *Myotis septentrionalis*, ESA-listed as threatened). The Mine is well outside of the known and predicted range of northern long-eared bat (USFWS 2018, MTNHP & MFWP 2018), suggesting the record most likely is a misidentification. Currently, the occurrence of northern long-eared myotis in Montana is considered accidental (MTNHP & MFWP 2018). OSMRE makes a finding of "no effect" for this species as a result of no species present and lack of suitable habitat.

The BLM Coal Lease EA previously found that while black-footed ferret (*Mustela nigripes*) and whooping crane (*Grus americana*) have potential habitat in Musselshell and Yellowstone Counties, it is not expected that either species would occur in the Federal coal lease tracts. Red knot (*Calidris contutus*) is listed as threatened and may occur in the counties affected by the Proposed Action. Red knot is migratory through Montana, but Montana is outside the primary migratory pathways of the species (MTNHP and MFWP 2018). OSMRE-Western Region makes a finding of "no effect" for these species as a result of no species present and lack of suitable habitat.

Greater Sage-grouse

Greater sage-grouse (*Centrocercus urophasianus*) may occur in the Mine permit area or vicinity but has not been observed during historical monitoring (1989-2016), which included spring lek surveys (Catena 2016b). Montana Fish Wildlife and Parks (MFWP) reports no leks within 5 miles of the Mine permit boundary (MFWP 2017).

Montana's Governor recently issued two EOs (EO 10-2014 and 12-2015) concerning conservation of sage-grouse habitat (Montana Office of the Governor 2014, 2015). The orders define suitable habitat as being "within the mapped occupied range of sage-grouse." The description of suitable habitat indicates there is generally five percent or greater canopy cover of sagebrush; or that sagebrush canopy cover may be less than five percent when complimented by other shrubs suitable for sage-grouse cover requirements, and in moist meadows containing forbs for brood-rearing within 300 yards of suitable sagebrush cover. Introduced species such as alfalfa may be important on these sites where native forbs are not available.

Southern portions of the Mine permit area are within "general" habitat for greater sage-grouse, and the nearest core area is approximately 15 miles north of the permit boundary (MFWP 2015). Habitat mapping of the Mine area in 2007 showed the vicinity of Dunn Mountain, including the general habitat in the area that would be affected by the Proposed Action and No Action Alternative, as being dominated by ponderosa pine forest and savanna, interspersed with small patches of grassland (Westech 2009). There were no mapped patches of shrublands, including sagebrush, in those sections. Silver sagebrush, skunkbrush sumac, and western snowberry occur in the understory of ponderosa pine, savanna, grasslands, and areas where the forest canopy has been opened by fire. Historical distribution of greater sage-grouse in Montana did not include the core of the Bull Mountains (MFWP 2000), likely due to tree cover that sage-grouse avoid. Ponderosa pine invasion of peripheral areas that may once have been sage-grouse habitat and are currently mapped as "general" habitat (MFWP 2015), including the permit area, probably no longer provide suitable habitat. There are no reported observations of sage-grouse within the Mine permit area between 1989 and 2016 (Catena 2017b), and there are no reported leks near the Mine permit area.

Approximately 24 miles of the rail spur between the Mine and Broadview traverses general habitat for greater sage-grouse (MFWP 2015). No wildlife monitoring was conducted specific to the spur. For the area within 5 miles of the spur, MFWP (2017) reports two historical lek locations last surveyed in 2001. At that time, one lek (1.7 miles from the spur) was confirmed inactive and status of the other lek (1.2 miles from the spur) was unconfirmed. Based on these data, OSMRE concludes that while greater sage-grouse may be present in habitats near the spur, impacts to this species resulting from coal transport along the spur do not have potential to be significant and are not further discussed in this EA.

In the event that any listed threatened or endangered species are found in the permit area, State regulations (ARM 17.24.751) require SPE to promptly report the discovery to MDEQ and the USFWS to ensure mining operations do not adversely affect the species.

3.9 Cultural and Paleontological Resources

The BLM Coal Lease EA (2011) described the historical context of the Mine vicinity and summarized findings of surveys conducted on tracts overlying the Federal coal lease area and other portions of the Mine permit area. No documented sites were determined to be eligible for listing on the National Register of Historic Places (NRHP); however, one site (24ML667) was listed as unevaluated (required further evaluation) because of the potential for deeply buried cultural deposits.

Federal coal lease special stipulations (Appendix A in BLM 2011) and the State-approved Mine permit require SPE to conduct Class III cultural resources inventories (i.e., surveys) before disturbances. Six additional resource studies have been conducted in the Mine permit area and vicinity since 2010 as summarized below.

- Ferguson (2010) recorded 15 sites (3 previously investigated) on 1,518 acres overlying Panel 1 and portions of Panels 2 through 4.
- Meyer (2012a) reported finding 63 sites on 3,025 acres overlying portions of Panel 3, most of Panels 4 through 5, and the western portion of Panel 6.
- Meyer (2014) reported 50 isolated finds on 3,572 acres overlying Panels 6 (eastern portion) through Panel 9 and two areas in the vicinity of the Surface Facilities Area.
- Martinson (2010) reported finding two sites on 16 acres proposed to be developed for an intake air portal and associated access road.
- Meyer (2012b) reported 11 sites and 17 isolated finds on 460-acres (80 of which were not investigated due to steep terrain) associated with an access road and associated stockpiles on the south side of Dunn Mountain.
- Aaberg and Crofutt (2014) surveyed 3,247 acres in two blocks mostly outside of the area to be affected by mining. The survey reported findings at 50 sites (including 19 previously recorded), 11 of which are in the Mine permit area.

No sites identified to date were determined eligible for listing in the NRHP. Nine sites in the permit area must be avoided by surface-disturbing activities pending further evaluation and final determinations of eligibility for listing in the NRHP, including the following.

- One lithic scatter site (24ML850) overlying Panel 3 consists of extensive deposits near a spring (Ferguson 2010);

- Three sites overlying Panel 4 (24YL1046 and 24YL1047) and Panel 7 (24YL1055) are large and unusual cairns (Meyer 2012a);
- One site (24ML478) northwest of the existing Surface Facilities Area is unevaluated pending further investigations (Aaberg & Crofutt 2014); and,
- Four camps or suspected camps overlying Panel 8 (24ML667, 24ML940, and 24ME 949) and Panel 11 (24ML942) occupy well-developed terraces with moderate to high potential of harboring a subsurface component (Meyer 2014).

The remaining sites are recommended as ineligible for listing in the NRHP and further treatment, consideration and avoidance are not necessary. The area east of longwall Panel 9 has not yet been surveyed for cultural resources and per BLM lease stipulations and State-approved Mine permit, Class III surveys would take place before the area is mined.

The BLM Coal Lease EA (Section 3.2) concluded that surficial geology is comprised of the Fort Union Formation which is expected to yield plant and invertebrate remains. Vertebrate remains are less-likely to be encountered.

3.10 Noise & Vibration

3.10.1 Mine Vicinity

Noise levels in the mining area continue to be affected by ongoing Mine operations. The BLM Coal Lease EA reported heavy equipment operation noise levels ranging from 72 to 95 A-weighted decibels (dBA) near the preparation facility to an ambient noise level of about 35 to 40 dBA in surrounding rural areas unaffected by Mine activity. While the ambient condition in the vicinity of the Surface Facilities Area has not been measured, it is expected to be comparable to that discussed in the BLM Coal Lease EA. The noise level in the Surface Facilities Area is generally continuous but varies in intensity depending on the extent of activity, while conditions outside of the Surface Facilities Area have a combination of intermittent and continuous effects on sound levels.

Vehicles typically have short-term effects, while construction equipment may work in an area for hours to days. In the vicinity of drillhole pads, the duration may be longer (days or weeks) while drilling occurs. Noise level varies by the receptor location but may be comparable to the Surface Facilities Area in the immediate vicinity of the equipment. The existing ventilation fan over the East Mains, just north of Panel 4, generates approximately 103 dBA of noise as measured in close proximity, which is reduced to 75 dBA at the fence of the pad located approximately 150 feet away (Weber 2014).

3.10.2 Rail Transport Corridor

Noise and vibration are traditionally linked in environmental impact assessments for rail because the two disciplines are perceived to have many physical characteristics in common. For example, noise can be generated by vibration of surfaces. Railroad operation noise is composed of wayside noise, meaning diesel locomotive engine and wheel/rail noise, and horn noise, which includes locomotive warning horns sounding at at-grade rail/roadway crossings. Wayside noise is primarily a function of train speed, train length, track construction, and number and type of locomotives. (STB 2015a, Chapter 7). Vibration relates to motion described in terms of displacement, velocity, or acceleration. Vibration caused by trains radiates energy into the adjacent soil in the form of different types of waves that propagate through the various soil and rock strata to nearby structures and other receptors.

Existing Regulations and Guidelines

A number of Federal noise and vibration statutes, regulations, and guidelines are applicable to rail transport, including the Noise Control Act of 1972 (42 U.S.C.§ 4910), STB and FRA regulations and guidance, and EPA's Railroad Noise Emission Standards (40 C.F.R. Part 201), Federal Transit Authority (FTA) assessment methods, and noise limits related to occupational safety. Freight railroads are exempt from State and local noise ordinances so as not to impede interstate commerce.

Thresholds and Basis for Analysis

Because OSMRE does not regulate rail traffic (see **Section 3.1**), for associated environmental impacts, the EA relies upon STB regulations, which only require analysis of noise where rail traffic increases at least 100 percent (i.e., doubles) or increases by at least 8 trains per day on any segment (49 CFR Part 1105.7e(6)). Where such thresholds are exceeded, noise effects are compared to two additional thresholds: (a) an increase in noise exposure as measured by a day-night noise level (L_{dn}) of 3 dBA or more; or (b) an increase to a noise level of 65 L_{dn} or more.

L_{dn} is defined as a receiver's cumulative noise exposure from all events over a full 24 hours and generally recognized as the standard by which to assess transit noise associated with residential land uses (FTA 2006). FTA (2006) also specifies human annoyance criteria for residences related to the frequency of events (e.g., frequency of train passage), whereby doubling the number of events is required for a significant increase for heavily used rail corridors (more than 12 trains per day) (FTA 2006, Page 8-5).

Baseline noise and vibration conditions associated with existing rail traffic along the rail lines would vary depending upon the day and the location. Existing conditions are assumed to be in conformance with Federal regulations for the purposes of this EA.

3.11 Socioeconomics

The BLM Coal Lease EA presented a history and description of the existing condition to support the analysis presented therein. Recent data including 2015 population and employment estimates and recent (2016) mine-related revenue data are presented to update information presented in the BLM Coal Lease EA. The Study Area for Socioeconomics includes both Musselshell and Yellowstone counties as these are the counties where mining operations occur and where employees reside. State and Federal revenues from mining activities are also discussed. Additional details regarding current socioeconomic conditions are presented in **Appendix G**.

3.11.1 Local Economy

The local economy in Musselshell County and rural portions of adjacent Yellowstone County is dominated by mine and ranching-related employment. Yellowstone County is the State's major retail and wholesale trade, financial, energy, transportation, and medical center. A comparison of county business patterns, including number of business establishments, paid employees and annual payroll is summarized in **Appendix G, Table G-1**.

Economies of both counties are affected by Mine payroll, local business transactions, infrastructure investments, community foundation contributions, coal board grant eligibility and awards, royalties and taxes. A summary of payrolls, expenditures, tax revenues (hereafter collectively referred to as "revenues") for 2016 and associated rates are provided in **Appendix G, Table G-2).** The 2016 Mine payroll totaled approximately $31 million. SPE spends approximately $40 million annually on local business transactions (e.g., purchases, contracting), approximately 90 percent of which are in Yellowstone County (SPE 2017c).

SPE (2017c) estimates approximately $500 million was spent in capital infrastructure between 2007 and 2009 when the rail spur and facilities were constructed and longwall mining began. Additional infrastructure investments are made annually at a rate of approximately $35 million per year. As a voluntary community service organization, the Signal Peak Community Foundation provides $350,000 annually to fund college scholarships and projects in Musselshell County. Projects have included updates to the hospital, swimming pool, 4-H building and 62 other grants (Olson 2017).

In 2016, revenue derived directly and indirectly from taxes and royalties was paid to the Federal government ($0.97 million), State of Montana ($5.93 million), Musselshell County ($14.5 million), and Yellowstone County ($58.1 million), including local governmental entities. Revenue sources include lease bonus bids, severance taxes, gross proceeds taxes (in lieu of county property tax), Montana resource indemnity trust and groundwater assessment tax, abandoned mine land (AML) fees, black lung tax, royalty payments, use taxes on coal-related equipment, and rental fees.

Due to the presence of the Mine and potential growth-related issues, Musselshell County has applied for and received Coal Board grants funded by the Coal Severance Tax and administered by the Montana Department of Commerce. Grants over the past eight years have included infrastructure projects, school improvements, construction equipment and vehicle purchases, and administrative support for development of a county growth policy. Additional details are provided in **Appendix G**.

3.11.2 Population.

The BLM Coal Lease EA presents an in-depth discussion of population fluctuations in Musselshell County. A comparison of 2015 census data (US Census Bureau 2000a, 2015a) to the data reported in the BLM Coal Lease EA identifies recent changes in populations in both Yellowstone and Musselshell Counties (**Appendix G, Table G-3**). Musselshell County experienced a 3.5 percent loss in population between 2000 and 2010, but increased 10 percent between 2010 and 2015. The approximate net change was an increase of 6.5 percent from 2000 to 2015.

3.11.3 Employment

Historical employment information for the Mine and the Study Area is presented in the BLM Coal Lease EA, where the most recent information presented therein was from 2010. **Appendix G, Table G-4** presents employment data from both 2000 and 2015, including the number of total employees in the civilian labor force, unemployment rates, and percent employed in agriculture, forestry, fishing and hunting, and mining sector for Musselshell County, Yellowstone County, and the State of Montana. Between 2000 and 2015 total employment in Montana increased by nearly 14 percent while employment in Musselshell County decreased by 1.2 percent (26 jobs) and Yellowstone County employment increased by more than 19 percent. The unemployment rate in both counties and the State fell between 2000 and 2015 (US Census Bureau 2000b, 2015b).

3.11.4 Housing

Section 3.15.4 of the BLM Coal Lease EA presents historic information on housing in both Musselshell and Yellowstone counties which indicated that housing supplies were growing faster than the population in Musselshell County, while Yellowstone County was experiencing an active housing and rental market. **Appendix G, Table 1-5** presents a summary of housing characteristics in the Study Area in both 2000 and 2015. The relative low percentage of housing occupied in Musselshell County and the City of Roundup indicate that there is still surplus housing in both jurisdictions, but especially in the Musselshell County, which is consistent with the findings of the BLM Coal Lease EA. Yellowstone County and the City of Billings continue to have an active housing market.

3.11.5 Local Government Facilities and Services

Detailed discussions on government facilities and services in the Study Area are included in Section 3.15.5 of the BLM Coal Lease EA. Revenues generated by mineral production continue to support Musselshell County facilities and services, allowing facilities to keep pace with growth (Musselshell County Commissioners 2017). Improvements in Musselshell County and the City of Roundup since 2011 include a new elementary school, improvements to the facility and equipment at Roundup Memorial Healthcare, a new senior center and other improvements funded in part by the Signal Peak Foundation and grants from the Montana Coal Board (see **Section 3.11.1**).

The BLM Coal Lease EA described existing facilities and services in 2011 as generally adequate for the current population. Based on the scope of improvements made in recent years, it is likely that current conditions meet the needs of the moderate population growth experienced in Musselshell County. Improvements in government facilities and services in Yellowstone County are paid for by increased property values and tax rates, including a number of special tax districts (Yellowstone County 2016).

3.12 Environmental Justice

Environmental justice is defined by EPA as, "The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, State, local, and tribal programs and policies" (EPA 2017d). EO 12898 titled "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" (59 FR 7629, February 16, 1994) also addresses this issue. Its purpose is to focus Federal attention on the environmental and human health effects of Federal actions on minority and low-income populations with the goal of achieving environmental protection for all communities.

Pursuant to EO 12898, CEQ prepared "Environmental Justice: Guidance under the Environmental Policy Act" (CEQ 1997) to assist Federal agencies with their NEPA procedures "so that environmental justice concerns are effectively identified and addressed." This analysis was conducted with the assistance of the CEQ guidance document. The CEQ identifies groups as environmental justice populations when either (1) the minority or low-income population of the affected area exceeds 50 percent, or (2) the minority or low-income population percentage in the affected area is meaningfully greater than the respective minority or low-income population percentage in the general population or appropriate unit of geographical analysis. In order to be classified "meaningfully greater", county rates must be 10 percentage points above the State of Montana rate or an individual tract or community rate must be 10 percentage points above its respective county rate.

The greatest potentials for disproportional impacts to environmental justice populations are in proximity to the mine and along the rail route used for coal transport. As the primary authority with jurisdiction over rail operations, STB applies a threshold of an 8 train per day increase or 100 percent increase (i.e., doubling) of rail traffic when determining whether to analyze potential effects to environmental justice populations (STB 2015a, Chapter 17). As discussed in **Section 3.1**, the percentage of rail traffic attributed to the Mine is on the spur from the Mine to Broadview (all traffic Mine-related) and the mainline from Broadview to Laurel (approximately half of traffic is Mine related), beyond which Mine-related traffic is less than 15 percent of all traffic. Supporting detail presenting census tract records within 1 mile of the Mine and rail segments between the Mine and Laurel are provided in **Appendix G**, **Table G-5**.

3.13 Visual Resources

The BLM Coal Lease EA presents a detailed characterization of the natural features of the permit area in **Section 3.11**, Visual Resources. No geologic or unique surface features or National Landmarks are present in the area. The BLM Coal Lease EA does not reference a BLM visual resources management classification. There are no Federal, State, or county guidelines or regulations governing visual impacts, dark skies or the use of industrial lights (Arave 2018, Anderson 2018, Hagstrom 2018).

As described in **Section 2.1**, several facilities and structures have been built and other surface disturbance activities have occurred since the BLM Coal Lease EA was prepared. Facilities located within the Surface Facilities Area (**Appendix A, Figure 2.1-1**) are shielded from traffic on US Highway 87 by natural topography, though visible from Fattig Creek Road and Old Divide Road. Outside of the Surface Facilities Area, surface disturbances are associated with ancillary facilities (e.g., air portal, boreholes, and a ventilation fan), subsidence repair, crack sealing, and road construction. Disturbances on the steep south slopes of Dunn Mountain are visible from US Highway 87. Disturbances associated with crack sealing and subsidence repair have been reseeded in accordance with the State-approved Mine permit, mitigating visual effects.

The Surface Facilities Area is illuminated at night (365 days a year). This lighting likely increased the amount of nighttime illumination visible to the scattered residences in the vicinity, affecting dark skies prevalent in the area before the Mine's expanded facilities construction in 2008 and 2009.

4.0 ENVIRONMENTAL CONSEQUENCES

This chapter discusses potential impacts of the Proposed Action and No Action Alternative, as described in **Chapter 2**. Discussion is organized by resource areas in the same order as they are described in **Chapter 3**.

An impact or effect is defined as a modification to the environment brought about by an outside action. Impacts vary in significance from no change, or only slightly discernible change, to a full modification or elimination of the resource. Impacts can be beneficial (positive) or adverse (negative). Impacts are described by their level of significance (i.e., major, moderate, minor, negligible, or no impact). For purposes of discussion and to enable use of a common scale for all resources, the following terms are used to describe qualitative impacts/effects.

- **Major:** Impacts that potentially could cause significant depletion, change, or stress to resources or stress within the social, cultural, and economic realm.
- **Moderate:** Impacts that potentially could cause some change or stress to an environmental resource but the impact levels are not considered major.
- **Minor:** Impacts that potentially could be detectable but slight.
- **Negligible:** Impacts in the lower limit of detection that potentially could cause an insignificant change or stress to an environmental resource or use.
- **No Effect/Impact:** No discernible or measurable impacts.

Impacts can also be defined as direct, indirect, or cumulative. Terminology presented in this analysis includes the following:

- **Direct** impacts are defined as those which are caused by the action and occur at the same time and place (40 CFR § 1508.8(a)). This primarily includes activities at the Mine.
- **Indirect** impacts are those are caused by the action and occur later in time or are farther removed in distance but are still reasonably foreseeable (40 CFR § 1508.8(b)). Indirect impacts include effects from activities after mining, including transport and subsequent activities and associated emissions.
- **Cumulative** impacts result from incremental effects of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or other entity undertakes such other actions (40 CFR § 1508.7). Cumulative impacts occur over the time period when the impacts of past and present actions and reasonably foreseeable future actions overlap with the time period during which project impacts would occur.

The duration of impacts is also presented throughout this chapter, as follows:

- **Short-term impacts** generally occur over a short period and revert to pre-disturbance conditions within a few years after mining occurs.
- **Long-term impacts** are defined as those that would remain beyond mining-related activities (including reclamation), generally lasting the life of the alternative being evaluated (e.g., Federal mining plan modification approval) and beyond.

Under the No Action Alternative, the mining plan modification for the Federal coal (MTM97988) within the Amendment 3 area would not be approved by the ASLM. Currently approved mining operations would continue for approximately 2.5 years from January 1, 2017 to mid-2019 at an estimated rate up to 10.0 Mtpy, which is higher than mining rates during the past 5 years (range of 5.72 to 8.03 Mtpy). Mining would be conducted in accordance with the State-approved Mine permit (SPE 2017a) but would cease when Federal coal is encountered by the longwall miner at the north end of Panel 7 in Section 8 (**Appendix A, Figure 1.0-2**). New mine facilities, associated surface disturbances, and subsidence repairs would be required in connection with the No Action Alternative as discussed in **Chapter 2**. Facilities would be removed and disturbances would be reclaimed at the end of mining, which would take approximately 16 months after mining is complete.

Under the Proposed Action, the Federal mining plan modification to mine coal in the remaining Federal Coal Lease MTM97988 would be approved. Coal recovery would continue at a rate up to 10.0 Mtpy and would continue for approximately 9 years, relative to the No Action Alternative, ending in approximately 2028. New mine facilities, associated surface disturbances, and subsidence repairs would be required in connection with the Proposed Action as discussed in **Chapter 2**. Facility removal and reclamation would occur during a 16-month period after mining is complete, as it would for the No Action Alternative.

The direct, indirect, and cumulative effects of the Proposed Action and No Action Alternatives are comparable to those described in the BLM Coal Lease EA, except as noted herein. In addition to addressing the specific issues identified in **Chapter 1**, this updated analysis of environmental consequences reflects changes to the mining operations since the BLM Coal Lease EA was prepared (**Chapter 2)** and the updated description of the affected environment reflecting current conditions (**Chapter 3**).

Effects of coal removal, subsidence, and WDA construction are discussed in the context of separate environmental resources, but geology, topography and physiography, and waste are not reiterated under separate headings. Effects of subsidence and WDA construction on topography and physiography are comparable to those previously described in Section 4.1.1 and 4.2.1 of the BLM Coal Lease EA and updated acreages and locations are presented in **Chapter 2**. Similarly, geologic effects related to coal removal were described in Sections 4.1.2 and 4.2.2 of the BLM Coal Lease EA and updated effects are discussed in the context of tons of coal mined and waste generated in **Chapter 2** without need for further analysis. Waste disposal is described in Sections 4.1.14 and 4.2.14 of the BLM Coal Lease EA and effects of waste disposal on soil and hydrology are specifically discussed in this chapter.

Short-term effects on land uses are discussed in the context of surface disturbance and impacts to vegetation and hydrology. Following mining, land uses are restored in accordance with the MSUMRA and the Mine permit (SPE 2017a). Reclamation practices and mitigation measures described in the BLM Coal Lease EA and various sections of this document ensure impacts to land uses are not major in the long-term.

Cumulative Effects Analysis

Cumulative effects discussed in this chapter consider other activities and processes including agricultural activities, residential development, rangeland and forest fires, coal exploration activities, and reasonably foreseeable future mining (i.e., reasonably foreseeable development; RFD). Agricultural uses and residential development would continue in the Mine permit and vicinity as described in the BLM Coal Use EA. Fires are expected to occur occasionally within the Mine permit as they have in the past.

Cumulative effects associated rail transport and combustion are considered in the general context of current and anticipated conditions on a regional, national, and global scale, as appropriate. Specifically, cumulative effects associated with rail transportation (**Section 4.1.2**) consider recent past, existing and predicted rail traffic and conditions on rail segments between the Mine and Westshore Terminal, of which the existing Mine-related coal transport is a part. Cumulative effects of all segments (mining, rail transport, seaport handling, ocean transport, and combustion) on air quality (**Section 4.2.2**) are considered in the context of other sources of pollution affecting ambient air quality where Mine-related emissions would occur. Similarly, cumulative effects on climate (**Section 4.3.2**) consider GHG emissions from all segments in the context of global GHG concentrations in the atmosphere and all other emission sources.

SPE has conducted exploration activities in the Mine permit and vicinity since 2012, completing 82 drillholes in Yellowstone County and 137 drillholes in Musselshell County. No new roads have been required in association with exploration activities and all drillholes have been reclaimed. SPE anticipates completing approximately 5 to 10 drill location per year going forward to both explore the coal reserve and verify anticipated mining conditions (SPE 2018a).

The Mine's RFD is limited to one additional longwall panel to the northeast of Panel 14, hereafter referred to as "Panel 15" (**Appendix A, Figure 1.0-2**; SPE 2018b). While this area is not yet proposed for mining, it is anticipated that it would be mined in the same manner as other longwall panels. Panel 15 contains approximately 6.0 Mt of coal, approximately 64 percent of which is Federal coal, and would extend mining by approximately 8 months (0.7 years) relative to the Proposed Action (SPE 2018b). While exploration activities are ongoing, current information is inadequate to prepare an underground mine plan for coal resources other than that described herein (see **Appendix A, Figure 1.0-2**; consistent with the Mine permit, SPE 2017a) and the Panel 15 RFD. No other mining, oil and gas operations, or similar industries are present or planned in the vicinity of the Mine.

4.1 Transportation & Transmission

4.1.1 Direct & Indirect Effects

To aid analysis, a comparison of annual mining rates under the baseline condition, Proposed Action, and No Action Alternative, and associated haulage rates required to transport the tonnage are presented in **Table 4.1-1**.

Table 4.1-1. Comparison of Baseline, No Action Alternative and Proposed Action Features.

	Maximum Saleable Coal Produced (Mtpy)	Maximum Average Trains Per Day, Roundtrip	Timeframe
Baseline Condition	5.96	2.1	1 year (2016)
No Action Alternative	10.0	3.6	2.5 years (2017-2019)
Proposed Action	10.0	3.6	9 years (2019-2028)

No Action

Vehicle Transportation & Electrical Transmission

Public roads, Mine roads, and ranch trails would continue to be used under the No Action Alternative. As many as 7.6 miles of secondary and tertiary roads would be constructed to access boreholes and perform reclamation activities (see **Section 2.1** and **Appendix A, Figure 2.1-2**). New buried or overhead electrical distribution lines would likely be required to power facilities such as ventilation fans installed at boreholes above the East Mains (**Appendix A, Figure 2.1-2**). These new transmission lines would connect to existing transmission lines in the Surface Facilities Area and extend from one facility (i.e., borehole pad) to the next as mining progresses eastward. At the conclusion of mining in 2019, roads and transmission lines would be decommissioned and roads would be reclaimed to the pre-mine condition unless landowners request that these facilities remain to support post-mine land uses.

Maximum Mine employment could increase relative to the existing condition to achieve a mining rate of 10.0Mtpy, so there could be some additional demand for transportation of employees. In addition, minor additional traffic could occur should increases in supplies and services be required to support increases in Mine production, relative to the recent condition. Layoffs could begin in 2018, which would reduce traffic related to employee transport. Mining operations would cease in 2019, prompting further layoffs and reducing employee and supply transport. Mine traffic would continue at a lower level during the reclamation phase (approximately 16 months) and would cease entirely in the long-term when the mine is fully reclaimed and no employees or contractors remain.

In the short-term, Mine-related traffic could increase and would have minor and short-term effects to public roads, before declining in association with Mine closure after the remaining 2.5 years of mining. There would be no effect of traffic in the long-term as all Mine-related traffic would cease after the Mine is fully reclaimed. Public road improvements and Mine roads and electrical transmission lines retained by landowners would have minor impacts in the long-term.

Rail Transportation

Under the No Action Alternative, up to 10.0 Mt of coal (3.6 trains per day round trip) would be shipped by rail in 2018, declining thereafter until Mine closure in 2019. The maximum 2018 shipment levels would represent an increase of approximately 1.5 trains per day relative to 2016 (2.1 trains per day) (see **Table 4.1**) and above the range of annual average Mine-related rail traffic for the 2012 to 2016 period (2.1 to 2.9 trains per day). Mine-related rail traffic would continue to comprise 100 percent of traffic on the rail spur and may comprise more than half of rail traffic between Broadview and Laurel. Up to 25 percent of traffic on the Main Line between Laurel and Westshore Terminal would be Mine-related, and that portion would decline as Mine production declines and overall rail traffic continues to increase as forecasted by State rail plans (see **Section 3.1**).

STB has concluded that "the potential for adverse impacts to result from increased rail traffic on existing lines is usually limited to rail safety, air quality (including an increase of at least three trains per day in nonattainment areas), noise and vibration, grade-crossing delay and safety, and environmental justice" (STB 2015, Chapter 17). STB's threshold for environmental analysis of air and noise is an increase of eight trains per day or a 100 percent increase in rail traffic (40 CFR § 1105.7). STB also applies this threshold when assessing the need to evaluate freight rail safety, grade-crossing safety and delay, and environmental justice (STB 2015a, Chapter 17). The percent change in rail traffic resulting from the No Action Alternative, relative to the existing condition (2016), would be highest on the rail spur (potentially a 70 percent increase from 2.1 to 3.6 trains per day) but would not exceed STB's thresholds for analysis of these issues. Considering this, short-term impacts of rail traffic on rail safety and grade-crossing safety and delay resulting from the No Action Alternative would not be major and are not further analyzed. Impacts to air quality, noise and vibration, and environmental justice are discussed later in this chapter.

Mine-related rail transport would only occur in the short-term and would cease after mining, thereby reducing rail segment utilization and reducing related rail transport effects to a minor extent. Impacts of coal dust on rail safety would be mitigated under the No Action Alternative through dust control and track maintenance; thereby ensuring effects are negligible in both the short and long-term.

Proposed Action

Vehicle Transportation & Electrical Transmission

The Proposed Action would continue to use existing public roads, Mine roads, and ranch trails in a manner comparable to the No Action Alternative except that mining would continue for 9 years longer than the No Action Alternative (11.5 years in total). In addition, the Proposed Action may require construction of as much as an additional 8.9 miles of new Mine roads relative to the No Action Alternative (**Appendix A, Figure 2.1-2**). Transmission lines would be constructed above the East Mains, extending from those constructed under the No Action Alternative to additional proposed boreholes. Construction, operation, and maintenance of the conveyor and the at-grade equipment crossing associated with WDA#2 (**Appendix A, Figure 2.1-1**) would periodically affect traffic on Fattig Creek Road. SPE would obtain the necessary permits or permissions from Musselshell County before constructing the crossings and would comply with provisions of the agreement and State-approved Mine permit pertaining to these facilities, ensuring that impacts to Fattig Creek Road would be minimized. Short-term effects to vehicle transportation on Fattig Creek Road would be minor. The conveyor and equipment crossings would be removed and reclaimed at the conclusion of mining, ensuring that there would be no long-term effects. Similar to the No Action Alternative, new transmission lines and Mine roads would be reclaimed unless retained at the request of landowners.

Mine employment and coal production rates would be comparable to the No Action Alternative, so there would be no additional demand for transportation of employees, contractors, or supplies, and traffic would be constant in the short-term, relative to the No Action Alternative. However, this level of activity and traffic would continue for an additional 9 years, relative to the No Action Alternative, declining at the time of Mine closure and eventually ceasing following reclamation, as it would under the No Action Alternative.

In the short-term, Mine-related traffic would continue to have minor and short-term impacts to public roads before declining in association with Mine closure after the remaining 11.5 years of mining (9 years beyond the No Action Alternative). There would be no effect on traffic in the long-term as all Mine-related traffic would cease after the Mine is fully reclaimed. Public road improvements, Mine roads, and electrical transmission retained by landowners would have minor long-term impacts.

Rail Transportation

Under the Proposed Action, up to 10.0 Mtpy of coal (3.6 trains per day round trip) would be shipped by rail in a given year, the same as the maximum shipment levels under the No Action Alternative, but this traffic would continue for an additional 9 years. Mine-related rail traffic would continue to comprise 100 percent of traffic on the spur and may comprise more than half of rail traffic between Broadview and Laurel. While as much as 25 percent of rail traffic between Laurel, Montana and Sandpoint, Idaho could be Mine-related, congestion is not forecasted on this segment (see **Section 3.1**). Between Sandpoint, Idaho and Pasco, Washington, where forecasted rail utilization is highest, Mine-related rail traffic would comprise a small portion of the traffic, which is expected to increase from 48 trains per day in 2012 to between 105 and 114 trains per day by 2035 (ITD 2013, WSDOT 2014). Based on these levels, the Proposed Action's 3.6 trains per day round trip would represent less than 8 percent of current traffic (based on 48 trains per day) and approximately 3 percent of forecasted rail utilization (based on 105 to 114 trains per day). The portion of overall rail traffic attributed to the Mine would decline from the current condition as overall rail traffic continues to increase.

On rail segments in Idaho and Washington with utilization at or over 100 percent, without rail improvement the Proposed Action would affect forecasted congestion. However, State rail plans have identified the forecasted conditions and railroad improvements are expected to be implemented to alleviate congestion and ensure service is not adversely affected in the long-term. Improvements to railroads or their operations required to address Mine-related traffic in conjunction with increased traffic from other activities would be subject to approval and oversight by STB and FRA. As a result of these expected improvements and the small portion of traffic composed by Mine-related trains on highly-utilized segments, Mine-related impacts to rail congestion are expected to be minor in the short-term. In the long term, Mine-related rail transport would cease, thereby reducing rail segment utilization and reducing related rail transport effects to a minor extent.

Impacts of coal dust on rail safety would be mitigated under the Proposed Action through dust control and track maintenance in the same manner as the existing condition (Coal Loading Rule and SPE's associated coal profiling and application of a dust suppressant agent) and No Action Alternative, thereby ensuring impacts are negligible in both the short and long-term.

4.1.2 Cumulative Effects

US Highway 87, Old Divide Road, and Fattig Creek road will continue to receive traffic related to a variety of activities, including Mine operation. Increases in Mine-related traffic under the Proposed Action would be minor in the short-term and would continue for an additional 9 years, relative to the No Action Alternative. During that period, transportation rates on public roads including US Highway 87, Old Divide Road, and Fattig Creek Road vary as they have been in the past. In recent years, reported AADT on US Highway 87 and Old Divide Road have included annual estimates substantially higher than 2016 (approximately 15 to 100 percent higher, respectively [MDT 2018]).

Future mining of Panel 15 (RFD, see **Section 4.1**) would result in the shipment of an additional 6.0 Mt of saleable coal, extending the LOM an additional 0.7 years (SPE 2018b). The maximum annual rate of mining would likely be the same as the Proposed Action, therefore, traffic rates would not increase above past rates. When combined with foreseeable traffic conditions, the cumulative indirect effects on road traffic associated with both the Proposed Action and RFD of Panel 15 would be minor and short-term, relative to the current and recent conditions, although such effects would be extended for an additional 0.7 years.

STB (2015a) noted that the determining factor for the level of rail traffic from the Powder River Basin to the Pacific Northwest terminals is the level of export terminal growth. While other terminals have been proposed, necessary approvals have been denied or rejected or projects have been withdrawn. Given this, changes in coal port capacity affecting rail traffic on the Main Line are not reasonably foreseeable.

As discussed in **Section 4.1**, rail traffic is expected to increase along the Main Line between Laurel and Westshore during the life of coal transport under both alternatives. Congested conditions currently exist on rail segments in Idaho west of Sand Point. Changes to these conditions are expected to be negligible during the life of the No Action Alternative. Coal shipment between 2019 and 2028 under the Proposed Action, would occur during a period when rail traffic is anticipated to increase, which, collectively, has the potential to adversely affect operations (due to congestion). However, railroads and other infrastructure owners are anticipated to address key capacity issues by implementing capacity and efficiency improvements (ITD 2013, WSDOT 2014); and all such changes will be subject to the review of STB and/or FRA, as appropriate. Based on this analysis, the indirect cumulative impacts of the Proposed Action and the potential RFD of Panel 15 would result in minor and short-term impacts on rail transportation.

Coal dust deposits on tracks resulting from the Proposed Action and No Action Alternative as well as Panel 15 (RFD) would combine with dust from other past, present, and reasonably foreseeable coal haulage on the tracks. Continued implementation of BNSF's Coal Loading Rule (BNSF 2015a, 2017b) would minimize coal dust emissions, and ongoing track maintenance ensures that rail conditions do not degrade to an extent that would affect rail safety. Cumulative adverse impacts of coal dust from all sources on rail safety would be negligible and short-term.

4.1.3 Mitigation Measures

No additional mitigation measures were determined necessary to avoid unacceptable impacts.

4.2 Air Quality

4.2.1 Direct & Indirect Effects

Effects on air quality are directly related to air pollutant emission rates that are generally proportional to the rate of saleable coal production across all segments as presented in **Section 3.2**. Direct and indirect impacts are evaluated by quantifying annual emissions at the maximum rate of saleable coal production under each alternative (10.0 Mtpy) for comparison to Mine production in 2016 (5.96 Mt). Estimated emissions and the difference between the evaluated mining rates are presented for each segment (Mine operations, rail transportation, seaport handling, ocean transport, and overseas combustion) in **Appendix B, Table B-12 through B-**

16 (respectively). Methods used to estimate emissions are described in **Appendix C**, where annual emissions are presented on a 1.0 Mt basis. Findings of the analysis of alternatives are summarized below.

No Action

Mining activities under the No Action Alternative could produce and ship up to 10.0 Mt saleable coal annually for 2.5 years. Mining activities would continue to be controlled by the existing MAQP (MDEQ 2016b) and the underlying regulations which are designed to prevent major impacts (see **Section 3.2** and **Appendix B)**. Ambient air monitoring has demonstrated that the Mine's historical impacts to local air quality have been minor with respect to applicable air quality standards (NAAQS and MAAQS). Although actual annual emissions from the No Action Alternative could increase relative to historical rates, they would not increase beyond levels associated with the MAQP limits which allow mining up to 15.0 Mtpy of raw coal (approximately 10.5 Mtpy salable coal). Therefore, the Mine operations' direct and indirect impacts to air quality are expected to be minor. This conclusion is supported by MDEQ's February 2017 approval to terminate local air monitoring for PM_{10} (MDEQ 2017a). Air quality impacts related to the No Action Alternative would be short-term, lasting at least 2.5 years while mining continues and then declining and eventually ceasing as the Mine is fully reclaimed in accordance with the Mine permit, which would take approximately 16 months after mining ends.

Rail transport emissions are presented as lbs/mile traveled, reflecting distribution of impacts over the 2,780 miles trains travel round-trip including rail segments that may see both loaded and unloaded rail traffic from both loaded and empty trains. Separate emissions are calculated for loaded and unloaded trains and combined to estimate total round-trip emissions (**Appendix C**). At the estimated annual criteria pollutant emission rates, impacts to air quality from rail transport under the No Action Alternative are expected to be negligible and short-term, lasting 2.5 years. Emissions would be distributed over long distances and transitory in nature. As described in **Appendix B**, rail routes do not encroach on any Class I areas, and areas with historically degraded air quality are likely to have developed mitigation measures similar to the referenced Missoula, Montana example. In addition, coal dust-related impacts associated with rail transport of coal under the No Action Alternative would be negligible. Impacts on air quality would be short-term as the duration of mining and transport would be extended by 2.5 years. Coal dust deposited in soil and water would remain in the long-term.

At estimated annual criteria pollutant emission rates, impacts to air quality from seaport handling under the No Action Alternative are expected to be negligible and short-term, lasting 2.5 years. As noted in **Appendix B**, measured ambient pollutant concentrations proximal to Westshore Terminal were all below the relevant air quality objectives and standards in 2014. Existing regulations will continue to ensure that individual emitting sources produce air quality impacts protective of human and environmental health.

Estimated annual criteria pollutant emissions related to transporting coal from the Westshore Terminal to the ROK and Japan are presented as lbs/mile traveled round-trip because impacts are distributed over a large distance, similar to locomotive emissions, as discussed above. At these emission rates, impacts to air quality from ocean transport are expected to be negligible and short-term, lasting 2.5 years. Localized impacts would be negligible as emissions would be distributed over long distances and transitory in nature.

Estimated annual pollutant emissions related to combusting coal for power generation in the ROK and Japan would be subject to air quality control laws that would ensure emissions and resultant air quality are within acceptable (regulatory) limits considered protective of human health and the environment (see **Appendix B**). The United Nations Environment Programme reports that ambient air quality standards in the ROK and Japan are within World Health Organization targets (UNEP 2016a, 2016b). Given this, air quality impacts from combustion would be minor and would be short-term, lasting 2.5 years. Cumulative effects of mercury are discussed in **Section 4.2.2** below.

Proposed Action

Under the Proposed Action, the Mine would continue to produce and ship up to 10.0 Mtpy of coal, the same annual production rate evaluated for the No Action Alternative (above), but this rate of production would last for 9 years longer than the No Action Alternative. Annual emissions and air quality effects from the Proposed Action would be the same as those resulting from the No Action Alternative but would continue for those additional 9 years. Air quality impacts related to the Proposed Action would be minor for Mine operations and negligible for rail transport, seaport handling and ocean transport. The degree of impacts from overseas combustion would depend on emission controls and local conditions within either the ROK and/or Japan but would be minor due to existing regulations in place that are considered protective of human health and the environment as noted above. Air quality impacts from all segments would be short-term, but would persist for 9 additional years relative to the No Action Alternative. As further described in **Appendix B**, impacts would be expected to decrease over time as equipment (e.g., locomotive engines, ship engines, boilers, etc.) that emits air pollutants is improved and replaced and as regulations become more stringent.

The Proposed Action would have the same rail transport rate as the No Action Alternative (1.8 loaded and 1.8 empty trains per day) and indirect impacts associated with generation of coal dust would be negligible. While effects would occur 9 more years under the Proposed Action, relative to the No Action Alternative, the duration of air quality effects is still considered short-term as the effects would cease after rail transport of the Mine's coal concludes. As with the No Action Alternative, coal dust deposited in soil and water would remain in the long-term.

4.2.2 Cumulative Effects

Cumulative impact assessment is inherent to evaluation of air quality impacts due to the combined effects of multiple emission sources on an affected area, whether it be the air quality in the vicinity of a monitoring station, an airshed, a region, or the world as a whole. Air pollutant emissions directly related to mining and indirectly resulting from rail transport, port operations, ocean transport, and combustion occur in a highly regulated context, as described in **Appendix B**.

If undertaken, emissions related to mining, transporting, and combusting 6.0 Mt of coal mined in Panel 15 over 0.7 years would not exceed those presented in **Section 3.2** as the annualized production rate is not expected to exceed 10.0 Mtpy under any scenario. Air quality effects from criteria pollutants and arsenic would be minor and short-term, lasting approximately 0.7 years after mining ceases under the Proposed Action.

Most emissions affect air quality in areas proximal to the emissions source and result in short-term effects as they dissipate rather than accumulate over time. While mercury air emissions also dissipate in the atmosphere, elemental mercury can travel long distances before depositing to soil and water where it accumulates and can be reemitted, resulting in long-term effects (see **Appendix B** for additional detail). Total mercury emissions range from 0.06 to 0.35 tons under the No Action Alternative and from 0.28 to 1.7 tons under the Proposed Action, accounting for between 0.001 and 0.03 percent of global mercury emissions (2,066 tons annually; UNEP/AMAP 2015). Total mercury emissions from combusting 6.0 Mt of coal from Panel 15 would add between 0.02 and 0.09 tons, a negligible contribution to emissions attributed to the Proposed Action and other sources. Existing regulations in the ROK and Japan and increasing implementation of mercury controls similar to those implemented in the US and are expected to reduce mercury accumulation in the environment in the short-term and long-term.

While the extent of cumulative air quality impacts would vary by segment as discussed and their locale, the factors identified above indicate that cumulative impacts on air quality resulting from criteria pollutants and arsenic emissions would be minor and short-term. Mercury emissions would be minor and have long-term effects as they are combined with global emissions and accumulate in the environment.

Coal dust resulting from the Proposed Action and No Action Alternative would combine with dust generated from other past, present, and reasonably foreseeable coal haulage. Continued implementation of BNSF's Coal Loading Rule (BNSF 2015a, 2017b) ensures that coal dust emissions are minimized on BNSF owned and operated rail lines; thereby minimizing the potential for coal-dust related emissions and subsequent deposition to soil and water. Increases to port capacity are not foreseeable, so the future rate of coal transport on the Main Line would not change significantly from recent shipping rates. Based on this and the findings of evaluations for other rail transport projects (WDOE and Cowlitz County 2017, STB 2015a), project-related coal dust emissions, dispersion and deposition would result in negligible long-term cumulative effects to air quality and the environment.

4.2.3 Mitigation Measures

No additional mitigation measures were determined necessary to avoid unacceptable impacts.

4.3 Climate

4.3.1 Direct & Indirect Effects

Direct and indirect GHG emission rates resulting from mining, transporting, and combusting coal from the Mine are presented in **Appendix C, Exhibit 6** and summarized in **Section 3.3** on a 1.0 Mt of saleable coal basis**.** Based on this foundation, GHG emissions generated from mining, transporting, and combusting 22.9 Mt of coal under the No Action Alternative (50.1 Mt-CO_2e) and 109.7 Mt under the Proposed Action (240.1 Mt-CO_2e) would have a net difference of 190.0 Mt CO_2e. Nearly all (99 percent) of GHGs are emitted outside of the US and 97 percent are a result of coal combustion.

While direct and indirect GHG emissions resulting from the Proposed Action and No Action Alternative would occur over multiple years, comparison to annual global statistics provides a context for evaluating total emissions related to both actions since 99 percent of GHGs would be emitted outside of the US. In 2010, global anthropogenic GHG emissions totaled approximately 54,000 Mt-CO_2e. Total emissions directly and indirectly resulting from mining under the No Action Alternative, would be approximately 0.09 percent of annual global GHG emissions, respectively, on a 2010 basis and would therefore have minor direct and indirect effects on climate in the short and long-term on an annual basis. Under the Proposed Action, direct and indirect emissions resulting from mining would be approximately 0.44 percent of annual global GHG emissions (2010). Therefore, while the Proposed Action would contribute to the effects of climate change, its contribution relative to other global sources would be minor in the short- and long-term on an annual basis.

Emissions from US based activities (i.e., mining and rail transport) are compared to US emissions on a 2015 basis and projected Montana emissions on a 2020 basis for comparison on a regional and national scale. Under the No Action Alternative, US based activities would emit approximately 0.622 Mt-CO_2e, less than 0.01 percent of annual US GHG emissions, and 1.34 percent of annual projected Montana emissions. By comparison, US based activities under the Proposed Action would emit approximately 2.98 Mt-CO_2e, 0.04 percent of annual US GHG emissions, and 6.43 percent of annual projected Montana emissions.

As noted in **Section 3.4**, the ROK and Japan have both submitted INDC GHG emissions reduction plans for achieving United Nations Framework Convention on Climate Change objectives (Japan 2015 and ROK 2015). These plans may reduce GHG emissions relative to these estimates during the life of the Proposed Action. Incremental effects of the Proposed Action and No Action Alternative on climate are expected to be minor in the short and long-term however due to the nature of climate change those effects cannot be attributed to anyone source at a small scale.

4.3.2 Cumulative Effects

Projected Climate Conditions and Effects

As discussed in **Section 3.3**, the most recent findings and broad predictions regarding climate change and its effects are presented in IPCC's report titled *Climate Change 2014: Synthesis Report*, the *Fourth National Climate Assessment* (USGCRP 2017), and *Montana Climate Assessment* (Whitlock et al 2017), which are incorporated by reference in this EA. Projected effects of climate change are discussed in each of these documents at varying scales (e.g., global, US, and Montana) covering a variety of topics and resources. A summary of projected cumulative conditions and trends, as reported in these three documents is presented in **Appendix D**.

Cumulative Effects of Mining-Related Emissions

As noted in **Section 4.3.1**, the Proposed Action and No Action Alternative would provide minor contributions to GHG concentrations in the atmosphere, relative to all other past and present global emission sources. In the future, these emissions are expected to comprise a smaller portion of global emissions as energy-related CO2 emissions (the largest contributor of GHG emissions) are projected to increase by approximately 7 percent between 2015 and 2030 (USEIA 2017b). Mining of Panel 15 (RFD, see Section 4.0) would produce approximately 6.0 Mt of saleable coal, equating to approximately 13.1 Mt-CO2e emissions from mining, transport, and combustion. Cumulative long-term effects of all mining-related emissions on climate change and subsequent effects on all resources are expected to be minor, but long-term, as emissions would persist in the atmosphere after mining is complete.

A protocol to estimate what is referenced as the "social cost of carbon" (SCC) associated with GHG emissions was developed by a Federal Interagency Working Group (IWG) to assist agencies in addressing EO 12866, which requires Federal agencies to assess the cost and the benefits of proposed regulations as part of their regulatory impact analyses. The SCC is an estimate of the economic damages associated with an increase in CO_2 emissions and is intended to be used as part of a cost-benefit analysis for proposed rules. Further discussion regarding the SCC as it relates to this EA is provided in **Appendix D**.

4.3.3 Mitigation Measures

No additional mitigation measures were determined necessary to avoid unacceptable impacts.

4.4 Water Resources

Predicted hydrologic impacts of the Proposed Action are presented in the statement of PHC presented in the Mine permit and further evaluated in MDEQ's CHIAs (MDEQ 2016a, 2017b). The hydrologic monitoring program approved by MDEQ as part of the Mine permit (SPE 2017a, Appendix 314-4) is designed to identify impacts to wells, springs, streams, and ponds, which may differ from predictions. The Mine permit specifies mitigation measures to be employed to address mining-related hydrologic impacts in a manner consistent with applicable regulations (SPE 2017a). An updated assessment of potential impacts to water quantity and quality based on recent monitoring observations and modeling completed since the BLM Coal Lease EA was prepared is presented in **Appendix E**, and summarized below:

4.4.1 Direct & Indirect Effects

No Action

For the No Action Alternative, the response of the underlying groundwater system is anticipated to be similar to, but slightly greater in magnitude than observations to date (see **Section 3.4**), and as further discussed in **Appendix E**. Drawdown would occur in the lower overburden strata, Mammoth coal, upper underburden and deep underburden aquifer. Impacts to groundwater quality and quantity would occur in the long-term. Mitigation would be implemented in accordance with the Mine permit and replacement water would likely be sourced from a well completed in the deep underburden aquifer. Some springs may be affected by mining in the short-term. Long-term effects to wells, springs and associated intermittent stream reaches, if any, would be mitigated in accordance with the Mine permit (SPE 2017a) resulting in minor long-term effects to water availability for existing uses.

Surface water downstream of disturbances and overlying the mining area would potentially be affected in the manner described in Section 4.2.4.2 of the BLM Coal Lease EA. Effects to surface water quantities would be minor and short-term. Subsidence would not be expected to affect surface water quality. Surface water quality in the vicinity of the Surface Facilities Area would potentially be affected in the short-term, but compliance with Montana Pollutant Discharge Elimination System (MPDES) permits would ensure those effects are minor.

Proposed Action

Mining under the Proposed Action would have broader impacts than the No Action Alternative, as summarized below, and discussed further in **Appendix E**. In general, mining is not expected to impact alluvial groundwater either in terms of water quantity or water quality. Impacts to shallower overburden groundwater levels, if they occur, are projected to be negligible and short-term. In contrast, impacts to the deeper overburden portions within fragmented/fractured zones are projected to be moderate and long-term.

A groundwater model developed by SPE (2017a, Appendix 314-6) presents quantitative water level changes in the Mammoth coal and the upper underburden. The cone of depression and magnitude of drawdown of the Mammoth coal and upper underburden aquifers outside the permit boundary would be greatest to the north-northwest (**Appendix A, Figure 4.4-1**). Drawdown would decrease progressively with distance from the Mine. The nature of recovery following mining (at end of mining and at 50 years after mining) would depend upon the behavior of the constructed gate roads. Under modelled Scenario 1, gate roads would collapse (cave in) following mining (**Appendix A, Figure 4.4-2** and **4.4-4**). Under modelled Scenario 2, gate roads remain generally intact (**Appendix A, Figure 4.4-3** and **4.4-5)**. Scenario 1 is considered to be the most likely long-term condition. The "Deep Underburden Groundwater Model" (SPE 2017a, Appendix 314-7) predicts that the maximum drawdown at the end of mining in the deep underburden sandstone would be 3 feet; a minor change.

Although shallower springs may be impacted, springs sourced by overburden interval 5 would be at a greater risk of impacts. The most likely effect to impacted springs would be reduced discharge rates including the cessation of discharge, which could persist in the long-term. Minor short-term surface water impacts are expected as a result of subsidence and surface facility construction and reclamation.

Long-term impacts to affected groundwater and surface water uses would be mitigated in accordance with the Mine permit, as described in **Appendix E**, ensuring that water is replaced and overall impacts of the Proposed Action do not rise to the level of significance. State regulations and permitting administered by USACE would ensure that impacts to waters of the US, including wetlands, would be short-term and would not be major.

4.4.2 Cumulative Effects

Cumulative effects of the Proposed Action and No Action Alternative on groundwater would be similar to the direct and indirect effects discussed in **Section 4.4.1**, which account for the entire water system including natural variability and existing uses (primarily agricultural uses as discussed in the BLM Coal Lease EA and CHIA [DEQ 2016]). Cumulative effects of the Proposed Action and No Action Alternative on surface water in combination with agricultural uses, fires, and minor construction activities, are generally expected to be comparable to the existing condition, but may have higher severity if overgrazing and fires are followed by intense precipitation events. Mitigation of mining effects on groundwater and surface water uses conducted in accordance with the Mine permit (SPE 2017a) would ensure that long-term effects of mining in combination with these other activities are not major in the long-term. Additional details regarding cumulative effects to water resources are presented in **Appendix E**.

4.4.3 Mitigation Measures

No additional mitigation measures, outside of those already specified in the SMCRA PAP, were determined necessary to avoid unacceptable impacts.

4.5 Soil

4.5.1 Direct & Indirect Effects

Impacts to the soil resource are discussed in Sections 3.1.5 and 3.2.5 of the BLM Coal Lease EA. Impacts discussed below are primarily associated with additional surface disturbances, including WDA #2, that were not expected or analyzed at the time the BLM Coal Lease EA was prepared.

No Action

Disturbance in association with the No Action Alternative would encompass approximately 73 acres (401 acres less than the Proposed Action) and would primarily occur in the Surface Facilities Area or in association with borehole pad and road construction. These disturbances would directly affect soil and be additive to the existing Mine disturbance. All soil management activities would occur as specified in the State-approved Mine permit. Soil suitable and necessary for use in reclamation would be salvaged by windrowing or stockpiling as an initial step in construction. Approved conservation and best management practices would help preserve soil conditions, limit wind and water erosion, and maintain suitability of soil for use in reclamation.

Following final grading of surface disturbances, soil would be replaced and promptly revegetated in accordance with reclamation methods specified in the State-approved Mine permit, further reducing potential for degradation or soil loss due to erosion. With the exception of the Surface Facilities Area that has specific replacement depths suited for specific reclamation types, most graded areas would receive soil salvaged from within the same footprint distributed at depths similar to those which existed prior to mining effects. Replaced soil may have more homogenous textures and may also exhibit more near-surface coarse fragments as a result of salvage, stockpiling, and distribution.

Short and long-term impacts to soils would be minimized by soil handling and revegetation methods specified in the Mine permit and State-regulations pertaining to mining. In the short-term, soil would be stockpiled, thereby minimizing impacts. Long-term effects would be minor as soil materials would be placed on graded surfaces and would be capable of supporting the desired vegetation communities and approved post-mine land uses.

Proposed Action

Impacts to soil under the Proposed Action would occur directly as a result of 401 acres of disturbance in addition to the acreage disturbed under the No Action Alternative. Most additional disturbance (79 percent) would occur in the Surface Facilities Area (primarily related WDA #2 construction), although other disturbance would occur in association with subsidence repairs, borehole pads and road construction. Adequate soil is available for salvage within the WDA #2 footprint to cover the facility during reclamation. Overall, impacts associated with the Proposed Action would be similar to the No Action Alternative, whereby effects would be minor in the long-term.

4.5.2 Cumulative Effects

Impacts of dispersed residential development were previously assessed in Section 4.3.3.5 of the BLM Coal Lease EA.

Mining of Panel 15 would likely result in surface disturbance comparable to that projected for the Proposed Action. Based on the extent of the delineated Panel 15 mining area, approximately 6 acres may be disturbed. Soil handling would occur as it would for the Proposed Action and final soil conditions would be suitable to support the post-mine land use.

Historical fires have affected a substantial portion of the Mine permit area and vicinity, particularly the western-most areas overlying Panels 1 through 6. Although minor erosion may have occurred in the short-term following fires, all fire-affected lands are relatively stable have revegetated to an extent that supports grazing and provides utility for wildlife. The long-term effects of any future fires are expected to be similar, resulting in minor impacts to soil.

Considering this, long-term cumulative effects to soil in the Mine permit area would be minor.

4.5.3 Mitigation Measures

No additional mitigation measures were determined necessary to avoid unacceptable impacts.

4.6 Vegetation

4.6.1 Direct & Indirect Effects

No Action

Few hydrophytic monitoring points have been undermined to date, and no site-specific conclusions have been reached regarding potential mining impacts to vegetation communities. The expected effects to vegetation due to subsidence are discussed in Section 4.2.6 of the BLM Coal Lease EA.

Mining activities conducted in association with the No Action Alternative would directly affect vegetation through surface disturbance of up to 73 acres (401 acres less than the Proposed Action). Projected disturbances would occur in shrubland, burned ponderosa pine, ponderosa pine forest, and grassland habitats. Removal of vegetation would temporarily eliminate associated livestock forage and wildlife habitat provided by existing vegetative cover.

In accordance with the State-approved Mine permit, facilities would be removed when they are no longer needed and disturbances would be promptly reclaimed and revegetated. Following final grading and soil placement, disturbed areas would be promptly seeded with seed mixes identified in the State-approved Mine permit. The approved seed mixes are selected to be compatible with surrounding vegetation types and to support the approved post-mine land uses. Reclaimed native plant communities would likely exhibit less overall diversity and possibly less woody plant density (depending on the community) in the short-term. In the long-term, reclamation requirements and associated bonding would ensure that vegetation communities support the desired postmining land use at least to the extent capable before mining.

Direct and indirect effects to vegetation could include the spread of noxious weed species known to occur in the permit area and potential introduction of other invasive plant species. Vehicles and mine equipment could potentially spread noxious weeds along roadways, mine facilities, and associated construction sites. State regulations (ARM 17.24.716) and the mine permit (SPE 2014a) require SPE to control noxious weeds on all disturbed and reclaimed areas and the noxious weed control plans (SPE 2014b, 2014c) specify controls on non-disturbed portions of the permit area. While implementation of weed control measures reduces the spread of noxious weeds, these species are well-adapted to establish in disturbed areas and could spread to native areas adjacent to disturbances and persist following mining, although they would be prevented from spreading to an extent that would substantially affect land uses.

Impacts to vegetation as a result of the No Action Alternative are expected to be minor, but long-term.

Proposed Action

Impacts to vegetation resulting from the Proposed Action would be similar to those described for the No Action Alternative but would occur over a larger area. An estimated 401acres would be disturbed under the Proposed Action in addition to that disturbed by the No Action Alternative. Most of the disturbance in addition to the No Action Alternative (316 acres, 79 percent) would be in the Surface Facilities Area, primarily in association with WDA #2. While a variety of habitats would be affected, most disturbance would occur in grassland and burned ponderosa pine habitats.

Noxious weeds would continue to be present and could potentially spread in the permit area as a result of the Proposed Action in a manner similar to that described for the No Action Alternative. Noxious weeds would be controlled and prevented from spreading to an extent that would substantially affect land uses.

Impacts to vegetation as a result of the Proposed Action are expected to be minor but long-term.

4.6.2 Cumulative Effects

The BLM Coal Lease EA Section 4.3.3.6 discussed effects of the Proposed Action and No Action Alternative in combination with grazing and residential development. Vegetation would also be affected by fires, potential future mining of Panel 15, ongoing exploration activities, and noxious weed infestations resulting from sources not related to mining.

Historical fires have affected a substantial portion of the Mine permit area and vicinity, particularly the western-most areas overlying Panels 1 through 6. Long-term effects including tree and shrub reduction are noticeable in areas of historical fires, which were cataloged as part of baseline vegetation surveys described in the BLM Coal Lease EA. All fire-affected lands are stable and have revegetated to an extent that supports grazing and provides utility for wildlife. Therefore, the effects of fires are considered minor in the long-term.

Mining of Panel 15 would likely result in surface disturbance comparable to that projected for the Proposed Action. Based on the extent of the delineated Panel 15 mining area, approximately 6 acres may be disturbed. Such disturbances would likely be temporary, as they would be for the Proposed Action, and long-term effects would be minor.

Exploration activities have been conducted outside of the Mine permit area. New roads are not constructed and surface disturbance is minimized. All disturbances are revegetated in accordance with the requirements of prospecting permits, ensuring long-term effects are negligible.

The inherent nature of noxious weeds and other invasive plants contributes to continued expansion throughout Yellowstone and Musselshell Counties, including the Mine permit area. Natural distribution occurs as a result of wind, water, and wildlife. Human activities, particularly activities involving movement of vehicles, machinery and livestock from weed impacted areas to other areas, can also contribute to expansion of noxious weeds. Continued application of herbicide and other measures to control noxious weeds would help limit this expansion, but noxious weeds are difficult to eradicate and are likely to be present to some extent in the vicinity of the Mine and surrounding counties into the foreseeable future. The cumulative effect would be minimized through continued implementation of noxious weed control plans, likely preventing substantial adverse effects to vegetation or associated land uses.

Cumulative impacts to vegetation resulting from these activities and natural processes are expected to be minor, but long-term.

4.6.3 Mitigation Measures

No additional mitigation measures were determined necessary to avoid unacceptable impacts.

4.7 Wildlife

4.7.1 Direct & Indirect Effects

No Action

Under the No Action Alternative, local wildlife populations are and would continue to be directly affected by ongoing mining activities for approximately 2.5 years and then reclamation activities thereafter (additional period of approximately 16 months). Direct effects would include road kills by mine-related traffic; restrictions to animal movement due to activity, noise, disturbance, and habitat fragmentation; and displacement due to avoidance of mining activities and associated habitat loss and modification. Species that are less mobile (e.g., amphibians, reptiles, small mammals, nesting birds) could suffer direct mortality due to construction activities (e.g., ground clearing), particularly if such construction would occur during seasons when they are most vulnerable (e.g., nesting season). Wildlife present in the Mine permit area and immediate vicinity (**Appendix F**) would be affected by subsidence in the manner described in the BLM Coal Lease EA.

Approximately 73 acres would be disturbed under the No Action Alternative, 21 acres in the Surface Facilities Area and 52 acres in association with roads, borehole pads, subsidence repairs, and a new air portal. Projected disturbances would occur in shrubland, burned ponderosa pine, ponderosa pine forest, and grassland habitats. Most surface activities would continue to occur in the existing Surface Facilities Area. New surface disturbances outside of the Surface Facilities Area would not experience continuous use (except for ventilation fans) and would be reclaimed promptly following discontinued use in accordance with the State-approved Mine permit, as discussed in the BLM Coal Lease EA.

Wildlife sensitive to noise likely would avoid the vicinity of the fan installations during the period of operation. Species sensitive to human noise and presence could be displaced from adjacent habitats not directly affected by project activities. Displaced animals could be incorporated into adjacent populations which could, in turn, experience increased inter-and intra-specific competition, increased energy expenditure, increased mortality, decreased reproductive rates, or other compensatory or additive responses depending on variables such as species behavior, density, and habitat quality. Unsuitable habitat resource selection by displaced wildlife could lead to a sink in population.

Many of the bird species identified in **Appendix F** nest within the permit boundary and may be directly affected to the extent that new disturbances occur during the nesting season or mining activities occur in such proximity that breeding or nesting is disrupted. Raptor nests occur in relatively close proximity (within 500 feet) to proposed roads and other facilities and other undiscovered nests are likely present within the permit boundary, including newly constructed nests. Short-term effects to individual nesting raptors would be reduced to a moderate level or less by implementing mitigation measures in accordance with the Mine permit, as identified in **Section 3.7**, which include measures specific to eagles developed in consultation with USFWS.

Pocket gopher and ground-squirrel colonies are present in the Mine permit area and vicinity, but prairie dog colonies are not known to occur within the permit area or surrounding one-mile area. The limited surface disturbance that would occur under the No Action Alternative would have little effect on small mammal communities; therefore, effects on foraging raptors would be negligible and short-term.

Sharp-tailed grouse leks occur in the permit area and vicinity, some of which have not been active in recent years. Lekking activities may be disrupted by nearby disturbance and equipment use, particularly at leks nearest to the Surface Facilities Area (**Appendix A, Figure 3.7-1**). While some leks may be avoided or have reduced attendance due to Mine activities, impacts on local grouse populations are expected to be minor and short-term.

Indirect impacts to wildlife may occur due to the effects of subsidence and changes to vegetative communities in association with surface disturbances and reclamation. These effects are expected to be minor and short-term, to the extent reclamation practices successfully reclaim or replace the habitats required for wildlife. Minor long-term effects to wildlife may occur due to changes to vegetation community composition and structure; permanent improvements to roads; or changes to water quality, quantity, and distribution. Wildlife may also experience minor, but long-term, indirect effects due to noxious weed infestations and associated changes to habitats.

In summary, direct effects on wildlife would be limited to the vicinity of proposed and existing disturbances and surface activity and would be moderate (at most) and short-term. Minor effects on wildlife habitats would persist in the long-term after reclamation is complete and utility of the area for wildlife and land uses is restored.

Proposed Action

Impacts to wildlife resulting from the Proposed Action would be similar to those described for the No Action Alternative but would encompass a larger area and occur for approximately 9 more years. As with the No Action Alternative, most of the direct effects of the Proposed Action, including habitat loss, would be limited to the vicinity of proposed and existing disturbances. An estimated 401 acres would be disturbed under the Proposed Action, in addition to that disturbed by the No Action Alternative. Most of the disturbance (340in addition to the No Action (316 acres, 79 percent) would be in the Surface Facilities Area. While a variety of habitats would be affected, most disturbance would occur in grassland and burned ponderosa pine habitats. The balance (85 acres) are projected for roads, boreholes, and subsidence repairs.

Construction and operation of WDA #2 would likely cause abandonment or relocation of three sharp-tailed grouse leks, which may affect local sharp-tailed grouse populations in the short-term. Such effects are expected to be minor, as those leks have exhibited low attendance (relative to leks on Dunn Mountain) in recent years of monitoring (see **Section 3.7**). Wildlife studies conducted at a large surface coal mine near Colstrip, Montana showed that as disturbed areas are reclaimed, grouse repopulate available habitats and establish dancing grounds in proximity to the historical locations (Yde and Waage 1996). If such lek reestablishment occurs, sharp-tailed grouse impacts would be further reduced in the long-term. Minor effects on local sharp-tailed grouse populations may also occur in the short-term due to construction of new infrastructure. Effects on sharp-tailed grouse may be similar to effects on sage-grouse, where new infrastructure has been observed to cause habitat avoidance, lower annual survival, reduce territory establishment by young males and otherwise contribute to population level declines (Hollaran et al. 2010).

Mining under the Proposed Action would move progressively farther from the nearest probable golden eagle nest on Dunn Mountain (**Appendix A, Figure 3.7-1**), reducing potential effects to that nest over time. Proposed activities would not further encroach on the other golden eagle nest located 1.6 miles northwest of the Surface Facilities Area. OSMRE is continuing consultation with USFWS to determine whether conservation measures in addition to the measures described in **Section 3.7** are needed to reduce impacts to eagles and other protected species.

Other effects on wildlife would be comparable to the No Action Alternative, but would occur over a larger area for a longer period of time. Direct effects on wildlife would be limited to the vicinity of proposed and existing disturbances and surface activity and would be moderate (at most) and short-term. Minor effects on wildlife habitats would persist in the long-term after reclamation is complete and utility of the area for wildlife and land uses is restored.

4.7.2 Cumulative Effects

Most peripheral activities and disturbance related to mining (e.g., monitoring activities, noise, and traffic) would primarily occur in the surrounding 1-mile buffer where wildlife monitoring is conducted. Cumulative effects in this area would result from implementation of the Proposed Action, future mining (including Panel 15), coal exploration, livestock grazing, noxious weed infestations, habitat loss and modification from agriculture, and habitat alteration as a result of wildfires.

Intensive livestock grazing can reduce forage available for wildlife and lead to reduced vegetative cover, increases in vegetation that is less palatable to wildlife, and invasion by noxious weeds. Livestock grazing can reduce habitat quality for small mammals that are prey for raptors and mammalian predators. Predator control activities in the vicinity of the Mine would adversely affect predator populations. Future mining or coal exploration activities and access roads can facilitate wind and water erosion that degrades wildlife habitat.

Drilling associated with coal exploration could further disturb wildlife due to human presence and noise. Drillhole disturbance is typically small and limited to the drillhole and surrounding spread cuttings. Exploration effects on wildlife are expected to be negligible and short-term.

Residential housing occurs in the vicinity of the Mine and further development may occur in the future. Residential developments can lead to habituation of wildlife and food-conditioning of some wildlife species, such as ravens, red fox, and black bear. Residential development leads to habitat alteration and loss of wildlife habitat. Roads and increased traffic levels associated with residential development increase the mortality risk of wildlife due to collisions with vehicles. Also, increased vehicle traffic can interfere with the behavior of migratory birds. It is likely that residential developments would have free ranging pets which can increase mortality risk for wildlife.

Based on the projected distribution of Mine disturbances and distribution of subdivided tracts, large patches of various habitats would remain in the permit area and vicinity to provide habitat for those species sensitive to or displaced by development. Successful reclamation of mining-disturbed areas would lessen the long-term effects of loss of habitat. Consequently, the effects of habitat loss and displacement are expected to be minor, but long-term, as residential uses, roads, and agricultural activities (including trail use and maintenance) would continue long after reclamation is complete.

All habitats would be affected by periodic fires which historically converted ponderosa pine and shrubland habitats to grassland. Ponderosa pine are slow to reestablish and future fires could affect remaining forested areas in the Mine permit area, thereby affecting species that prefer forested and shrub habitats. Impacts to species affected by habitat loss would be matched by habitat creation as the fires and subsequent plant establishment and regeneration naturally transforms the landscape. While future fires could have substantial effects on the habitats in which they occur, overall those effects would likely be comparable to the effects of recent and historical fires, resulting in minor long-term changes to the landscape and habitat availability as a whole. Forest fires, as opposed to prairie fires, may be beneficial to cavity nesting birds (e.g. mountain bluebird, Lewis's woodpecker) and grassland species such as sharp-tailed grouse.

Noxious weed infestations would likely continue to persist and possibly expand in the Mine vicinity in the long-term, affecting the habitats in which they occur and, in turn, displacing wildlife dependent on those habitats. While infestations can have moderate and long-term localized effects, compliance with laws requiring noxious weed control would prevent such impacts from reaching the level of significance in the landscape as a whole.

While Mine effects on habitats would be minor in the long term, habitats could be impacted to a moderate extent through the combined effects of fragmentation, fires, and noxious weed infestation. The cumulative effect of proposed Mining and other listed factors would result in, at most, moderate long-term effects on wildlife.

4.7.3 Mitigation Measures

No additional mitigation measures were determined necessary to avoid unacceptable impacts.

4.8 Threatened, Endangered, and Special Status Species

4.8.1 Direct & Indirect Effects

As discussed in Section 3.8, no species listed as threatened or endangered under ESA are known or likely to occur in the area affected by the Proposed Action; therefore, OSMRE has determined that there would be "no effect" to listed species. Effects of subsidence on special status species was previously discussed in the BLM Coal Lease EA.

Greater sage-grouse has not been observed in the Project Area, core habitat is not present, and there is little habitat that would be considered suitable for sage-grouse. Considering this and the limited disturbance that would occur under either action, there would be no effects to this species. Because the Mine permit would not be amended under the proposed action, further review or approval pursuant to EO 12-2015 would not be required for either alternative.

Special status species present in the Mine permit area (**Appendix F**), including BLM-sensitive species and Montana Species of Concern (SOC), would be directly and indirectly affected by the Proposed Action in a manner similar to other wildlife, as discussed in **Section 4.7** and in the BLM Coal Mine EA**.** Such effects would be moderate (at most) and primarily short-term, although some minor effects to habitats would persist in the long-term.

4.8.2 Cumulative Effects

Threatened or endangered species or their habitats and greater sage-grouse would not be affected by Mine activities; therefore, there would be no cumulative effects to those species. Although, future wildfires at the periphery of forested habitat in the Bull Mountains may serve to improve sage-grouse habitat conditions by removing trees. Fire also removes less fire-adapted shrub species such as big sagebrush which counteracts the benefit to sage-grouse. Montana SOC and BLM sensitive species may experience moderate impacts (at most) from the combination of existing and proposed mining, continued agricultural land uses, residential development, and future mining of Panel 15 similar to the effects on other wildlife as discussed in **Section 4.7.2**.

4.8.3 Mitigation Measures

No additional mitigation measures were determined necessary to avoid unacceptable impacts.

4.9 Cultural and Paleontological Resources

4.9.1 Direct & Indirect Effects

Cultural resources may be affected by surface disturbing activities during facility construction, subsidence repair, or other equipment operations. Cultural resources on steep slopes and in areas of cliffs and rock outcrops may be affected by subsidence movement resulting from underground mining. As discussed in **Section 3.9** and the BLM Coal Lease EA referenced therein, before conducting mining related activities in areas to be affected, all areas to be undermined or potentially affected by surface disturbing activities are surveyed and the State Historic Preservation Office (SHPO) is consulted regarding potential impacts to sites potentially eligible for NRHP listing.

No Action

The area to be affected by subsidence and 73 acres of surface disturbance under the No Action Alternative has been surveyed as discussed in **Section 3.9**. One site requiring further evaluation before assessing eligibility for NRHP listing (24YL1055) is in the area to be undermined. However, this site is not in an area of steep slopes and rock outcrops and is not in an area where surface disturbing activities are planned. No other sites identified as eligible for listing in the NRHP or requiring further evaluation are within areas where surface disturbance is likely to occur under the No Action Alternative. Based on the current underground mine plan and projected disturbance footprint (**Appendix A, Figure 2.2-1**), additional surveys would not likely be required under the No Action Alternative.

If site 24YL1055 or any other potentially eligible cultural resources could be affected by the No Action Alternative, SHPO would be consulted regarding those effects. If adverse effects would occur, all parties would seek options to avoid, minimize, or mitigate those effects. Isolated finds and other sites not eligible for listing on the NRHP do not require further investigation or avoidance. Direct and indirect effects on cultural resources from the No Action Alternative would be negligible but long-term.

While no specific paleontological resources are known to occur in the Mine permit area, surface disturbing activities could cause long-term impacts to any paleontological resources encountered. Stipulation to the Federal coal lease requires SPE to report paleontological resources discovered during construction and suspend activity, thereby ensuring effects do not rise to the level of significance.

Proposed Action

Portions of the area that would be affected by subsidence and up to 401 acres of additional surface disturbance under the Proposed Action, relative to the No Action Alternative, have been surveyed. These include lands overlying Federal coal lease areas, the area overlying Panels 5 through 9 where subsidence and surface activities would occur (including activities under the No Action Alternative), and the area where WDA#2 would be constructed. In addition to the site to be undermined by the No Action Alternative, studies completed to date identified four sites (24ML667, 24ML940, 24ME949, 24ML942) in areas to be undermined by the Proposed Action and requiring further evaluation before assessing eligibility for listing on the NRHP. These sites are not located in areas of steep slopes and rock outcrops and are not in areas of planned surface disturbing activities. As required by the State-approved Mine permit and BLM Federal coal lease stipulations, remaining portions of the potentially affected area would be surveyed before undermining or conducting surface disturbing activities. OSMRE received concurrence from Montana SHPO on February 22, 2018 of No Adverse Effect.

If the four unevaluated sites listed above or other potentially eligible cultural resources are located in areas that could be affected by the Proposed Action, SHPO would be consulted regarding those effects, as discussed for the No Action Alternative above. Isolated finds and other sites not eligible for listing on the NRHP do not require further investigation or avoidance. Direct and indirect effects on cultural resources from the Proposed Action would be negligible but long-term. Similar to the No Action Alternative, impacts to paleontological resources would not rise to the level of significance due to stipulations of the Federal coal lease.

4.9.2 Cumulative Effects

Surveys ensure cultural resources are identified and permit requirements and lease stipulations ensure that sites eligible (or unevaluated and potentially eligible) for listing on the NRHP are avoided or impacts are otherwise mitigated. Isolated finds and other sites not eligible for listing on the NRHP could be affected by the Mine. As a result, cumulative impacts on cultural resources would be negligible but long term.

4.9.3 Mitigation Measures

No additional mitigation measures are necessary.

4.10 Noise & Vibration

4.10.1 Direct & Indirect Effects

Noise-related impacts associated with mining would continue in a manner comparable to the existing condition but for an additional 9 years under the Proposed Action in addition to the 2.5 years under the No Action Alternative.

Noise and vibration associated with rail operation have closely related causal factors with the magnitude of effect relating to the frequency of train passage. According to STB's regulations, noise levels resulting from the passing trains would not have a measurable noise impact (thus requiring additional analysis) unless levels would exceed 65 L_{dn} or increase by at least 3 dBA. Changes in a noise level of less than 3 dBA are not typically noticed by the human ear.

The following equation was recently used for two projects involving coal transport by rail (STB 2015a, WDOE and Cowlitz County 2017) to calculate the change in noise levels.

$$10 \times \log (N2 \div N1) = \text{dBA change}$$

In this equation, NI equals the existing (baseline) traffic volume along the rail line in 2016 and N2 equals the maximum estimated traffic additive of the action. The equation assumes that the distribution of the number of trains between daytime and nighttime does not change. This equation has been carried forward to analyze noise-related impacts associated with the Proposed Action and No Action Alternative in the context of STB's 3 dBA threshold. Using this equation, traffic must increase 100 percent to increase noise by at least 3 dBA.

No Action

Mine Vicinity

Surface activities associated with the No Action Alternative would continue to generate noise for approximately 2.5 years using mine-related and employee vehicles and equipment comparable to existing condition. However, if production increases under the No Action Alternative (up to 10.0 Mtpy from 5.96 Mtpy in 2016), this could translate into more frequent mine and rail-related activities (e.g., additional tipple operations, more waste generation and handling) which could result in more frequent mine and rail-related noise generation on a daily basis. Outside the Surface Facilities Area, noise would continue to be generated along roads, at borehole pads, air portals and in the vicinity of subsidence repairs. The level and extent of noise generation would be comparable to the existing conditions and would occur at new locations (**Appendix A, Figure 2.1-2**) as mining progresses but would not occur east of Panel 8. The continuously operated ventilation fan may be moved to one new location above the East Mains. If constructed, the new fan would be approximately 4,400 feet from the nearest residence, equating to an estimated maximum noise level of 46 dBA at the residence, not accounting for further noise attenuation by the natural terrain and vegetation. Impacts would be considered minor and short term, as the duration of mining would be extended by 2.5 years and effects would diminish after mining concludes and cease after reclamation is complete.

Rail Transportation Corridor

As noted in **Section 3.1**, coal trains from the Mine are the only traffic on the spur to Broadview. The No Action Alternative's maximum transport rate of 3.6 trains per day (loaded and unloaded) would yield maximum noise increase of 2.3 dBA compared to the average annual transport rate of 2.1 trains per day on the rail spur in 2016 (see **Section 2.1.6**). Noise increase relative to recent conditions on the spur would be below the 3 dBA threshold and would be less on segments between Broadview and Westshore, which have other rail traffic ranging from 14.5 to 70 trains per day (see **Section 3.1.3**). Because the noise increases along the various segments would neither double nor meet the 3 L_{dn} dBA threshold for further analysis, impacts from the No Action Alternative would be considered minor and short term.

Based on the lack of noise-related impacts associated with the No Action Alternative, no corresponding change or impacts relative to FTA human annoyance vibration criteria guidelines would be expected. While additional vibration would occur as a result of the No Action Alternative and be most pronounced in close proximity to the rail line, using FTA (2006) evaluation criteria, vibration effects would not increase substantially between Laurel and Westshore Terminal as the additional trains would not double rail traffic on any segment.

Noise and vibration effects would be short-term and would cease after mining concludes in 2.5 years.

<u>Proposed Action</u>

Mine Vicinity

Surface activities associated with the Proposed Action would continue to generate noise for approximately 11.5 years total (9 more years than the No Action Alternative) in a manner comparable to the No Action Alternative, but the location of noise generating activities and facilities would expand (**Appendix A, Figure 2.1-2**). Additional noise generating activities in the Surface Facilities Area would include construction and operation of the proposed WDA #2, which is expected to have noise levels comparable to the existing and adjacent WDA #1. Outside the Surface Facilities Area, noise would be generated along existing and new roads, at borehole pads, and in the vicinity of subsidence repairs. The level of noise generation would be comparable to that generated from existing activities and facilities, but would occur at new locations as mining progresses. As such, noise levels in the Amendment 3 mining area under the Proposed Action would be higher than ambient conditions (35 to 40 dBA).

The most notable noise generation would occur in association with a continuously operated ventilation fan, which may be installed at new locations above the East Mains as mining progresses

(**Appendix A, Figure 2.1-2**). If installed at the planned location, the ventilation fan would be located approximately 1,800 feet from a residence. Based on recent measurements at the existing fan, the fan noise could be approximately 54 dBA at the residence due to new installations, not accounting for attenuation by terrain and vegetation. The estimated noise level from the fan would be higher than ambient conditions and may be comparable to sound levels at an urban residence or conversation at a distance of 1 meter (OSHA 2013). Impacts would be considered moderate and short-term.

The slow expansion of mining activity north-eastward as mining progresses would be coupled with reduced activity above earlier mining areas (e.g., first few panels) as facilities outside of the Surface Facilities Area are decommissioned and reclaimed. The distance to receptors at residences and public roads would change as boreholes and associated facilities are added or decommissioned. While noise effects would occur over a longer period of time under the Proposed Action (9 years longer), the duration is still considered short-term as the effects would diminish after mining concludes and cease after reclamation is complete.

Rail Transport Corridor

The maximum rail transport rate under the Proposed Action, up to 3.6 trains per day (loaded and unloaded trains), would be the same as the highest rate under the No Action Alternative but would last for an additional 9 years. Accordingly, noise impacts from Proposed Action-related trains would be considered minor and generally consistent with the No Action Alternative. Similarly, based on the lack of noise-related impacts associated with the Proposed Action, no corresponding change or impacts relative to FTA human annoyance vibration criteria guidelines would be expected. While noise and vibration effects would occur over a longer period of time under the Proposed Action (9 years longer), the duration is still considered short-term as the effects would cease after mining concludes.

4.10.2 Cumulative Effects

In addition to Mine-related noise contributions, other potential sources of noise near the Mine include exploration activities, residential uses, and agricultural activities. Cumulative noise effects near the Mine associated with the Proposed Action as discerned by the public would be moderate but short term (11.5 years).

Guideline criteria for evaluating rail-related noise and vibration effects described in **Section 4.9.1** are based on existing rail traffic on rail line segments. As discussed in **Section 3.1**, rail transport is forecast to increase along most segments of the rail line between Laurel and Westshore Terminal and rail line owners and operators are expected to make changes to rail systems in response to traffic forecasts. Noise and vibration effects of future actions related to rail operations will be evaluated by FRA, STB, and/or other permitting authorities in the context of existing regulations. Avoidance, minimization and mitigation measures will be adopted in association with approvals, as needed, to reduce rail-related noise effects to acceptable levels and avoid major impacts related to noise and vibration. Examples include but are not limited to wheel treatments to reduce wheel/rail interaction, use of sound barriers, use of wayside horns versus locomotive horns, stringent noise specifications for grade-crossing signals and equipment, operational restrictions lowering speed and reducing nighttime operations) and use of ballast versus concrete for guideways to improve ground absorption of noise (FTA 2006).

4.10.3 Mitigation Measures

No additional mitigation measures were determined necessary to avoid unacceptable impacts.

4.11 Socioeconomics

4.11.1 Direct & Indirect Effects

Economic costs and benefits of the Proposed Action were not calculated or compared to the No Action Alternative for this EA. Rather, a regional economic impact analysis (see **Appendix G**) was conducted to describe the alternatives' effects on economic conditions and local economic activity, generally expressed as projected changes in employment, labor income, and economic output (Watson et al. 2007). Additional discussions about socioeconomic impacts are presented in Sections 4.1.15 and 4.2.15 of the BLM Coal Lease EA.

Appendix X (Table 1-7) compares total estimated revenue under the Proposed Action and No Action Alternative based on current tax and revenue rates as discussed in **Section 3.11** (see **Table 3.11-2**), mining duration (years), and total tons of saleable coal (see **Table 2.2-1**).

No Action

Under the No Action Alternative, the Mine would produce approximately 22.9Mt of saleable coal over 2.5 years, ending in 2019, which is 86.7Mt and 9 years less the Proposed Action. Total revenue would be approximately $432 million, including approximately $385 million at the local and County-level, $44 million in State revenue, and $3 million Federal revenue (**Appendix G, Table G-7**). The Signal Peak Community Foundation would cease its scholarship activities after 2017. Capital infrastructure investments would be $35 million in 2017 and 2018, declining to $10 million in 2019 (SPE 2017c).

Under the No Action Alternative Mine employment could increase to achieve a mining rate of 10.0Mtpy. This increase would be followed by layoffs, potentially beginning in 2018. Most reductions in employment would likely occur in 2019 when mining ceases. In the near-term, unemployment in Musselshell County could rise as there is currently no additional local industries able to employ all workers that would be laid off by the Mine. In Roundup, where there is already surplus housing, housing availability could increase to the extent workers and their families move away from Roundup to accept new employment. Local businesses, Yellowstone and, in particular Musselshell, Counties would see a decline in revenue associated with Mine activities, and no replacement revenue sources have been identified.

During the 2.5-year period of continued mining, revenue from the No Action Alternative would result in moderate, short-term impacts to the local economy, and minor direct and indirect effects at the State and national level.

Proposed Action

The Proposed Action would extend the duration of mining 9 years (relative to the No Action Alternative), and the Mine would produce an additional 86.7 Mt of saleable coal. All effects of the No Action Alternative would occur under the Proposed Action, but revenue would be generated and mine closure and associated layoffs would be delayed approximately 9 years. Approximately $1.39 billion dollars of revenue would be generated under the Proposed Action, $957 million more than the No Action Alternative (**Appendix G, Table G-7**). The revenue (relative to the No Action) would be greatest at the local and county level ($670 million), followed by State revenue (approximately $243 million) and Federal revenue (approximately $44 million). Mine capital infrastructure investments would be $35 million per year through 2027, declining to $10 million in 2028 (SPE 2017c).

No additional employees are anticipated under the Proposed Action relative to the No Action Alternative, although the duration of employment would continue 9 years longer than the No Action Alternative (until approximately 2028). At the end of mining, layoffs would occur and Mine-related revenue would eventually cease as it does for the No Action Alternative. Because no new jobs would be created, availability of housing units would not be impacted during the mining term. After mining, availability of housing in Musselshell County would potentially increase, similar to the No Action Alternative, unless a new industry is identified.

During the 9-year period of continued mining, revenue from the Proposed Action would result in moderate, short and long-term impacts to the local economy, and minor direct and indirect effects at the State and national level.

4.11.2 Cumulative Effects

Cumulative socioeconomic impacts related to the Proposed Action are those described in **Section 4.11.1** (Proposed Action), which includes analysis of impacts at a local, county, State, and national level. The effects of the Proposed Action would be a smaller part of the economy as the scale of analysis is increased from a local level to a national scale, whereby the greatest effects would be nearer to the Mine (i.e., the cities of Roundup and Billings and Musselshell and Yellowstone counties) where Mine activities and revenues compose a larger portion of the economy. At the local and county level, cumulative effects of the Proposed Action on socioeconomics are expected to be moderate but short-term (11 years), delaying impacts that could occur at the time of Mine closure if new industries are not added to employ laid-off workers and replace revenue. At the State and national level, Mine-generated revenue is a small portion of budgets that are continually changing as old revenue sources decline and new revenue sources are identified; therefore, the continuation of mining and eventual Mine closure would have minor and short-term impacts on State and Federal government.

Mining of Panel 15 (RFD) could lead to additional of approximately 6.0 Mt over 0.7 years. Revenues could increase at a local and county level (estimated at $54.9 million dollars), at the State level (estimated at $18.7 million dollars) and at the Federal level (estimated at $5.9 million dollars) totaling over $79.5 million dollars, collectively. Total future revenue generated by the Mine in association with the Proposed Action and Panel 15 would be approximately $1.47 billion.

4.11.3 Mitigation Measures

No mitigation measures specific to reducing socioeconomic impacts are necessary.

4.12 Environmental Justice

4.12.1 Direct & Indirect Effects

As discussed in **Section 4.1**, STB's threshold for analysis of environmental justice concerns (i.e., increase of eight trains per day or 100 percent increase in traffic) would not be exceeded by either alternative relative to the current condition. Economic and demographic data presented in **Section 3.12** indicate that no environmental justice concerns are present in the Study Area. No environmental justice populations would be disproportionally affected and no mitigation is required.

4.13 Visual Resources

4.13.1 Direct & Indirect Effects

No Action

Under the No Action Alternative, mining and associated operations would disturb approximately 73 acres. Of this total, 21 acres of additional disturbance would occur within the Surface Facilities Area in a manner similar to the existing condition. Outside of the Surface Facilities Area, disturbance would generally occur in conjunction with subsidence repairs, up to 15 boreholes, a new air portal, a new ventilation fan, and 7.6 miles of associated access roads.

New facilities would be shielded from view from US Highway 87 by natural terrain but would be visible from Fattig Creek Road and local ranch trails. Additional facility lighting would most likely be employed at facilities at the north end of the panels (vicinity of the East Mains) where existing powerlines could be constructed to power a new ventilation fan similar to the existing fan. If installed, additional lighting would affect the night sky in a manner similar to existing lighting in the facilities area. Such lighting could be visible from nearby residences (dwellings), particularly those nearest to potential borehole locations above the East Mains (**Appendix A, Figure 2.1-2**).

Outside of the Surface Facilities Area, disturbed sites would be reclaimed as mining progresses, minimizing the duration of effects and returning the landscape to a condition that approximates the original surface contour, blends with the surrounding natural area, and supports the primary postmine land use of grazing land.

Visual effects would be minor in most areas depending on the proximity of lights to individual residences. Impacts would be short-term as the duration of mining would be extended by 2.5 years, and lighting would be removed as individual facilities are decommissioned. Lighting at some locations may be only temporary, further reducing the duration of impacts. Disturbances would be revegetated at the time of mine closure, allowing affected areas to blend with the surrounding landscape, resulting in negligible long-term effects.

Proposed Action

Under the Proposed Action, mining and associated operations would disturb an additional 401 acres, relative to the No Action Alternative. Most of these acres (316 acres) would be associated with WDA#2 in the Surface Facilities Area. Outside of the Surface Facilities Area, additional surface disturbances would occur in association with subsidence repairs, boreholes, new access roads, and a new ventilation fan which would be constructed over the East Mains. Similar to the No Action Alternative, new facilities would be shielded from view from US Highway 87 by natural terrain, but many would be visible from Fattig Creek Road, including WDA#2.

Facility lighting would only be employed at active facilities, so the location of lighting would change over time as mining progresses. In the short-term, lighting in the Surface Facilities Area could increase as WDA#2 is constructed and prior to closure and reclamation of WDA#1, after which lighting of WDA#1 would not likely be needed. Where exterior lighting is employed at facilities outside the Surface Facilities Area (e.g., new ventilation fans), those lights could be visible from residences (dwellings), such as those north of Panels 9 through 14 and northeast of the Mine permit boundary (**Appendix A, Figure 2.1-2**).

While visual effects would occur over a longer period of time under the Proposed Action (9 years longer than the No Action Alternative), the duration is still considered short-term as the effects would cease after mining concludes in 2028 and reclamation is performed, which would take approximately 16 months after mining is complete. Visual effects from new disturbances would be minor as most would occur in the Surface Facilities Area where the visual character is already altered by existing operations. Disturbances occurring at the north end of the panels (e.g., vicinity of East Mains) would likely be visible from Fattig Creek Road. In contrast, disturbances above the longwall panels and in the southern portions of the permit area would likely be visible only from ranch trails. Long-term effects of surface disturbances would be negligible due to the mitigating effects of reclamation, as described for the No Action Alternative.

Lighting effects would be minor depending on the proximity of lights to individual residences but would be short-term as lighting would be removed as individual facilities are decommissioned. Lighting at some locations may be only temporary, further reducing the duration of impacts.

4.13.2 Cumulative Effects

In addition to Mine-related effects, scenic values within and proximal to the Mine's landscape in the Bull Mountains are most notably affected by fires and residences in subdivided tracts. Fires have altered vegetation in the permit area and vicinity, reducing the extent of conifer forests in favor of the now prevalent grassland and shrub-grassland communities. Yard lights associated with local residences provide scattered illumination in an otherwise rural landscape. Subdivided tracts without existing residences could become occupied in the future, increasing the number of parties affected by mining activities and possibly further affecting visual character of the area. While these changes could occur, the landscape is expected to remain a rural setting and the cumulative effects on visual resources is expected to be moderate in the short-term and negligible in the long-term as mine facilities and lighting is removed and disturbances are reclaimed.

4.13.3 Mitigation Measures

No additional mitigation measures were determined necessary to avoid unacceptable impacts.

4.14 Short-term Uses and Long-term Productivity

Discussions contained within this chapter and the BLM Coal Lease EA provide analysis and relationships of shorter uses (such as mining coal) and long-term productivity (such as land use for grazing and fish and wildlife habitat).

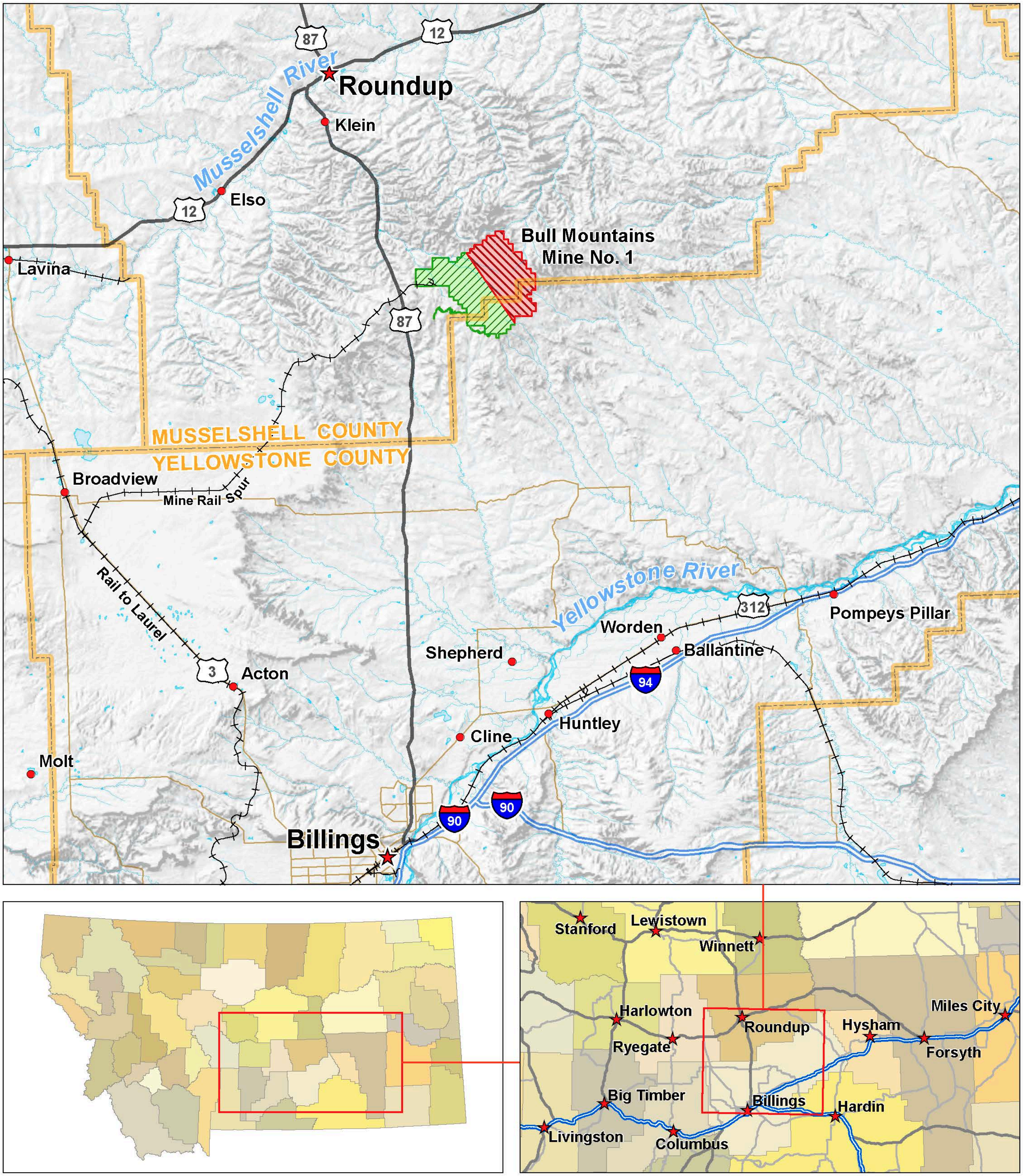
4.15 Unavoidable Adverse Effects

Unavoidable adverse impacts are the effects on natural and human resources that would remain after mitigation measures have been applied. For the Proposed Action, subsidence is unavoidable if coal is mined in a productive and economic manner. Subsidence indirectly affects a number of resource areas as described in the BLM Coal Lease EA and updated herein. Details regarding mitigation measures and these impacts are presented in the preceding resource sections and the BLM Coal Lease EA. Unavoidable adverse effects are summarized in **Table 4.15-1**.

Table 4.15-1. Unavoidable Adverse Effects of the Proposed Action.

Resource	Unavoidable Adverse Effect
Topography and Physiography	Topographic effects of WDA #2 construction are unavoidable because waste must be generated and permanently stored to conduct operations in an economical manner and to maximize coal quality. Subsidence lowers the topography overlying the mining area.
Geology Mineral Resources and Paleontology	Buried paleontological resources may be permanently impacted by construction activities however once discovered construction would stop in accordance with lease stipulations. Such impacts are unavoidable as the resources are not locatable and, therefore, cannot be avoided by construction.
Air Quality	Emissions and associated impacts are unavoidable, but are not expected to degrade ambient air quality to a level that would violate NAAQS or standards in other jurisdictions outside of the US for emissions and associated impacts associated with seaport handling, ocean transport and combustion.
Climate	Mined coal is primarily used for combustion. GHG emissions from mining, transport, and combustion are unavoidable if the Proposed Action is implemented.
Water Resources	Impacts to water resources resulting from coal extraction and subsidence are unavoidable, particularly impacts and may include changes to the Overburden 5 aquifer which would be fractured and drained by subsidence. Replacement of water sources would to support uses that existed prior to mining.
Soil	Soil in disturbance areas would exhibit more homogenous textures and may have more coarse fragments near the surface following mining. Some soil loss may occur as a result of erosion, prior to stabilization.
Vegetation	Vegetation would be eliminated beginning with the initial disturbance and continuing until reclamation is complete, which would extend to the end of the mining term for many facilities. Noxious weeds may be introduced as a result of mining activity, potentially affecting vegetation communities and requiring implementation of control measures in the long-term.
Wildlife	Wildlife would be temporarily affected by mine activities which would alter habitat conditions, particularly in the vicinity of surface disturbances.
Cultural Resources	Although searches would be conducted, undiscovered cultural resources could be impacted by subsidence and surface disturbing activities. If cultural resources potentially eligible for NRHP-listing could be affected by the No Action Alternative, SHPO would be consulted regarding those effects.
Visual Resources	Mining activity and associated disturbances and facilities would unavoidably alter the landscape during the mining term, affecting the aesthetic qualities. Some features would be visible from public access points, including US Highway 87, Old Divide Road, and Fattig Creek Road.
Noise	Noise would result from mining activities at similar levels to the existing condition. However, activities would extend farther eastward in the permit area. Noise levels would change in location over time. Ventilation fans could result in 54 dBA noise levels at the nearest residence during a portion of the future mining term.
Transportation Facilities	Fattig Creek Road would be periodically affected by construction and use of road crossings associated with WDA #2. The effects would occur during the mining term. Rail transportation effects during the mining term are primarily cumulative and any adverse effects would be managed under the authority of the STB (outside of OSMRE's jurisdiction).
Hazardous and Solid Waste	Economical coal mining and associated coal processing would yield coal waste to be permanently stored in existing WDA #1 and proposed WDA #2.

APPENDIX A – FIGURES



10 mi

km 10

★ County Seats (Administrative Center)

● Other Cities & Towns

Bull Mountains Mine No. 1

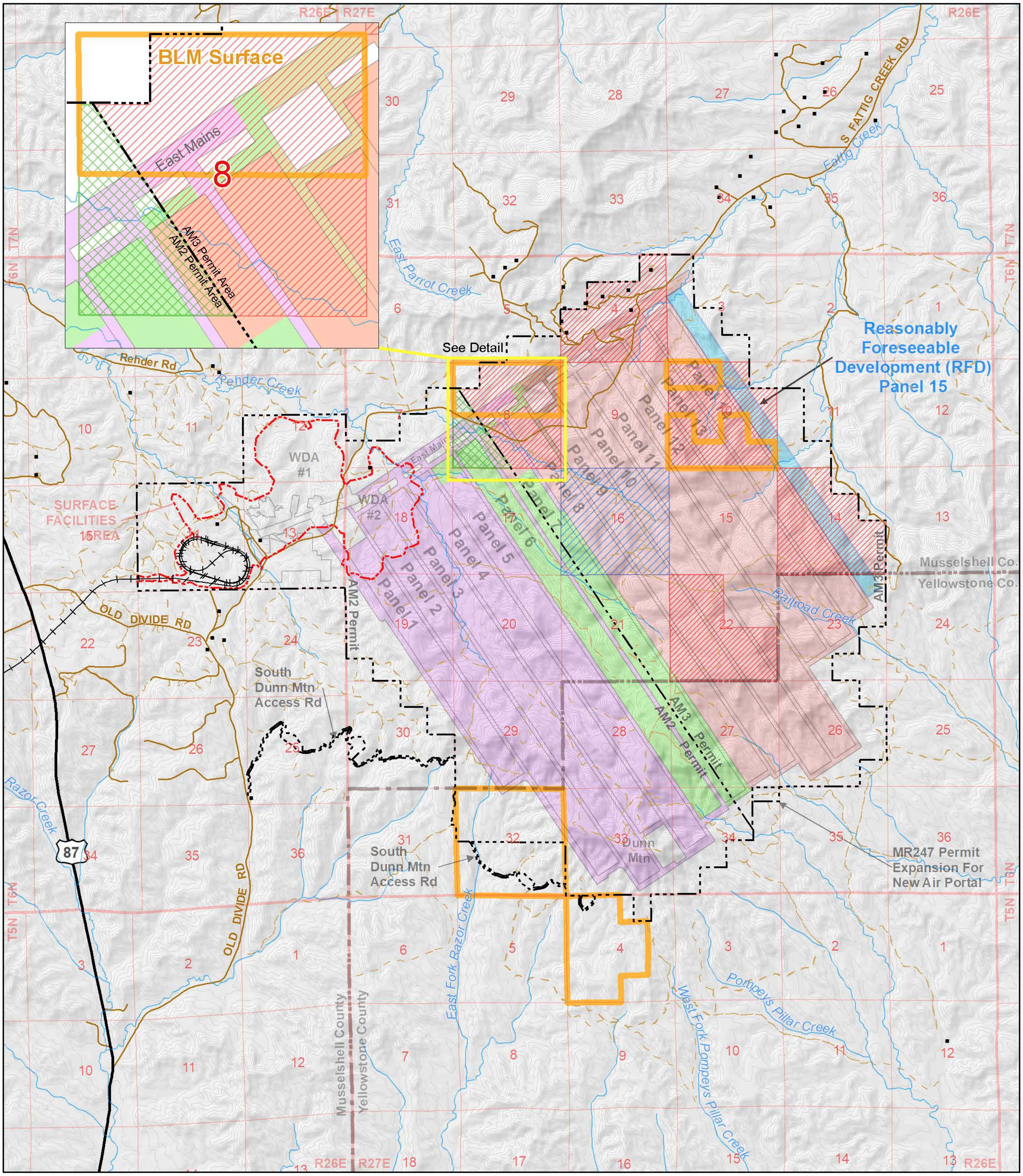
Amendment 2 (AM2) Mining Area

Amendment 3 (AM3) Mining Area

Bull Mountains Mine No. 1
Federal Mining Plan
Modification EA

Last Updated: 29 JAN 2018

Figure 1.0-1
Project Location



Dwellings
Highway
Public Roads
Ranch Trails
Permit Boundaries
BLM Surface
State Coal Lease
Federal Coal Lease Mining Plan Status
Existing Approval
Proposed Mod.
Underground Mine Plan
Mining Status*
Mined Out
No Action
No Action (additional)**
Proposed Action
Reasonably Forseeable

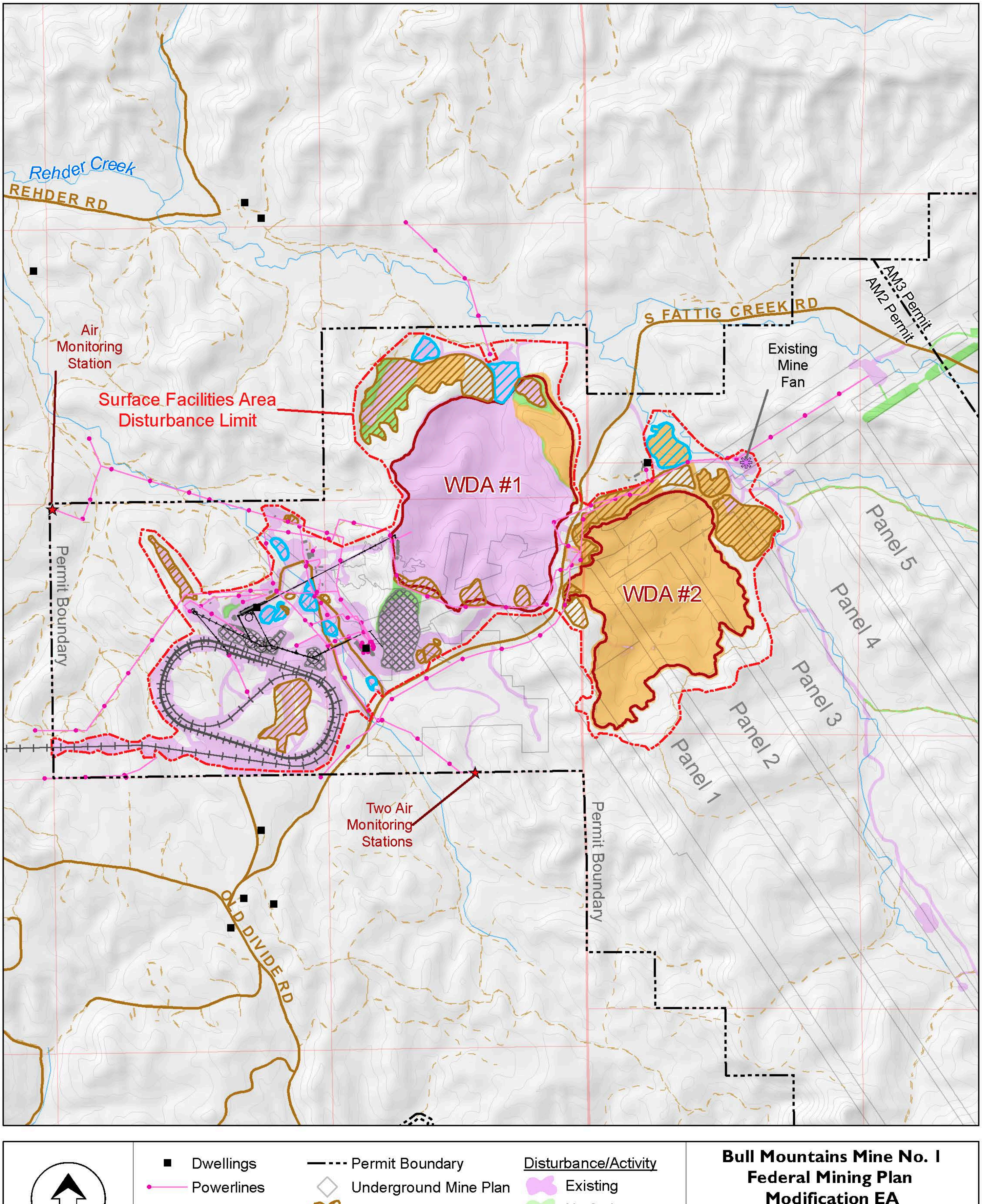
1 mi
1 km

* Status on January 1, 2017 ** Development work allowed per October 31, 2017 US District Court Order.

Bull Mountains Mine No. 1 Federal Mining Plan Modification EA

Last Updated: 14 FEB 2018

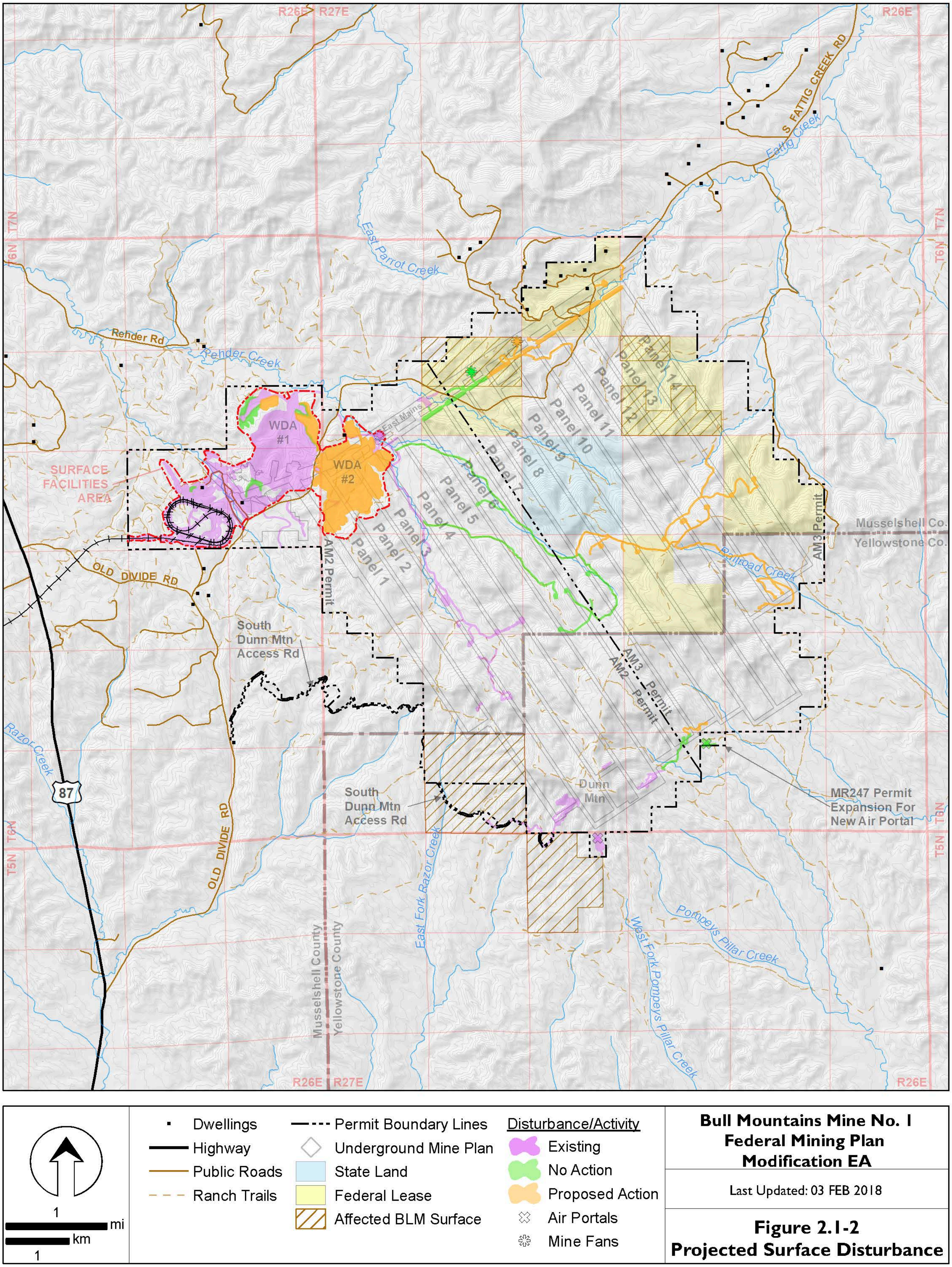
Figure 1.0-2 Mining Plan



Bull Mountains Mine No. 1 Federal Mining Plan Modification EA

Last Updated: 08 FEB 2018

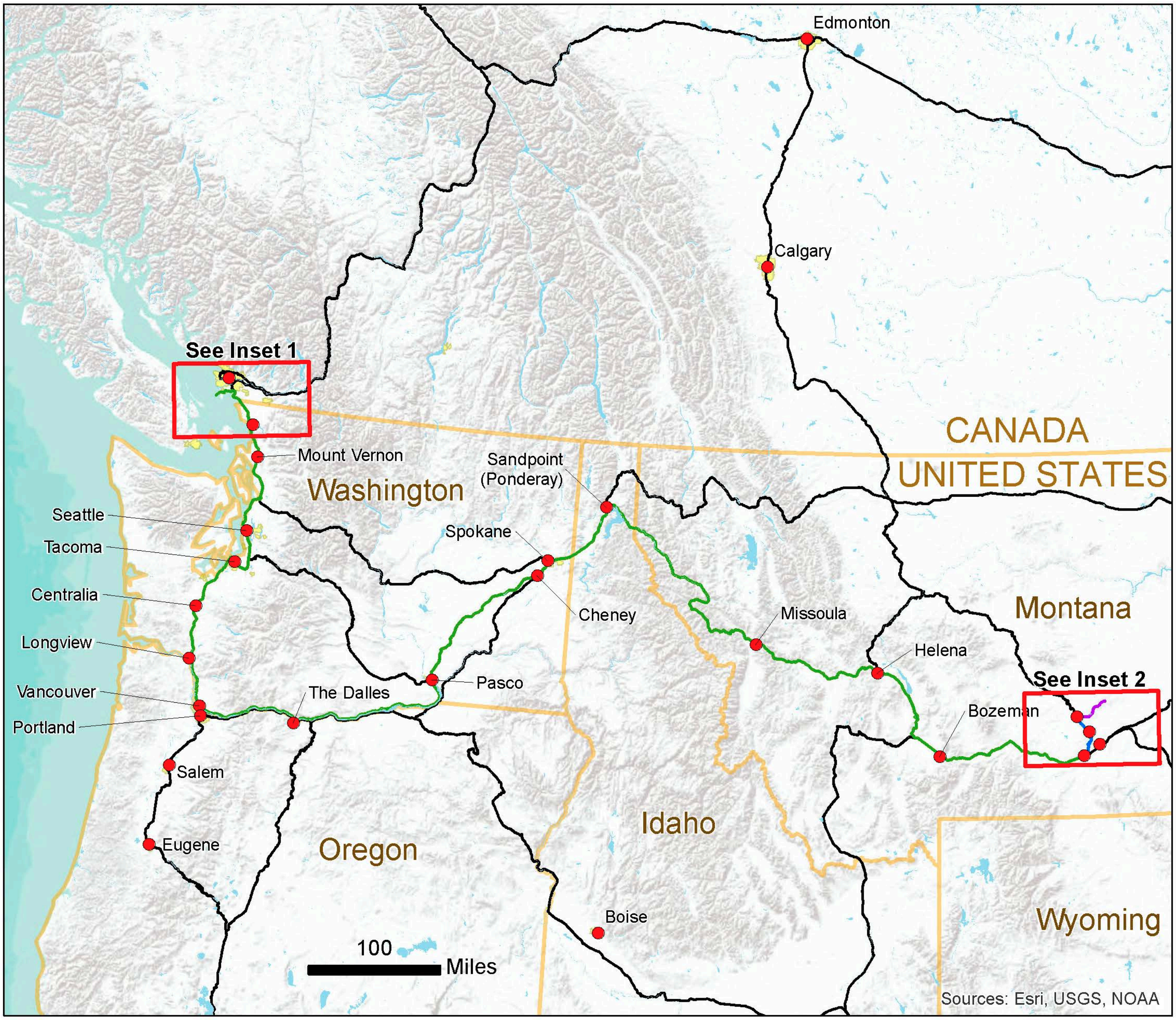
Figure 2.1-1 Surface Facilities Area

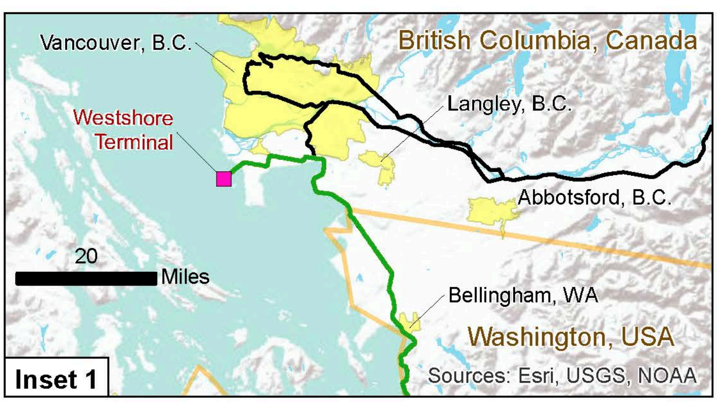


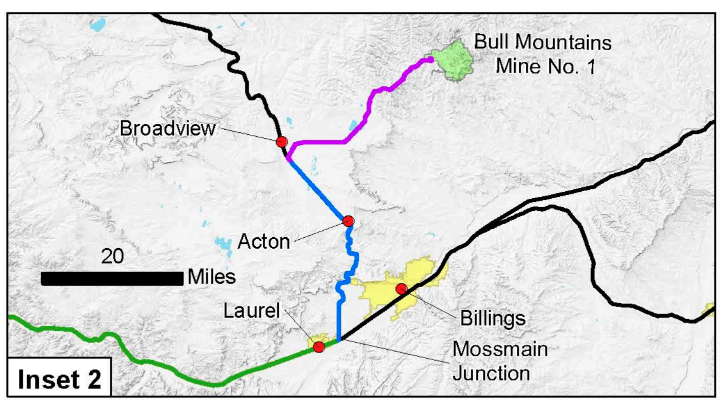
Bull Mountains Mine No. 1
Federal Mining Plan
Modification EA

Last Updated: 03 FEB 2018

Figure 2.1-2
Projected Surface Disturbance







Cities
Urban Areas
State Lines
Westshore Terminal

Other Major Railroads

Rail Transport Route

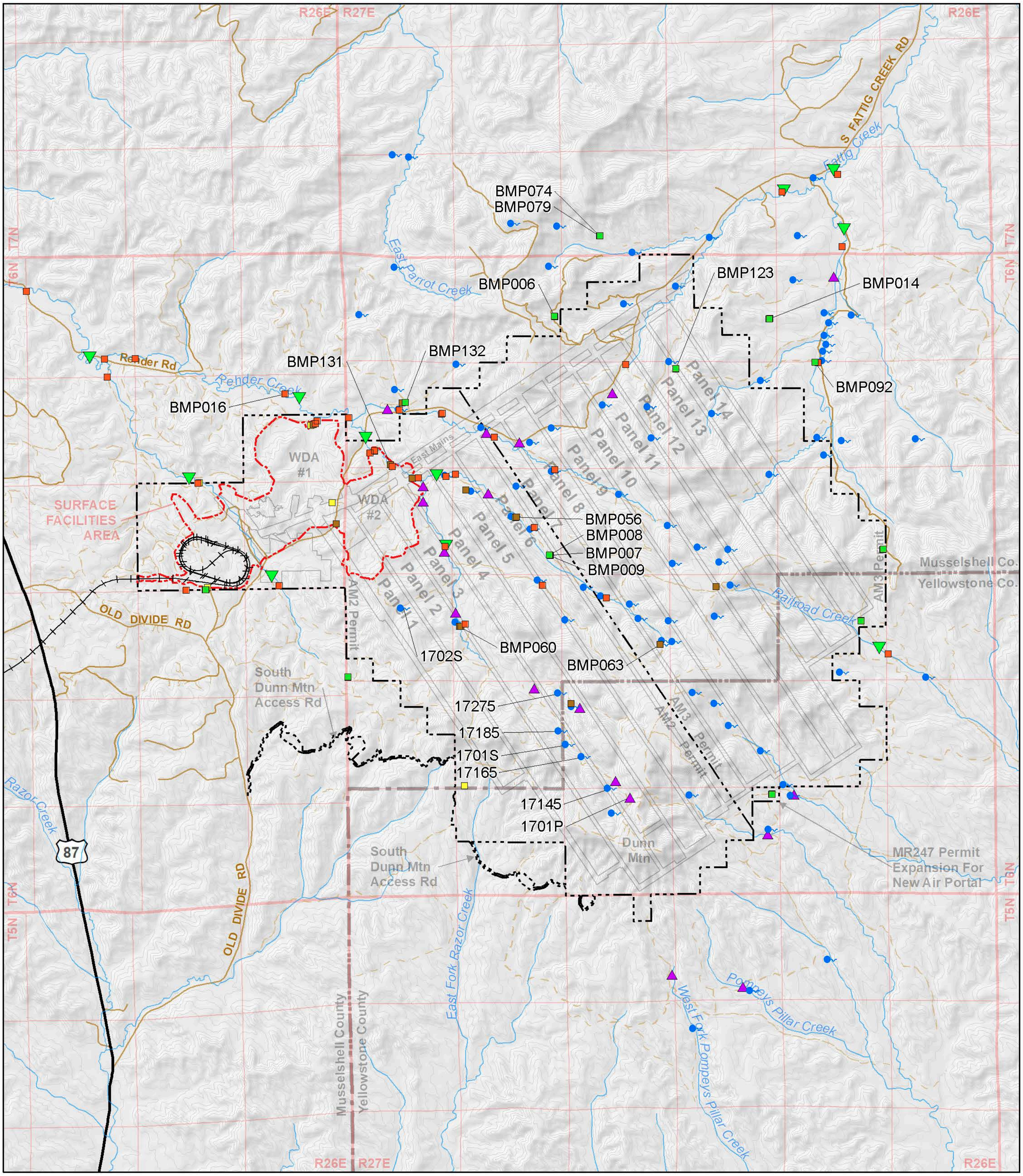
Rail Spur, Mine to Broadview
Short Line from Broadview to Laurel
Main Line*, Laurel to Westshore Terminal

* Main Coal Line as identified by BNSF (2013)

Bull Mountains Mine No. 1
Federal Mining Plan
Modification EA

Last Updated: 16 FEB 2018

Figure 2.1-3
Rail Transport Route



Underground Mine Plan
Permit Boundary Lines
Highway
Public Roads
Ranch Trails

1 mi
1 km

Active Hydrologic Monitoring Stations (SPE 2017a)

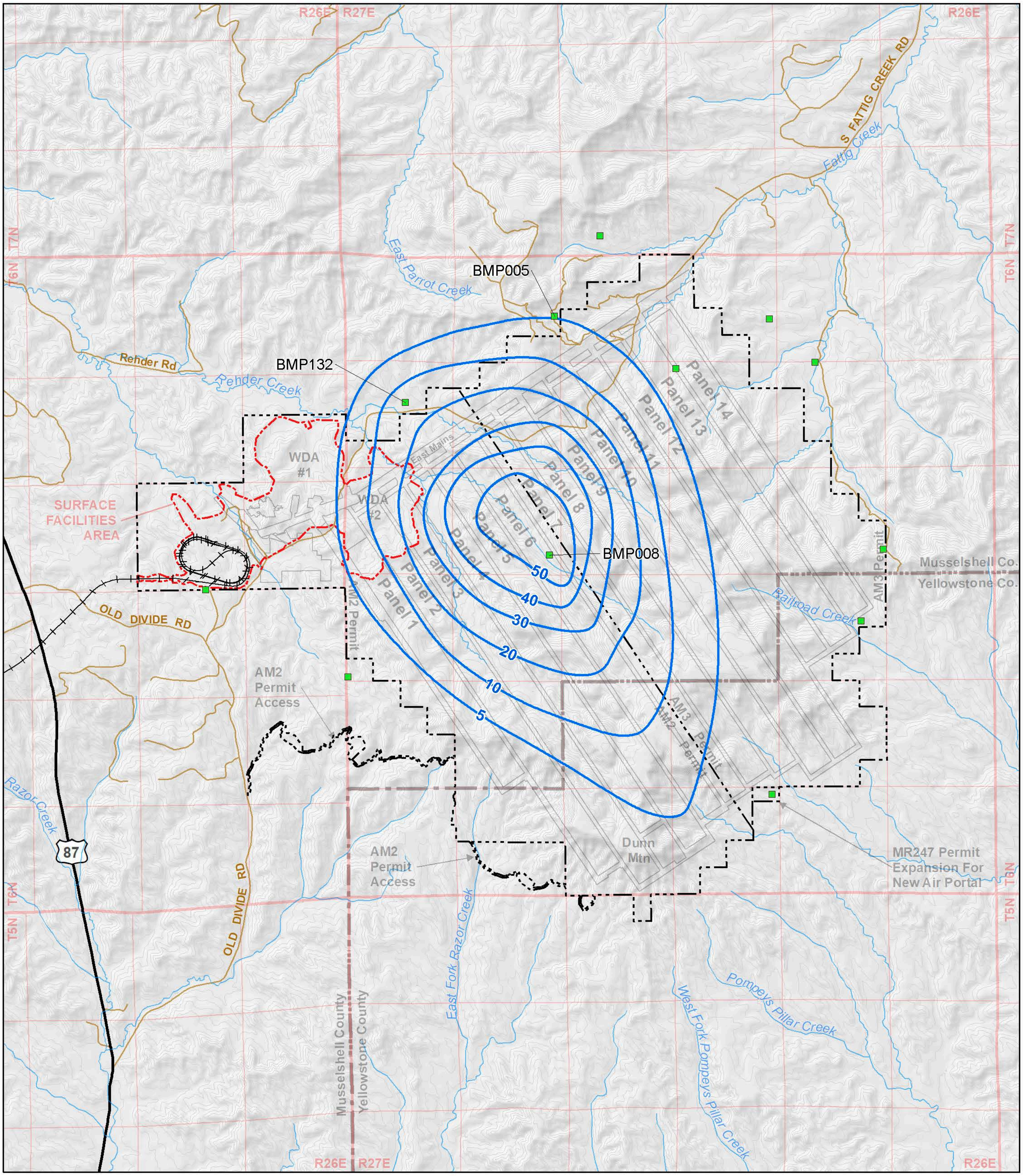
- Well (Alluvium)
- Well (Overburden)
- Well (Mammoth Coal)
- Well (Underburden)
- Spring
- Pond
- Stream

*Some stations may not be identified due to overlapping symbology. Refer to Mine permit Appendix 313-4 for all locations (SPE 2017a).

Bull Mountains Mine No. 1 Federal Mining Plan Modification EA

Last Updated: 08 MAR 2018

Figure 3.4-1 Hydrology Monitoring Stations



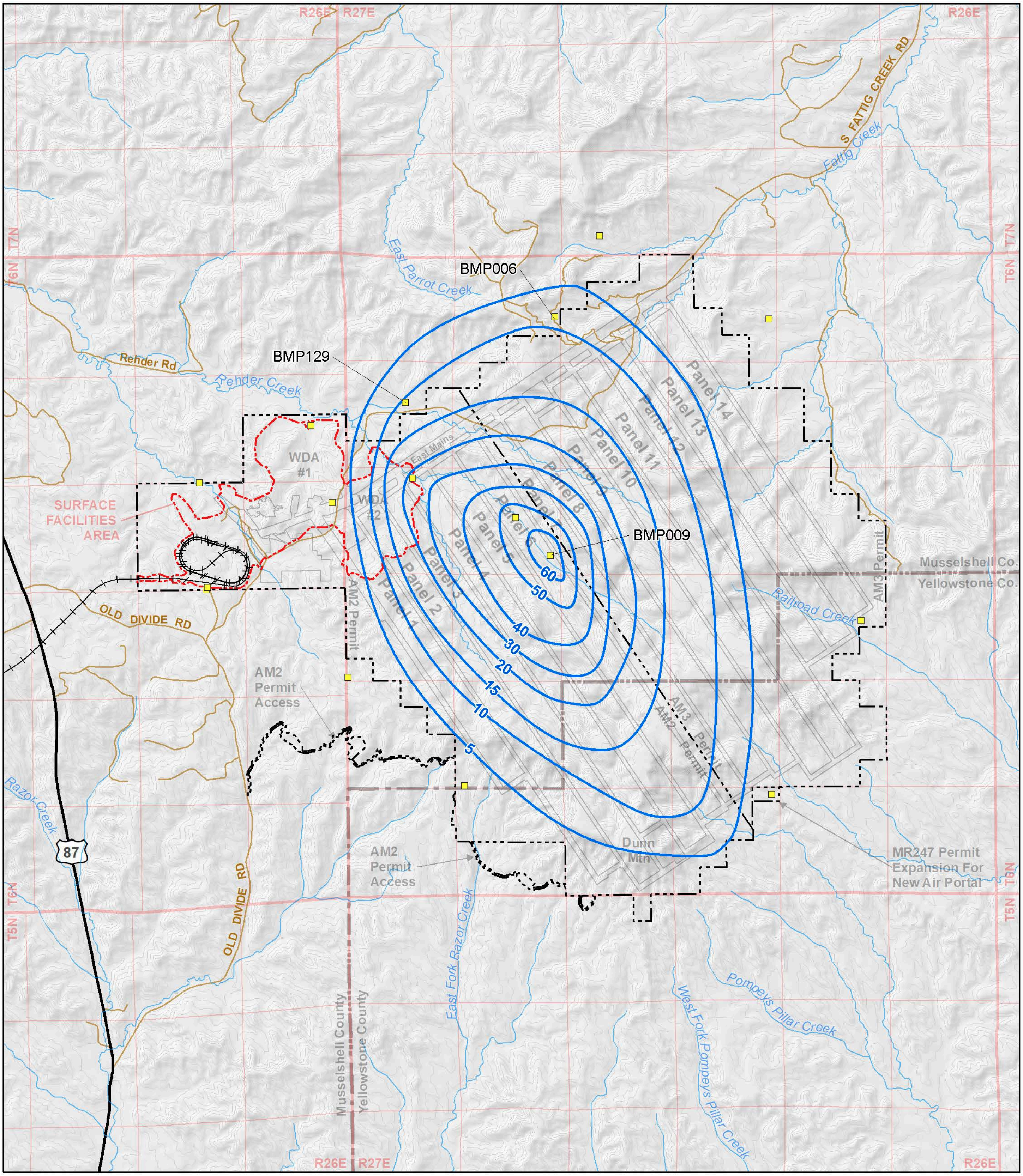
1 mi
1 km

Underground Mine Plan
Permit Boundary Lines
Highway
Public Roads
Ranch Trails
Mammoth Coal Well
Drawdown Contours* (feet of drawdown)
* SOURCE: Catena and WET 2018
Drawdown contours reflect data through September 2017

Bull Mountains Mine No. 1
Federal Mining Plan
Modification EA

Last Updated: 22 JAN 2018

Figure 3.4-2
Mammoth Coal Drawdown



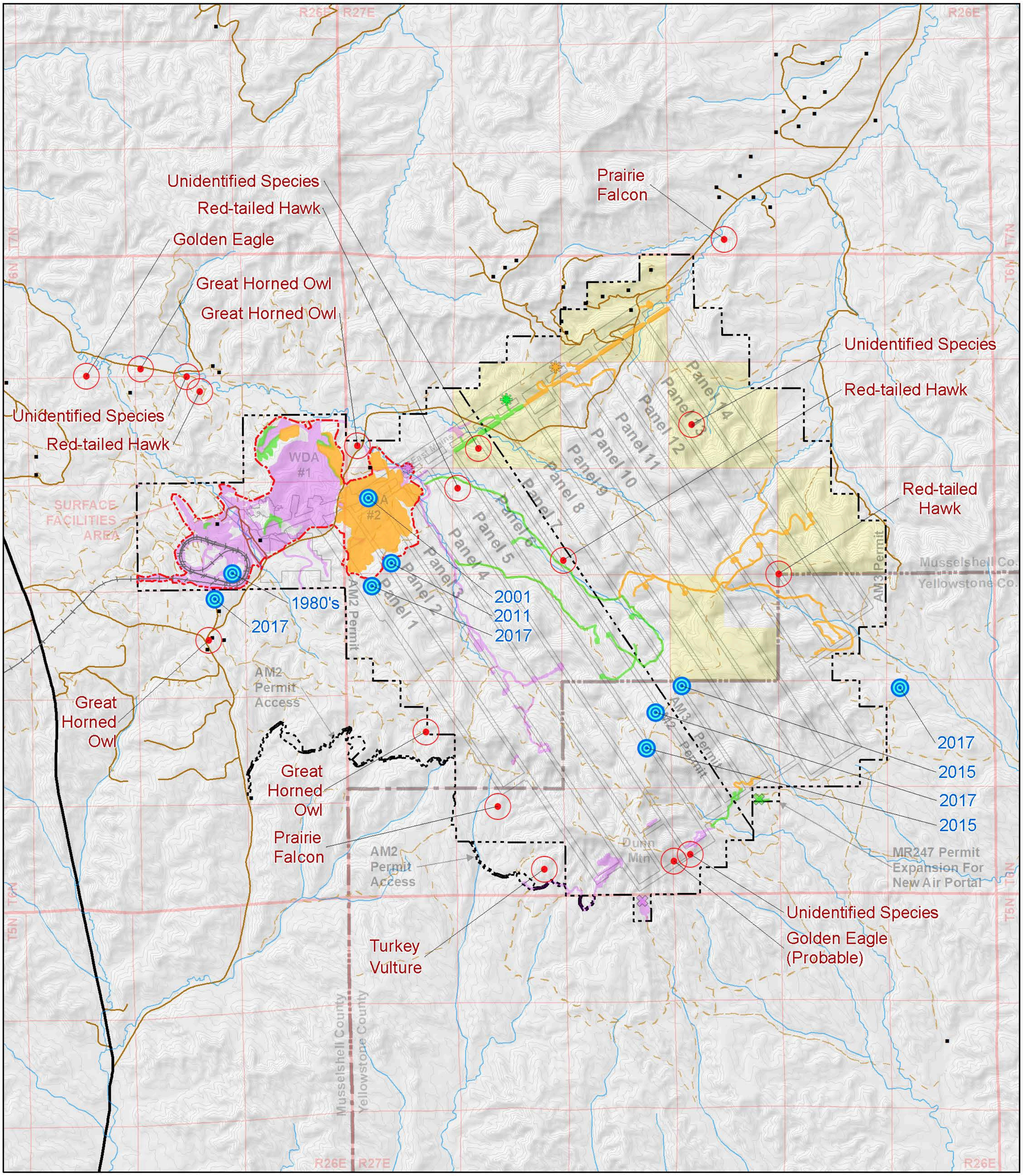
1 mi
1 km

Underground Mine Plan
Permit Boundary Lines
Highway
Public Roads
Ranch Trails
Underburden Well
Drawdown Contours* (feet of drawdown)
* SOURCE: Catena and WET 2018
Drawdown contours reflect data through September 2017

Bull Mountains Mine No. 1 Federal Mining Plan Modification EA

Last Updated: 22 JAN 2018

Figure 3.4-3
Underburden Drawdown



Raptor Nests & Species*

** Intact nests last monitored in 2017.*

Sharp-tailed Grouse Leks**

*** Label indicates year last active.*

Disturbance/Activity

- Existing
- No Action
- Proposed Action
- Air Portals
- Mine Fans

1 mi

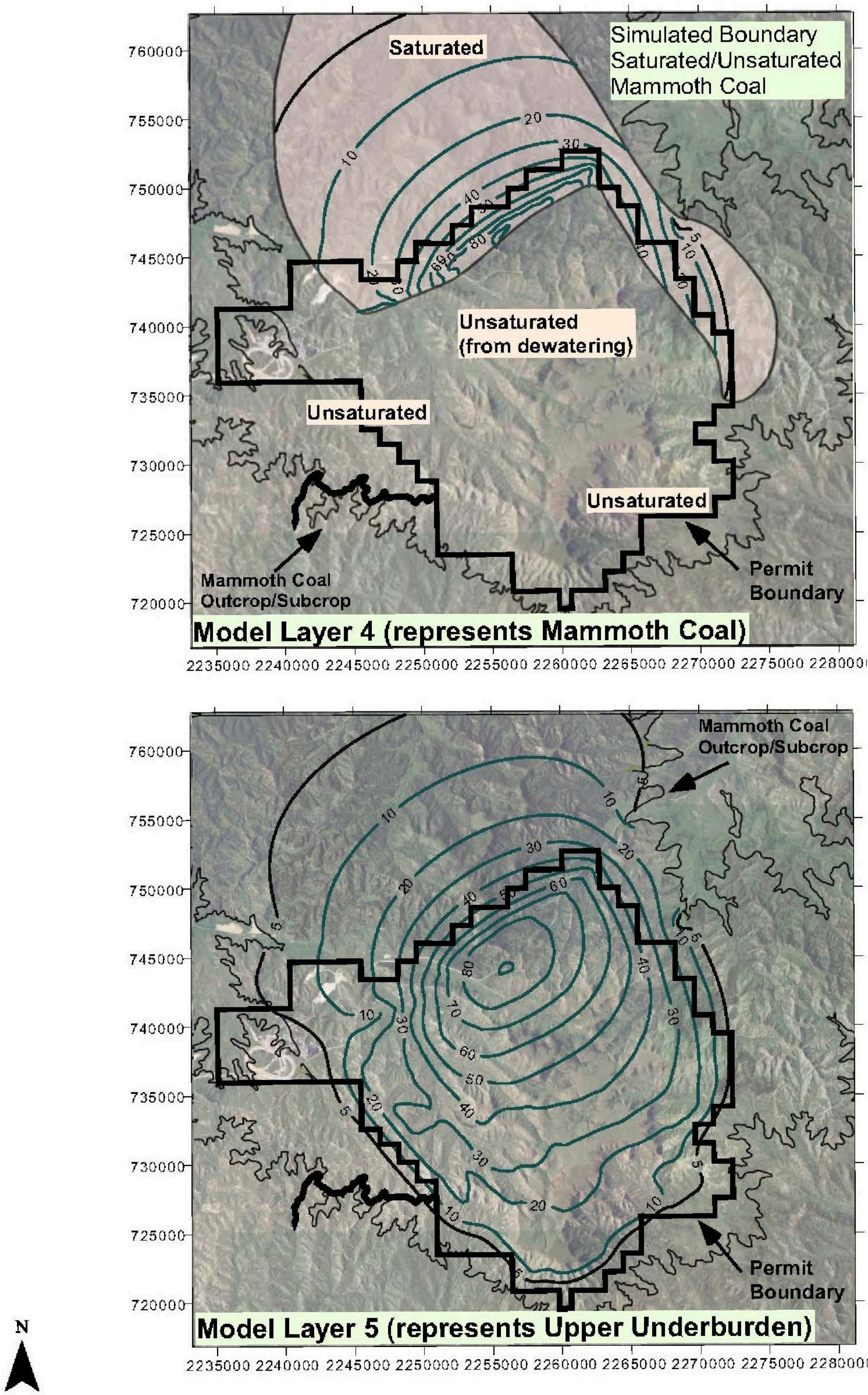
1 km

NOTE: See Figure 2.1-2 for additional details.

Bull Mountains Mine No. 1 Federal Mining Plan Modification EA

Last Updated: 29 JAN 2018

Figure 3.7-1
Raptor Nests & Grouse Leks



Units indicated are in Montana NAD 83, State-Plane, Feet

Drawdown Contour Line (10-foot intervals)

1 mi
km 2

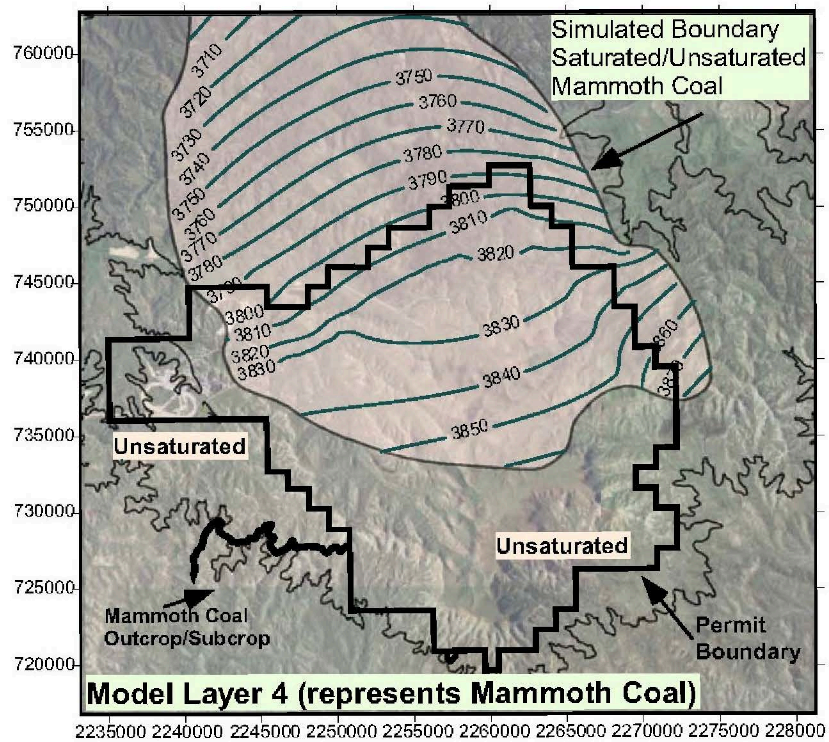
Source: SPE 2017a
see Appendix 314-6, Groundwater Model

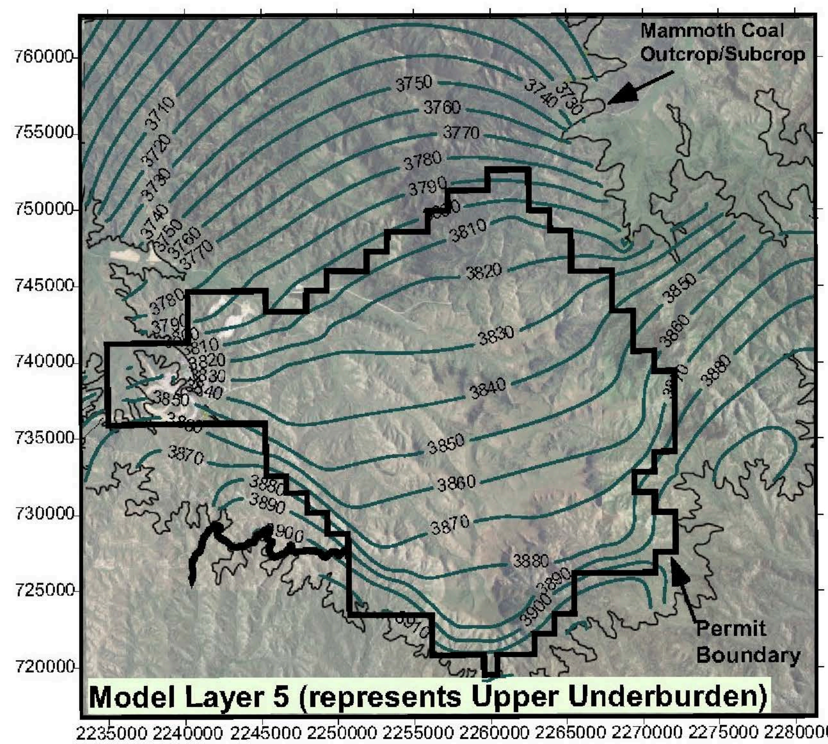
Bull Mountains Mine No. 1
Federal Mining Plan
Modification EA

Last Updated: 22 JAN 2018

Figure 4.4-1
Simulated Drawdown
at End of Mining

This scenario assumes gate roads cave following mining.





N

Units indicated are in Montana NAD 83, State-Plane, Feet

1 mi
km 2

Water Level Contour Line (10-foot intervals)

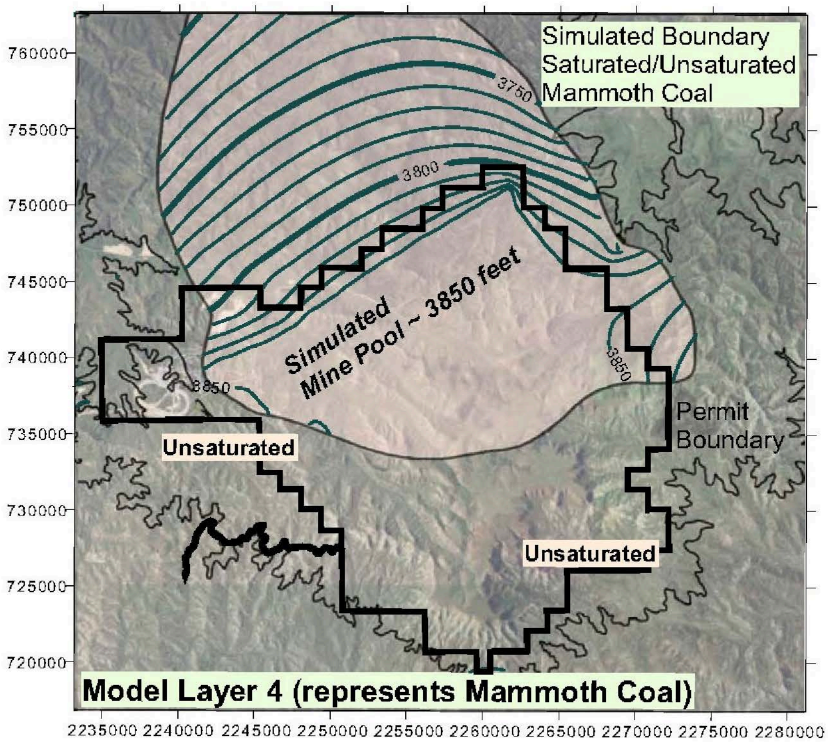
Source: SPE 2017a
see Appendix 314-6, Groundwater Model

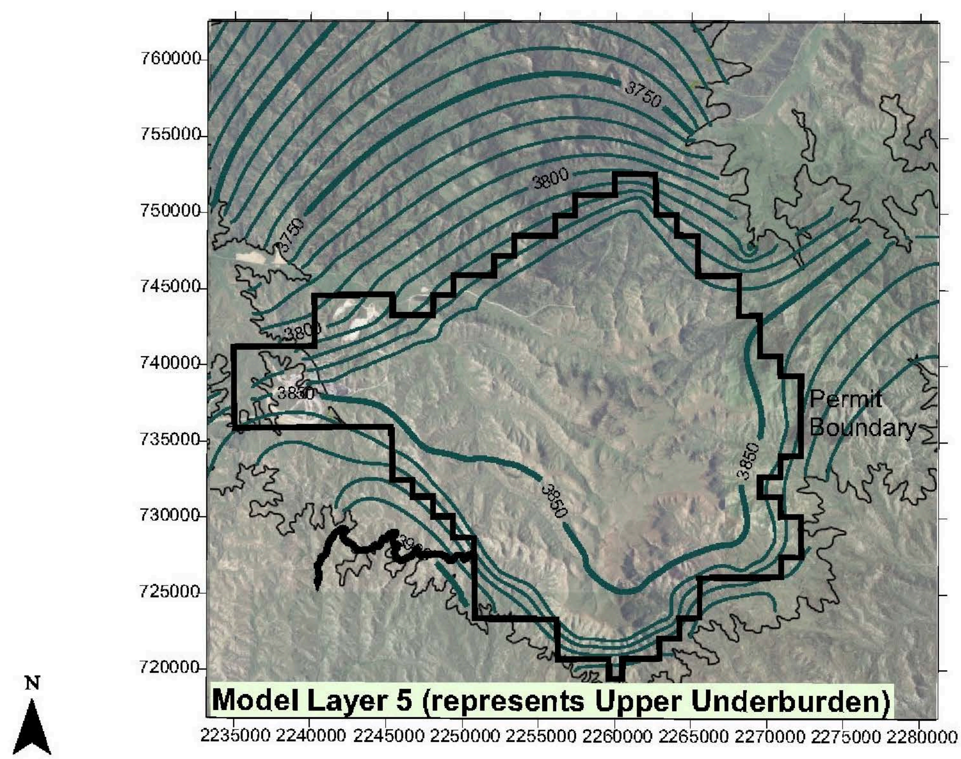
Bull Mountains Mine No. 1
Federal Mining Plan
Modification EA

Last Updated: 22 JAN 2018

Figure 4.4-2
Water Levels Scenario 1
50 years After Mining

This scenario assumes gate roads remain intact following mining.

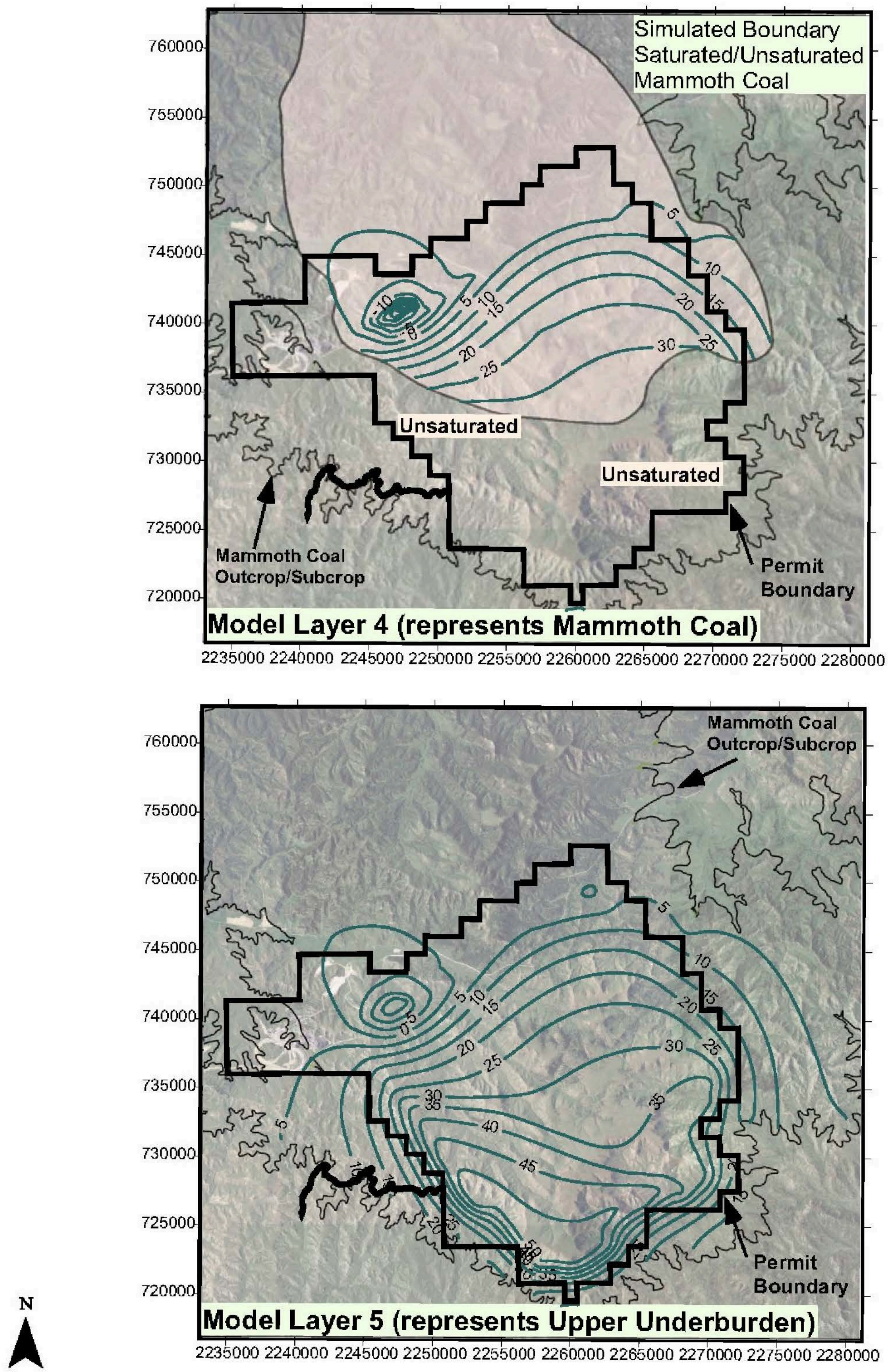




Units indicated are in Montana NAD 83, State-Plane, Feet

1 mi / km 2	Water Level Contour Line (10-foot intervals) Source: SPE 2017a see Appendix 314-6, Groundwater Model	**Bull Mountains Mine No. 1 Federal Mining Plan Modification EA** Last Updated: 22 JAN 2018 **Figure 4.4-3 Water Levels Scenario 2 50 years After Mining**

This scenario assumes gate roads cave following mining.



Units indicated are in Montana NAD 83, State-Plane, Feet. Drawdown in Feet.

1 mi
2 km

Drawdown Contour Line (10-foot intervals)

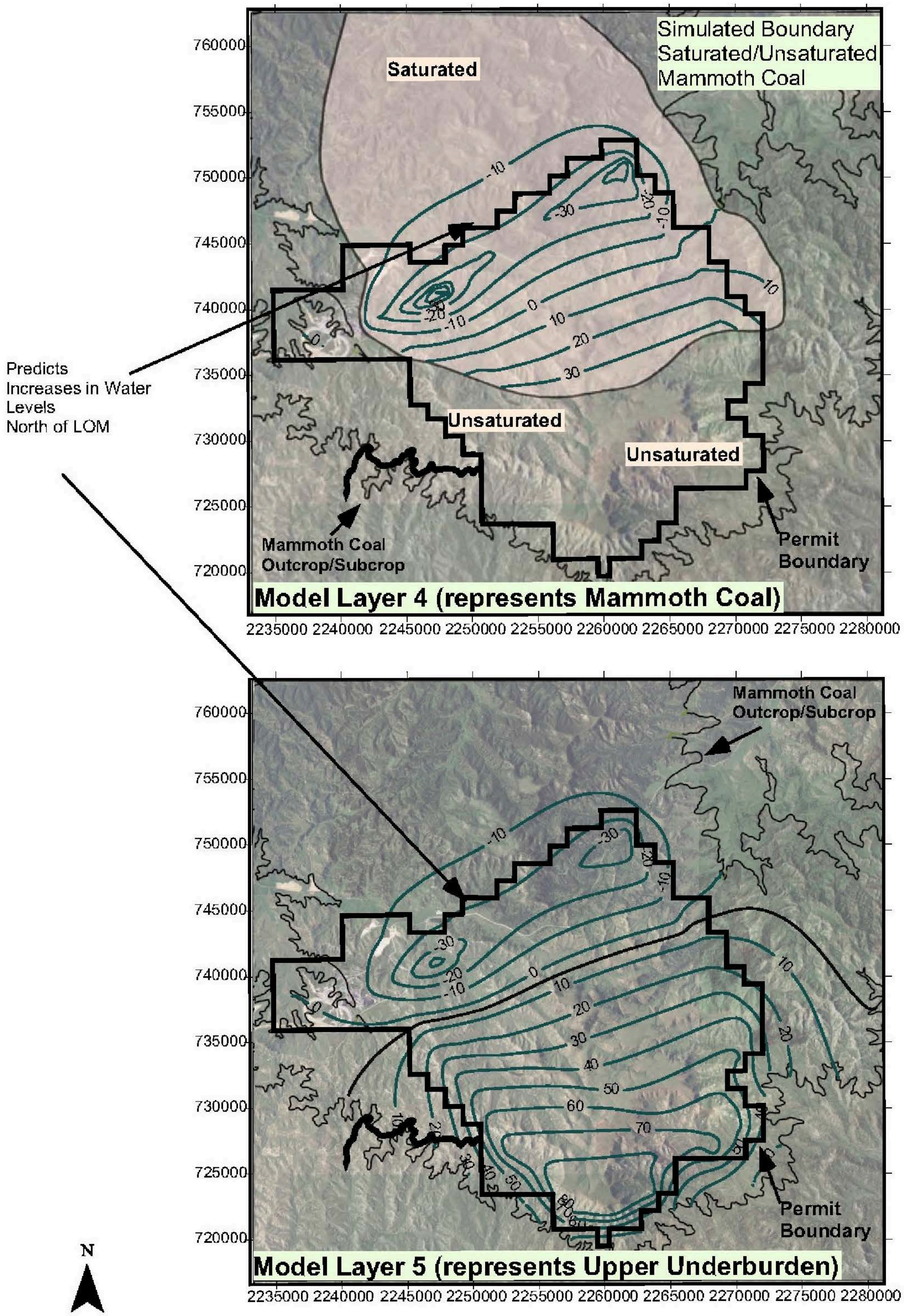
Source: SPE 2017a
see Appendix 314-6, Groundwater Model

Bull Mountains Mine No. 1
Federal Mining Plan
Modification EA

Last Updated: 22 JAN 2018

Figure 4.4-4
Drawdown Scenario 1
50 years After Mining

This scenario assumes gate roads remain intact following mining.



Units indicated are in Montana NAD 83, State-Plane, Feet. Drawdown in Feet.

Drawdown Contour Line (10-foot intervals)

1 mi
2 km

Source: SPE 2017a
see Appendix 314-6, Groundwater Model

Bull Mountains Mine No. 1
Federal Mining Plan
Modification EA

Last Updated: 22 JAN 2018

Figure 4.4-5
Drawdown Scenario 2
50 years After Mining

APPENDIX B – AIR QUALITY

1.0 Existing Conditions

Unless otherwise noted, baseline air quality described in this Appendix reflects 2016 conditions, including direct effects from mining and indirect effects of rail transport, seaport handling, ocean transport, and combustion (referred to as "segments") of 5.96 Mt of saleable coal shipped in 2016 (see **Table 2.1-1** of the EA). Air quality considerations, baseline conditions, and applicable regulations and jurisdictions differ for each "segment" from mining to combustion, as discussed in this section.

1.1 Mining

Regulatory Setting

Under the CAA, EPA has established concentration levels for a set of seven common air pollutants judged "necessary, with an adequate margin of safety, to protect the public health" and "necessary to protect the public welfare from any known or anticipated adverse effects" [40 CFR § 50.2(b)]. These pollutants, referred to as "criteria pollutants," are: carbon monoxide (CO), NO_2, SO_2, ozone, lead, and particulate matter with aerodynamic diameters less than or equal to 10 microns (PM_{10}) and less than or equal to 2.5 microns ($PM_{2.5}$). Ozone is not directly emitted in substantial quantities but is formed in the atmosphere primarily from reactions between nitrogen oxides (NO_x) and volatile organic compounds (VOCs). Consequently, NO_x and VOC emissions are often regulated as ozone precursors. Federal concentration thresholds for criteria pollutants are known as NAAQS, last revised in 2015 (see **Table B-1**). No new NAAQS are currently proposed. States are generally responsible for ensuring these standards are met within their boundaries and may establish additional or more stringent standards (Montana's standards are referred to as MAAQS) (see **Table B-1**). Tribal governments, with EPA approval, may also administer air quality standards within their boundaries, or they may default to EPA administration.

For each NAAQS, responsible administrative agencies are required to designate areas within their jurisdictions as either in attainment, in violation ("nonattainment"), or "unclassifiable" in areas where insufficient data exist to make a definitive designation. EPA often combines the latter two classifications into an "unclassifiable/attainment" designation. In general practice, air quality is monitored in areas with potential standards violations due to the character and extent of area pollutant emissions sources. A nonattainment designation triggers extensive regulation designed to bring the area back into attainment. Official designations are listed at 40 CFR Part 81, Subpart C.

Musselshell and Yellowstone Counties, within which the Mine is located, are designated "unclassifiable/attainment" for all criteria pollutants. Nonattainment areas nearest the Mine are for PM_{10} at Lame Deer, Montana in the Northern Cheyenne Indian Reservation (95 miles southeast) and for SO_2 at Laurel, Montana (45 miles south).

Table B-1. National and Montana Ambient Air Quality Standards.1

Pollutant & Averaging Period	NAAQS	MAAQS
Nitrogen Dioxide (NO_2)		
Hourly	100 ppb (2)	0.30 ppm (3)
Annual	53 ppb (4)	0.05 ppm (5)
Ozone		
Hourly	---	0.10 ppm (5)
8-Hour	0.070 ppm (6)	---
PM-10		
24-Hour	150 μg/m³ (7)	150 μg/m³ (8)
Annual	---	50 μg/m³ (4)
PM-2.5		
24-Hour	65 μg/m³ (9)	---
Annual	15 μg/m³ (10)	---
Sulfur Dioxide (SO_2)		
Hourly	75 ppb (11)	0.50 ppm (12)
3-Hour	0.50 ppm (8)	---
24-Hour	---	0.10 ppm (8)
Annual	---	0.02 ppm (4)
Carbon Monoxide (CO)		
Hourly	35 ppm (8)	23 ppm (8)
8-Hour	9 ppm (8)	9 ppm (8)
Lead		
90-Day	0.15 μg/m³ (13)	1.5 μg/m³ (5)

Notes:
μg/m3 - micrograms per cubic meter; ppb = parts per billion
Montana has additional standards for other pollutants that are not of concern for this assessment.
(1) See ARM 17.8 Subchapter 2 for MAAQS and 40 CFR Part 50 for NAAQS.
(2) 98th percentile of 1-hour daily maximum concentrations, averaged over 3 years.
(3) Federal violation when exceeded more than once per calendar year.
(4) Annual mean.
(5) Not to be exceeded for the averaging time period as described in the regulation.
(6) Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years.
(7) Not to be exceeded more than once per year on average over 3 years.
(8) No more than one exceedance allowed per calendar year.
(9) 98th percentile, averaged over 3 years.
(10) Annual mean, averaged over 3 years.
(11) 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years.
(12) Not to be exceeded more than 18 times in any 12 consecutive months.
(13) Rolling 3-month average. Not to be exceeded.

MDEQ maintains a network of monitoring stations to measure ambient concentrations of specific air pollutants throughout the state. This monitoring network is reviewed annually and adjusted to ensure resources are directed toward areas of interest, including areas of possible high pollutant concentrations. Active ambient monitoring stations closest to the Mine are located in Lewistown (73 miles northwest) and Billings (34 miles south). These monitoring stations are too distant for pollutant emissions from Mine-related activities to appreciably contribute to measured pollutant concentrations; therefore, reported concentrations at these stations are not considered to be associated with the Mine's affected environment.

The CAA also establishes areas, known as Class I areas and consisting primarily of national parks and wilderness areas, with special air quality protections. In addition to these "mandatory" areas, several tribal governments have applied for and have been granted Class I area status. The two closest Class I areas are both located approximately 85 to 90 miles from the Mine: the UL Bend Wilderness Area to the north and the Absaroka-Beartooth Wilderness Area to the southwest. Due to its low levels of qualifying air pollutant emissions, the Mine is not subject to Prevention of Significant Deterioration New Source Review (PSD-NSR) rules (see below) that would require it to evaluate potential impacts to Class I areas for permitting purposes.

Visibility degradation at Class I areas due to "regional haze" is a recognized concern. Regional haze is made up of microscopic particles that can travel long distances and that are mostly formed by chemical reactions in the atmosphere of gaseous air pollutants such as nitrogen and sulfur oxides. To prevent future and remedy existing visibility impairment in mandatory Class I areas, EPA promulgated the Regional Haze Rule in 1999 (40 CFR §§ 51.308 through 51.309). A component of that rule requires installation of pollutant emissions control technologies and applies to existing industrial sources that meet several criteria including industry type and pollutant emissions potential. The Mine does not meet any of these applicability criteria.

The CAA contains many provisions and programs to limit air pollutant emissions from stationary sources, including the Title V Operating Permit Program, the PSD-NSR construction permit program, and the National Emissions Standards for Hazardous Air Pollutants (NESHAP) program. The Title V Operating Permit Program and PSD-NSR program apply only to "major" stationary sources, where "major" is specifically defined based on, among other factors, a source's potential to emit regulated pollutants above defined threshold values (100 tons/year for Title V and 250 tons/year for PSD-NSR). The NESHAP program also generally applies only to "major" facilities, although some NESHAP standards apply to "area" (non-major) sources. A major source in accordance with the NESHAP rules has the potential to emit 10 or more tons/year of any single HAP or 25 tons/year of all HAPs combined. The Mine's highest potential emission rate of any Title V or PSD-NSR pollutant from qualifying sources is 20 tons/year, and its total potential emission rate of HAPs from qualifying sources is 0.3 tons/year (SPE 2014a). The Mine is therefore classified as a "minor" and "area" emissions source. No other stationary emission sources located near the Mine are considered major stationary sources.

Mine-Related Emissions

Based on information included in SPE's Application for Modification to Air Quality Permit #3179 (SPE 2014a), the Mine's annual PM_{10} emission rate is estimated to be approximately four times greater than the rate for any other criteria pollutant. Approximately 98 percent of mine-related PM_{10} emissions results from fugitive sources, such as haul truck traffic and wind erosion of exposed surfaces, which tend to concentrate air quality impacts locally. Until recently, SPE was required to operate three monitoring stations at two sites (two stations co-located) proximal to the Mine (**Appendix A, Figure 2.1-1**) to measure concentrations of PM_{10}. This network was intended to track localized impacts from the Mine and assure no ambient air quality standards were violated.

In February 2017, MDEQ allowed SPE to discontinue this monitoring effort based on the fact that in the preceding seven years none of the monitor stations measured a PM_{10} MAAQS or NAAQS exceedance attributed to Mine operations (MDEQ 2017a). Specifically, the maximum NAAQS-comparable PM_{10} concentration measured by any of the three SPE monitoring stations totaled 24 micrograms per cubic meter (μg/m^3) (24-hour average), occurring in 2016. By comparison, the applicable NAAQS for PM_{10} is 150 μg/m^3. While $PM_{2.5}$ concentrations were not directly measured, $PM_{2.5}$ is a minor fraction of PM_{10} for sources with predominately fugitive dust emissions. Further, the $PM_{2.5}$ 24-hour NAAQS of 35 μg/m^3 is substantially higher than the maximum measured PM_{10} 24-hour concentration occurring at any of SPE's three monitoring stations. **Table B-2** presents the maximum average PM_{10} concentration measured near the Mine for the last five years monitoring was conducted.

Table B-2. Summary for PM_{10} Ambient Monitoring Near the Mine.

Year	Measured Value[1] (μ/m^3)
2016	21.7
2015	40.3
2014	22.0
2013	42.0
2012	43.2

Source: SPE 2016, MDEQ n.d.
(1) Values (measured in micrograms per cubic meter) are the average of highest 24-hour values measured at monitors operated near the Mine. They are presented in a form comparable to the PM10 NAAQS.

The next-closest ambient air quality monitoring stations are in the Billings area (approximately 35 miles south), Laurel (approximately 46 miles south) and Lewistown (approximately 73 miles northwest). Data from these monitoring stations (**Table B-3**) do not reflect ambient air quality in the vicinity of the Mine due to distances from the Mine and differences between air pollutant emitting sources in the areas.

Mine activities that could adversely affect air quality are constrained by several conditions in MAQP #3179-12 (MDEQ 2016b). Operating restrictions include:

- Limit raw coal production to no more than 15.0 Mt during any 12-month rolling average;
- Use fabric filter baghouses to control particulate emissions from surface crushing operations;
- Limit the size of surface coal and other stockpiles to prescribed areas;
- Limit crushing capacity to a prescribed throughput rate; and,
- Develop and follow a fugitive dust control plan that includes prescribed mitigation measures.

The Mine is also subject to several opacity limits which effectively limit fugitive dust emissions and is subject to the Federal Coal Preparation and Processing Plants New Source Performance Standards (40 CFR Part 60, Subpart Y). Annual reporting requirements and unscheduled periodic inspections help ensure compliance with all applicable conditions.

SPE (2014a) estimated the Mine's potential maximum annual emissions of criteria pollutants of concern **Appendix C** summarizes the results of those estimates the portion attributed to each 1.0 Mt of saleable coal produced for reference in this analysis. **Table B-4** presents estimated annual emissions (tons per year) from Mine operations in 2016, which produced 5.96 Mt of saleable coal.

Table B-3. Summary of Ambient Monitoring in Region.

Monitor Location/Name	Pollutant Monitored	Most Recent Data	Measured Value (1) (2)	MAAQS/ NAAQS	Units (3)	NAAQS/MAAQS Averaging Period	Design Value Method
Billings / St Lukes	$PM_{2.5}$	2016	15	35	μg/m³	24-Hour NAAQS	98th Percentile
			6.1*	12	μg/m³	Annual NAAQS	Weighted Annual Mean
Billings / Coburn Road	SO_2	2016	18	75	ppb	1-Hour NAAQS	99th Percentile
			n/a	0.5	ppm	3-Hour NAAQS	Not exceeded more than 1/year
			0.005	0.10	ppm	24-Hour MAAQS	Second Max 24 hr
			0.00096	0.02	ppm	Annual MAAQS	Annual Mean
Lewistown	NO_2	2016	9.0	100	ppb	1-Hour NAAQS	98th Percentile
			0.49	53	ppb	Annual NAAQS	Annual Mean
Lewistown	Ozone	2016	0.061	0.10	ppm	1-Hour MAAQS	2nd Max 1 hr
			0.055	0.070	ppm	8-Hour NAAQS	4th Max 8 hr
Lewistown	PM_{10}	2016	33	150	μg/m³	24-Hour NAAQS/MAAQS	Not to be Exceeded in a Year
			33	50	μg/m³	Annual MAAQS	Second Max 24 hr
Lewistown	$PM_{2.5}$	2016	10	35	μg/m³	24-Hour NAAQS	98th Percentile
			3.6	12	μg/m³	Annual NAAQS	Weighted Annual Mean
Laurel / BLAQTC-Laurel	SO_2	2015	38	75	ppb	1-Hour NAAQS	99th Percentile
			n/a	0.5	ppm	3-Hour NAAQS	Not exceeded more than 1/year
			0.0089	0.10	ppm	24-Hour MAAQS	Second Max 24 hr
			0.00154*	0.02	ppm	Annual MAAQS	Annual Mean
Billings / St Lukes	CO	2011	2.5	35	ppm	1-Hour NAAQS	2nd Max 1 hr
			1.3	9	ppm	8-Hour NAAQS/MAAQS	2nd Max 8 hr
			2.5	23	ppm	1-Hour MAAQS	2nd Max 1 hr

Source: EPA 2018b
(1) * indicates the mean does not satisfy minimum data completeness criteria
(2) n/a - data not available
(3) μg/m3= micrograms per cubic meter, ppm = parts per million, ppb = parts per billion

Table B-4. Estimated Total Criteria Air Pollutant Emissions from Producing 5.96 Mt of Saleable Coal in 2016.

	PM_{10}	$PM_{2.5}$	NO_x[1]	SO_2	CO	VOC[2]
Estimated 2016 Emissions (tons)	236	32	47	16	63	15

(1) Oxides of nitrogen, commonly quantified as a surrogate for NO_2, a criteria pollutant.
(2) Volatile Organic Compounds. As a major component in atmospheric reactions that form ozone, it is generally regulated as an ozone surrogate. The application calculations quantify "total hydrocarbon" emissions, of which VOCs are a subset.

1.2 Rail Transport

Sections 2.1.7 and **3.1** of the EA describe the rail transport route considered in this analysis. From the Mine, coal is hauled approximately 1,390 miles (one way) through Montana, Idaho, and Washington to Westshore Terminal at the Port of Vancouver, British Columbia, Canada. The route does not pass through any Class I areas and, with one exception, all areas in the US through which the route would pass are designated as either in attainment or unclassifiable with respect to all NAAQS.

The city and partial county of Missoula, Montana were designated in 1990 as being in nonattainment with the PM_{10} NAAQS based on violations in the 1980s. The Missoula City-County Health Department evaluated sources of particulate matter and designed a control program which brought the area back into compliance with the NAAQS. As a result, no PM_{10} standard violation has been observed in the area since 1989 (Missoula County n.d.). MDEQ has petitioned the EPA for a redesignation to attainment and the request is currently being evaluated (Schmidt 2018).

Locomotive Emissions

Under the CAA, EPA has sole authority to adopt and enforce locomotive emission standards (CARB 2006). States and localities are prohibited from creating statutes or rules that apply to mobile source emissions. Some municipalities, however, have coordinated with railroad operators to develop and implement plans to limit locomotive emissions at railyards. For example, in 2011 Missoula County developed a Montana Rail Link Idling Emissions Reduction Project. Funded by an EPA grant, the project installed small, fuel-efficient engines on 34 aged diesel locomotives to keep the main engines warm in cold weather. This reduced locomotive idling in the Missoula switchyard which, in turn, reduced railroad traffic-related emissions in the Missoula-area (Missoula 2011).

Under current regulations (40 CFR Part 1033) EPA has established tiered emissions standards that apply to locomotive engines based on the year of manufacture or remanufacture. The standards, which limit emissions of NO_x, particulate matter, hydrocarbons, and carbon dioxide (CO_2), establish four tiers of increasingly stringent limits for newer engines. The most stringent limits apply to engines manufactured in 2015 or later. Overall air pollutant emissions from locomotive fleets would decrease over time as old engines are retired and replaced with newer models.

Baseline criteria air pollutant emission rates for each 1.0 Mt of coal transported by rail between the Mine and Westshore Terminal were estimated using methods described in **Appendix C**. Those estimated emissions were used to estimate the total emissions from transporting 5.96 Mt of saleable coal in 2016 (see **Table B-5**). Emission rates for each pollutant are estimated in tons per year (2016) as well as average pounds per mile (lbs/mile) over the 2,780 miles trains travel round-trip, with the latter reflecting the transitory and distributed nature of locomotive emissions.

Table B-5: Estimated Total Criteria Air Pollutant Emissions from Transporting 5.96 Mt of Coal by Rail (Round-Trip) in 2016.

	PM10	PM2.5	NOx	SO2	CO	VOC
Total Round-trip Emissions (tons)	45	42	1,622	2	386	78
Emissions Per Mile (lbs/mile)	33	30	1,167	1	278	56

PM_{10} and $PM_{2.5}$ emissions from diesel fuel combustion may also be referred to as diesel particulate matter (DPM), which is composed of elemental carbon particles with adsorbed organic compounds as well as condensed aerosols. EPA (2003, pg. 11) evaluated toxic effects of diesel exhaust, which includes DPM, and determined it is "likely to be carcinogenic to humans by inhalation from environmental exposures." EPA (2003, pg. 9) also observed that DPM is a portion of ambient $PM_{2.5}$ and that the $PM_{2.5}$ NAAQS "would be expected to offer a measure of protection from effects associated with DPM."

Coal Dust Emissions

Coal dust is generated by uncovered loaded coal trains as discussed in **Section 3.1** of the EA. In addition to potential impacts related to rail safety, coal dust is identified as having potential to affect human health and environmental quality. Particulate emissions (i.e., PM_{10} and $PM_{2.5}$) can affect the heart and lungs and cause serious health effects (EPA 2017a), and trace elements in coal could potentially affect the environment where coal dust deposition occurs.

In non-occupational settings, particulate matter and airborne dust is regulated by NAAQS. Because NAAQS regulate environmental exposure of the general population to all sources of particulate matter, these regulations are more stringent than standards regulating occupational exposure to coal dust at coal mines. There are no Federal or state guidelines or standards that identify acceptable levels of ambient dust deposition.

BNSFs Requirements and Actions Pertaining to Coal Dust

BNSF currently enforces the Safe Harbor provision in the BNSF Coal Loading Rule (BNSF 2015a, 2017b) to limit deposition (**Section 3.1.3** of the EA). Since 2015, BNSF has also been operating a surfactant re-spray facility along its main line in Pasco, Washington to further limit coal dust. Coal trains traveling west along the main line route through the Columbia River Gorge are sprayed with a topper agent as it passes through to lessen potential coal dust release from rail cars (WDOE and Cowlitz County 2017).

On March 3, 2017, a consent decree (CASE NO. 2:13-cv-00967-JCC) was finalized between BNSF and the Sierra Club along with several other environmental groups settling a multi-year lawsuit over alleged coal and petroleum coke (petcoke) dust emissions from rail cars operating on rail routes in Washington State. Under this consent decree, BNSF will conduct a study on the feasibility of physical covers for coal and petcoke rail cars and pay $1 million to fund environmental projects across Washington State aimed at improving water quality or habitat. BNSF will also clean up coal and petcoke materials on or adjacent to BSNF's right-of-way (on land only) at five locations in Washington State and conduct follow-up inspections of each area two times during the period of the Consent Decree (WDOE and Cowlitz County 2017)

Coal Dust Generation, Dispersion, and Deposition

Comprehensive literature reviews on topics related to coal dust emissions, dispersion, and deposition were conducted by STB (2015a) and WDOE and Cowlitz County (2017) to complete NEPA analyses for recent projects involving coal transport by rail (with transport rates ranging from 10 to 70 trains per day). These prior analyses concluded that most coal dust from rail cars is generated from the top surface of the loaded rail car. Volume of dust emitted depends on several factors including the type and composition of the coal, moisture content, ambient wind speed and direction, precipitation, use of topper agents, size of rail car's top opening, the shape or profile of the coal surface in the car, the position of the car in the train, time and distance traveled, and train speed.

Connell Hatch (2008) estimated that rail cars, each containing approximately 90 tons of coal, could lose an average of 0.0035 percent of total load over trips between 100 and 300 miles (estimated 6 pounds for each car). WDOE and Cowlitz (2017) considered the estimate high given the study did not make adjustments for moisture, including wetting or use of other dust control techniques such as toppers as required by the BNSF Coal Loading Rule.

STB (2015a) modeling for a scenario with an additional 26.7 trains per day over current levels reported that at 50 meters from the rail line, the maximum annual increase in PM_{10} and $PM_{2.5}$ from coal dust would be 6.1 μg/m^3 and 1.2 μg/m^3, respectively. STB concluded that these predicted increases would be insufficient to lead to a violation of NAAQS for either PM_{10} or $PM_{2.5}$. Similarly, WDOE and Cowlitz (2017) concluded that adding predicted coal dust emissions from eight loaded and eight empty trains per day to background levels would not lead to a violation of NAAQS along the evaluated rail segments.

The distance between the rail and point of deposition (where dust settles on the ground) varies and depends primarily on the size of the particles, meteorological conditions including wind speed, and/or train speed (WDOE and Cowlitz County 2017). An Australian coal dust deposition study (as reported in Connell Hatch 2008, associated traffic rates unknown) found that maximum dust deposition occurred at 3 meters from the track with a coal dust deposition rate of approximately 90 milligrams per square meter per day (mg/m^2/day). At 10 meters the deposition rate dropped to 30 mg/m^2/day. STB (2015a) estimated the maximum modeled deposition rate would be 36 mg/m^2/day at 50 meters from the track for a scenario with an additional 26.7 loaded trains per day and use of topper agents.

Coal Dust and Human Health

From a human health perspective, inhalation of coal dust (particulate matter) is the primary exposure pathway of interest. Human exposure could also occur by ingestion of soil, sediment, water, agricultural products, fish, or other animals that have ingested soil or water affected by coal dust deposits. STB (2015a) conducted dispersion modeling to assess potential health impacts from inhalation of coal dust. Based on model results neither background conditions nor the addition of airborne coal dust from the high production level (26.7 trains per day) to the estimated background levels of particulate would cause particulate matter concentrations to exceed the NAAQS either alone or in combination with other project-related PM_{10} or $PM_{2.5}$ particulate emissions, including exhaust emissions from locomotives and fugitive particulate matter from wind erosion.

STB (2015a) used the air dispersion and deposition model in combination with a fate and transport model to estimate concentrations of chemicals in coal dust in soil, water, and sediment. The model results were used to analyze potential human health impacts from ingestion of coal dust based on applicable EPA screening levels. The study determined that concentrations of coal dust constituents (including trace elements in coal and the chemical constituents of coal topper agents) in soil, dust, water, and fish would be below EPA screening levels for human exposure for all evaluated pathways. Estimated concentrations in soil ranged from two to five orders of magnitude below the soil ingestion screening levels. For movement through soil to groundwater, none of the estimated trace metal concentrations exceeded the screening level values; most of these values were two to three orders of magnitude less than the screening levels.

Coal Dust and Ecological Health

As part of the same study noted above, STB (2015a) combined the results of the modeling analysis discussed above to estimate chemical concentrations in soil, water, and sediment for evaluation of potential ecological impacts of the same project (26.7 loaded trains per day). Consistent with the study related to human health (ingestion), none of the chemical concentrations estimated for soil resulted in values greater than the EPA ecological soil screening levels for plants, soil invertebrates, avian wildlife, or mammalian wildlife.

STB (2015a) estimated concentrations of coal dust constituents in surface water for the same project based on the average deposition from air over a modeled watershed and subsequent runoff and erosion into a modeled water body. Estimated values for water were well below available EPA freshwater screening benchmarks, with the exception of barium. However, based on the use of conservative assumptions, the concentration of barium in surface water was likely overestimated. When barium is released to water, the compound precipitates as barium sulfate, which has low solubility in water. As such, concentrations of soluble barium in surface water would not be expected to exceed benchmark or screening levels.

1.3 Seaport Handling

As discussed in **Section 2.1.7** of the EA, nearly all coal from the Mine is shipped overseas from Westshore Terminal in British Columbia, Canada. Westshore Terminal is one of 27 major marine terminals that comprise the Port of Vancouver located in the Vancouver metropolitan area. The governments of Canada, British Columbia, and Metro Vancouver have developed several criteria pollutant ambient concentration standards and objectives as shown in **Table B-6** and **Table B-7**, and air quality is monitored in the Vancouver metropolitan area. Measured ambient pollutant concentrations at the station nearest to Westshore Terminal were all below the relevant air quality standards and objectives in 2014, the most recent year reported (Metro Vancouver 2015).

In 2013, an air quality study was conducted to evaluate local and regional baseline conditions and potential environmental impacts related to Westshore Terminal's proposed port improvement and expansion project (Westshore Terminal LP 2013). The study evaluated emissions from marine and rail traffic, cargo-handling equipment, and on-road vehicles. It projected air emissions that would result from terminal activities in 2018 under two scenarios of coal throughput: Scenario A—39.7 Mtpy if the proposed expansion were to be completed—and Scenario B—36.4 Mtpy coal throughput if the project were not completed (existing condition). Except for particulate emissions, the differences in criteria pollutant emission rates between the two scenarios were approximately 5 percent or less. The proposed port project was, however, expected to reduce particulate emissions by approximately 20 percent due to improvements in materials handling equipment.

Appendix C presents estimated port-wide criteria pollutant emissions attributed to handling 1.0 Mt of coal based on existing port capacity and emission rates (i.e., Scenario B, above) as this reflects the more conservative (i.e., highest) estimated emission rates of the two scenarios (Westshore Terminal LP 2013). Although emission rates for some of Westshore Terminal's emitting units are not related to coal throughput by a direct linear correlation, the apportionment adequately describes the existing environment and is suitable for estimating emissions attributed to transferring 5.96 Mt of coal from the Mine in 2016 (**Table B-8**).

Table B-6. Metro Vancouver's Ambient Air Quality Objectives.

Air Contaminant and Averaging Time	AQO Level ($\mu g/m^3$)	AQO Level (Ppb)
CO		
1-hour	30,000	262,000
8-hour	10,000	8,700
NO2		
1-hour	200	106
Annual	40	21
SO2		
1-hour	196	75
24-hour	125	48
Annual	30	11
Ozone		
1-hour	161	82
8-hour	128	65
PM10		
24-hour	50	-
Annual	20	-
PM2.5		
24-hour	25	-
Annual	8	-
Total reduced Sulphur		
1-hour (acceptable)	14	10
1-hour (desirable)	7	5

Source: Metro Vancouver 2016

Notes:

AQO = Ambient Air Quality Objective

µg/m3 = micrograms per cubic meter

Ppb = parts per billion

Table B-7. British Columbia Ambient Air Quality Objectives.

Air Contaminant and Averaging Period	AQO Level (µg/m³)	AQO Level (ppb)	Source [1]	Date Adopted by Source
Formaldehyde				
1-hour	60	50	Provincial AQO	1995
NO2				
1-hour	188	100	Interim Provincial AQO	2014
Annual	60	32	Interim Provincial AQO	2014
Ozone				
1-hour	160	82	NAAQO	1989
8-hour	123	63	CAAQS	2013
PM2.5				
24-hour	25	-	Provincial AQO	2009
24-hour	28	-	CAAQS	2013
Annual	8	-	Provincial AQO	2009
Annual	10	-	CAAQS	2013
PM10				
24-hour	50	-	Provincial AQO	1995
SO2				
1-hour	196	75	Interim Provincial AQO	2016
1-hour	183	70	CAAQS	2016
Annual	13	5	CAAQS	2016
Total Suspended Particulate				
24-hr	120	-	NAAQS	1974
Annual	60	-	NAAQS	1974

Source: BCME 2016
Notes:
AQO = Ambient Air Quality Objective
µg/m3 = micrograms per cubic meter
ppb = parts per billion
(1) NAAQO = National Ambient Air Quality Objective
CAAQS = Canadian Ambient Air Quality Standard

Table B-8: Estimated Total Criteria Air Pollutant Emissions from Transferring 5.96 Mt of Coal Through Westshore Terminal in 2016.

	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC
Total Emissions (tons)	20	4	31	1	9	2

1.4 Ocean Transport

In 1973, the United Nations IMO developed the International Convention for the Prevention of Pollution from Ships. Modified in 1978, it is known as MARPOL 73/78. It forms a structure for regulations that help reduce and limit environmental damage from operational and accidental oil discharge, shipped cargo, sewage, garbage, and air pollutant emissions (IMO 2017). The last of these is addressed by Annex VI, "Regulations for the Prevention of Air Pollution from Ships," which entered into force in 2005 and was supported by 86 countries as of June 2016 (Hughes 2016). For the purposes of this assessment, Annex VI Regulations 13 and 14 are the most relevant.

- *Regulation 13:* Establishes three tiers of NO_x emission limits based on the year a vessel was manufactured and engine speed rating in units of revolutions per minute. Tier limits apply to manufacture dates as follows: Tier 1 after 1999, Tier 2 after 2010, and Tier 3 after 2015 (if operating in an Emissions Control Area, or ECA). ECAs apply for up to 200 nautical miles from the Canadian and United States Pacific coastline.
- *Regulation 14:* Limits SO_x and particulate matter in ship engine exhaust primarily by limiting sulfur content in fuel that is allowed to be combusted. It also establishes three tiers of limits based on the vessel manufacture date brackets. Different fuel sulfur limits apply to ships operating within and outside of designated ECAs.

Appendix C presents estimated criteria pollutant emissions from ocean transport of 1.0 Mt of coal. The one-way shipping distance was assumed to be 5,300 miles, the approximate average distance between Westshore Terminal and Japan or the ROK. Estimates reflect round-trip travel assuming the same emissions in both directions (i.e., emissions occurring over 10,600 miles). Estimated baseline criteria air pollutant emissions from ocean transport of 5.96 Mt of coal in 2016 are presented in **Table B-9.** Emission rates for each pollutant are estimated in total tons as well as lbs/mile, with the latter reflecting the transitory and distributed nature of cargo vessel emissions.

Table B-9. Estimated Total Criteria Air Pollutant Emissions from Round-Trip Ocean Transport of 5.96 Mt of Coal in 2016 (units as shown).

	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC
Total Round-trip Emissions (tons)	698	642	5,238	4,941	472	202
Emissions Per Mile (lbs/mile)	132	121	988	932	890	38

1.5 Overseas Combustion

As discussed in **Section 2.1.7** of the EA, nearly all coal is sold to power generators in the ROK and Japan. These countries therefore comprise the affected environment for analysis of overseas combustion effects on air quality. Both countries maintain a structure of regulations designed to maintain or improve air quality by limiting pollutant emissions from industrial and other emitting sources.

ROK

The ROK's Framework Act on Environmental Policy (ROK 2008) describes fundamental environmental policy goals for preventing pollution and managing natural resources for sustainable use. Air quality is managed under the Clean Air Conservation Act (ROK 2011). This legislation establishes:

- A permitting and reporting system for facilities that emit one or more of 26 designated air pollutants;
- Permissible emission limits designed to progressively become more stringent as emissions control technology improves;
- Guidance programs and periodic inspections with the potential for prosecution related to noncompliance; and
- Improvement mandates and improvement charges in cases where emissions limits are exceeded.

Japan

Japan's Air Pollution Control Act directs the control and monitoring of air pollution under the direction of the Japan Ministry of the Environment (JMOE). JMOE has established environmental air quality standards for several pollutants (JMOE 2014). According to the United Nations Environment Programme, current standards are within World Health Organization targets, and "[a]ir quality in the country has improved dramatically over the past few decades even as the economy has grown, thanks to stringent legislation; Japanese cities [are] amongst [the] world's least polluted.…" (UNEP n.d.).

JMOE has established national standards limiting air pollutant emissions from stationary sources, and prefectural governors can set more stringent emissions standards within their jurisdiction as needed. Emission standards include: maximum permissible limits for each type and size of facility; special standards which are stricter for areas where air pollution has or is likely to exceed the limits; more stringent prefectural emission standard in areas where national emission standards might be insufficient to protect human health or living conditions; and standards for controlling total emissions that prescribe maximum limits for specific large-scale factories (UNEP n.d.).

Appendix C presents estimated emissions of criteria pollutants and heavy metals HAPs (i.e., lead, mercury and arsenic), generated from combusting 1.0 Mt of coal at utility-scale power plants in the ROK and Japan (separately or collectively). Because specific power plants are not known, the range of estimates generated reflects the varying types of boilers and effectiveness of pollution control technologies that may be implemented at power plants in both countries. A low emission range assumes that a relatively effective pollution control technology is in place, while a high emission range assumes a relatively ineffective pollution control technology is in place. Estimated ranges of baseline pollutant emissions from combusting 5.96 Mt of coal in 2016 are presented in **Table B-10.**

Table B-10. Estimated Total Air Pollutant Emissions from Combusting 5.96 Mt of Coal in ROK and Japan in 2016.

Emission Range	PM_{10} (tons)	$PM_{2.5}$ (tons)	NO_x (tons)	SO_2 (tons)	CO (tons)	VOC (tons)	Pb[1] (lbs)	Hg[1] (lbs)	As[1] (lbs)
Low	890	861	578	2,367	30	4	30	30	26
High	1,751	1,363	23,095	11,834	373	52	592	182	520

(1) Pb = lead, Hg = mercury, As = arsenic

Effects of most industrial source air pollutants are limited to the immediate area or, at most, the region surrounding the source. However, mercury emissions can also have a global effect. Because it does not degrade in the environment, mercury emitted to the atmosphere eventually deposits onto land or water bodies. Through a series of chemical transformations and environmental transport processes, deposited mercury can eventually accumulate in the food chain (EPA 2017e). Exposure to mercury threatens human health, with developing fetuses and young children most at risk. Mercury pollution can also harm wildlife and ecosystems (EPA 2017b).

Mercury's fate after it is emitted into the air depends primarily on its as-emitted chemical form and dispersion characteristics of the emitting source, such as stack height, and of the receiving atmosphere, such as wind currents. Depending on these factors, emitted mercury can travel thousands of miles in the atmosphere before eventually depositing in rainfall or in dry gaseous form. Recent estimates of annual global mercury emissions from both natural and anthropogenic sources are in the range of approximately 5,500 to 8,800 tons per year, including re-emitted mercury (EPA 2017f). Global emissions of mercury from anthropogenic sources are estimated at approximately 2,066 tons annually (UNEP/AMAP 2015). **Table B-11** summarizes estimated 2010 mercury emissions from the US, Japan and ROK.

Table B-11: Estimated Annual Mercury Emissions in 2010.

Sector	United States	ROK	Japan
Stationary Fossil Fuel Combustion –Power Plants – Coal (tons)	30	1.1	1.0 to 1.1
Total Emissions, all sectors (tons)	61	8.9	19 to 24

Source: UNEP/AMAP 2015, Annex 7.

Mercury emissions from both existing and new coal-fired power plants in the US are regulated by EPA's Mercury and Air Toxics Standards (MATS) rule. EPA (2017g) estimates that the rule prevents approximately 90 percent of the mercury in coal burned in US power plants from being emitted to the air. As domestic coal-fired power plants have worked to comply with these standards in recent years, mercury controls have also progressed and are available for coal-fired generation plants of various designs and ages in Japan and the ROK. Emissions reductions from these controls are reflected in the low range of mercury emissions presented above in Table B-9.

2.0 Environmental Consequences

2.1 Direct & Indirect Effects

Effects on air quality are directly related to air pollutant emission rates that are generally proportional to the rate of saleable coal production across all segments as presented in **Section 1.0** (above). Direct and indirect impacts are evaluated by quantifying annual emissions at the maximum rate of saleable coal production under each alternative (10.0 Mtpy) for comparison to Mine production in 2016 (5.96 Mt) as described in **Section 1.0** (above). In addition to representing the most recent condition, the 2016 production rate is close to the lowest saleable coal production in the past five years (5.72 Mt in 2012, see **Table 2.1-1** of the EA).

Methods used to estimate emissions in this analysis are consistent with **Section 1.0** of this Appendix and are further described in **Appendix C**, where annual emissions are presented on a 1.0 Mt basis.

<u>*No Action*</u>

Mining

Table B-12 shows estimated annual criteria pollutant emission rates related to Mine operations for saleable coal production rates of 5.96 Mt for the 2016 baseline year, 10.0 Mt for the No Action Alternative, and the difference between the two annual rates.

Table B-12. Estimated Annual Total Criteria Air Pollutant Emissions from Mine Operations (tons).

Saleable Coal Annual Production Rate	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC
Baseline (5.96 Mt in 2016)	236	32	47	16	63	15
No Action (10.0 Mt)	396	54	79	27	106	25
Difference (4.04 Mt)	160	22	32	11	43	10

Mining activities under the No Action Alternative would continue to be controlled by the existing MAQP (MDEQ 2016b) and the underlying regulations which are designed to prevent major impacts for 2.5 additional years (see **Section 1.0**, above). Potential emissions would not change, and the Mine would continue to qualify as a "minor" or "area" (i.e., non-major) stationary emissions source. The Mine would also continue, under the Regional Haze Rule, to be a non-regulated source and would not be expected to impact air quality at any Class I area for 2.5 additional years.

Ambient air monitoring has demonstrated that the Mine's historical impacts to local air quality have been minor with respect to applicable air quality standards (NAAQS and MAAQS). Although actual annual emissions from the No Action Alternative could increase relative to historical rates, they would not increase beyond levels associated with the MAQP limits (MDEQ 2016b). MAQP limits ensure acceptable air quality impacts. The annual production rate of 10.0 Mt under the No Action Alternative is less than the MAQP production rate limit. Therefore, the Mine operations' direct and indirect impacts to air quality are expected to be minor. This conclusion is supported by MDEQ's February 2017 approval to terminate local air monitoring for PM_{10} (MDEQ 2017a). Air quality impacts related to the No Action Alternative would also be short-term, lasting at least 2.5 years while mining continues and then declining and eventually ceasing as the Mine is fully reclaimed in accordance with the Mine permit.

Rail Transport – Locomotive Emissions

Table B-13 presents estimated annual criteria pollutant emissions related to transporting coal by rail between the Mine and Westshore Terminal at annual saleable coal production rates of 5.96 Mt for the 2016 baseline year, 10.0 Mt for the No Action Alternative, and the difference. Emissions are presented as pounds per mile traveled, reflecting distribution of impacts over the 2,780 miles trains travel round-trip including rail segments that may see both loaded and unloaded rail traffic from both loaded and empty trains. Evaluating emissions on a local scale (per mile of track, in this instance) is more informative than evaluating total emissions.

Table B-13. Estimated Annual Total Criteria Air Pollutant Emissions from Rail Transport (lbs/mile).

Saleable Coal Annual Production Rate	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC
Baseline (5.96 Mt in 2016)	33	30	1,167	1	278	56
No Action (10.0 Mt)	55	51	1,957	2	466	95
Difference (4.04 Mt)[1]	22	21	791	1	188	38

(1) Minor discrepancies occur due to rounding of source values.

At these emission rates, impacts to air quality from rail transport under the No Action Alternative are expected to be negligible and short-term, lasting 2.5 years. Emissions would be distributed over long distances and transitory in nature. As discussed in **Section 1.0** (above), rail routes do not encroach on any Class I areas, and areas with historically degraded air quality are likely to have developed mitigation measures similar to the referenced Missoula, Montana example.

Rail Transport – Coal Dust

WDOE and Cowlitz County (2017) and STB (2015a) analyzed projects involving coal transport by rail at daily rates and a total duration greater than what would be undertaken by the No Action (1.8 loaded and 1.8 empty trains per day). These analyses concluded that impact of coal dust is below regulatory standards for air emissions and below human health and ecological screening levels associated with subsequent deposition to soil and water. As such, there would be no measurable effect on human or ecological health. Given this, coal dust-related impacts associated with the No Action-related rail transport of coal would be negligible. Impacts on air quality would be short-term as the duration of mining and transport would be extended by 2.5 years. Coal dust deposited in soil and water would remain in the long-term.

Seaport Handling

Table B-14 shows estimated annual criteria pollutant emissions related to transferring coal at Westshore Terminal at annual saleable coal production rates of 5.96 Mt for the 2016 baseline year, 10.0 Mt for the No Action Alternative, and the difference.

Table B-14. Estimated Annual Total Criteria Air Pollutant Emissions from Operations at the Westshore Terminal (tons).

Saleable Coal Annual Production Rate (Mt)	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC
Baseline (5.96 Mt in 2016)	20	4	31	2	9	2
No Action (10.0 Mt)	33	7	53	3	14	3
Difference (4.04 Mt)[1]	13	3	21	1	6	1

(1) Minor discrepancies occur due to rounding of source values.

At these emission rates, impacts to air quality from port operations under the No Action Alternative are expected to be negligible and short-term, lasting 2.5 years. As noted in **Section 1.0** (above), measured ambient pollutant concentrations proximal to Westshore Terminal were all below the relevant air quality objectives and standards in 2014. Existing regulations would continue to ensure that individual emitting sources produce air quality impacts protective of human and environmental health.

Ocean Transport

Table B-15 shows estimated annual criteria pollutant emissions related to transporting coal from the Westshore Terminal to the ROK and Japan at annual rates of 5.96 Mt for the 2016 baseline year, 10.0 Mt for the No Action Alternative, and the difference. Emissions are presented as pounds per mile traveled round-trip because impacts are distributed over a large distance, similar to locomotive emissions, as discussed above.

Table B-15. Estimated Annual Total Criteria Air Pollutant Emissions from Ocean Transport (lb/mile)

Saleable Coal Annual Production Rate	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC
Baseline (5.96 Mt in 2016)	132	121	988	932	89	38
No Action (10.0 Mt)	221	203	1,658	1,564	149	64
Difference (4.04 Mt)	89	82	670	632	60	26

At these emission rates, impacts to air quality from ocean transport are expected to be negligible and short-term, lasting 2.5 years. Localized impacts would be negligible as emissions would be distributed over long distances and transitory in nature.

Overseas Combustion

Table B-16 shows estimated annual pollutant emissions related to combusting coal for power generation in the ROK and Japan at annual rates of 5.96 Mt for the 2016 baseline year, 10.0 Mt for the No Action Alternative, and the difference.

Table B-16. Estimated Annual Total Air Pollutant Emission Ranges from Combusting Coal in the ROK and Japan

Saleable Coal Annual Production Rate	PM_{10} (tons)	$PM_{2.5}$ (tons)	NO_x (tons)	SO_2 (tons)	CO (tons)	VOC (tons)	Pb[1] (lbs)	Hg[1] (lbs)	As[1] (lbs)
Low Emission Range									
Baseline (5.96 Mt in 2016)	890	861	578	2,368	30	4	30	30	26
No Action (10.0 Mt)	1,494	1,445	970	3,971	50	7	50	50	44
Difference (4.04 Mt)	604	584	392	1,604	20	3	20	20	18
High Emission Range									
Baseline (5.96 Mt in 2016)	1,751	1,363	23,095	11,835	373	52	592	182	520
No Action (10.0 Mt)	2,938	2,287	38,750	19,855	625	88	994	306	873
Difference (4.04 Mt)	1,187	924	15,655	8,021	253	35	401	124	353

(1) Pb = lead, Hg = mercury, As = arsenic

As discussed in **Section 1.5** (above), combustion activities at power plants in the ROK and Japan are subject to air quality control laws that would ensure emissions and resultant air quality are within acceptable (regulatory) limits considered protective of human health and the environment. The United Nations Environment Programme reports that ambient air quality standards in the ROK and Japan are within World Health Organization targets (UNEP 2016a, 2016b). Given this, air quality impacts from combustion would be minor and would be short-term, lasting 2.5 years. Cumulative effects of mercury are discussed below.

Proposed Action

Under the Proposed Action, the Mine would continue to produce and ship up to 10.0 Mt of coal annually, the same annual production rate evaluated for the No Action Alternative (above). Annual emissions and air quality effects from the Proposed Action would be the same as those resulting from the No Action Alternative but would continue for an additional 9 years. Air quality impacts related to the Proposed Action would be minor for Mine operations (**Table B-12)** and negligible for rail and ocean transport (**Tables B-13** and **B-15**) and terminal operations (**Table B-14**). The degree of impacts from overseas combustion would depend on emission controls and local conditions within either the ROK and/or Japan but would be minor due to existing regulations in place that are considered protective of human health and the environment as noted above (**Table B-16**). Air quality impacts from all segments would be short-term, though would persist for 9 additional years relative to the No Action Alternative. As discussed in **Section 1.1** (above), impacts would be expected to decrease over time as equipment (e.g., locomotive engines, ship engines, boilers, etc.) that emits air pollutants is improved and replaced and as regulations become more stringent.

The Proposed Action would have the same rail transport rate as the No Action Alternative (1.8 loaded and 1.8 empty trains per day) and indirect impacts associated with generation of coal dust would be negligible. While effects would occur 9 more years under the Proposed Action, relative to the No Action Alternative, the duration of air quality effects is still considered short-term as the effects would cease after rail transport of the Mine's coal concludes. As with the No Action, coal dust deposited in soil and water would remain in the long-term.

2.2 Cumulative Effects

Cumulative impact assessment is inherent to evaluation of air quality impacts due to the combined effects of multiple emission sources on an affected area, whether it be the air quality in the vicinity of a monitoring station, an airshed, a region, or the world as a whole. Air pollutant emissions directly related to mining and indirectly resulting from rail transport, port operations, ocean transport, and combustion occur in a highly regulated context, as described in **Section 1.0** (above).

If undertaken, emissions related to mining, transporting, and combusting 6.0 Mt of coal mined in Panel 15 over 0.7 years would not exceed those presented in **Section 2.1** (above) as the annualized production rate is not expected to exceed 10.0 Mtpy under any scenario. Air quality effects from criteria pollutants and arsenic would be minor and short-term, lasting approximately 0.7 years after mining ceases under the Proposed Action. Cumulative effects of mercury emissions are discussed below.

Mine-related emissions in the US occur in a general environment of improving air quality. The EPA (2016b) reports: "Nationally, concentrations of the criteria and hazardous air pollutants have dropped significantly since 1990. During this same period, the U.S. economy continued to grow, Americans drove more miles and population and energy use increased."

According to the International Energy Agency (IEA 2016, pg. 44), "China, [South] Korea, Japan, the United States and European Union currently have the most stringent emission standards in the world." Additionally, various government agencies continually monitor ambient air quality to ensure maintenance of acceptable conditions and progress toward improvement where conditions are unacceptable. These multiple regulatory restrictions and monitoring programs address and minimize cumulative air quality impacts.

As discussed in **Section 1.0** (above), most emissions affect air quality in areas proximal to the emissions source and result in short-term effects as they dissipate rather than accumulate over time. While mercury air emissions also dissipate in the atmosphere, elemental mercury can travel long distances before depositing to soil and water where it accumulates and can be reemitted, resulting in long-term effects. Estimated mercury emissions from combusting 10.0 Mt of coal (the Mine's maximum output) would constitute approximately 0.05 percent to 0.25 percent of combined annual mercury emissions of the ROK and Japan (see **Section 1.5**, above).

Total mercury emissions range from 0.06 to 0.35 tons under the No Action Alternative and from 0.28 to 1.7 tons under the Proposed Action, accounting for between 0.001 and 0.03 percent of global mercury emissions (2,066 tons annually; UNEP/AMAP 2015). Total mercury emissions from combusting 6.0 Mt of coal from Panel 15 would add between 0.02 and 0.09 tons, a negligible contribution to emissions attributed to the Proposed Action and other sources. Existing regulations in the ROK and Japan and increasing implementation of mercury controls similar to those implemented in the US (see **Section 1.0**, above) are expected to reduce mercury accumulation in the environment in the short-term and long-term.

While the extent of cumulative air quality impacts would vary with the specific related activity and location, the factors identified above indicate that cumulative impacts on air quality resulting from criteria pollutants and arsenic emissions would be minor and short-term. Mercury emissions would be minor and have long-term effects as they are combined with global emissions and accumulate in the environment.

Coal dust resulting from the No Action and Proposed Action alternatives would combine with dust generated from other past, present, and reasonably foreseeable coal haulage. Continued implementation of BNSF's Coal Loading Rule (BNSF 2015a, 2017b) ensures that coal dust emissions are minimized on BNSF owned and operated rail lines; thereby minimizing the potential for coal-dust related emissions and subsequent deposition to soil and water. Increases to port capacity are not foreseeable, so the future rate of coal transport on the Main Line would not change significantly from recent shipping rates. Based on this and the findings of evaluations for other rail transport projects (WDOE and Cowlitz County 2017, STB 2015a), project-related coal dust emissions, dispersion and deposition would result in negligible long-term cumulative effects to air quality and the environment.

APPENDIX C - AIR EMISSIONS

This appendix provides supports the EA's descriptions of the existing conditions in **Section 3.2** (Air Quality) and **Section 3.3** (Climate) and also supports impact analysis for air quality and climate in **Sections 4.2** and **4.3**, respectively. Content is organized to separately evaluate emissions from the following "segments": mining operations, rail transport, seaport operations, ocean transport, and combustion in both ROK and Japan. This presentation has three objectives:

1. Estimate emissions of pollutants of concern (i.e., "criteria" pollutants for which NAAQS are defined and heavy metal HAPs from coal combustion) resulting from mining, transport, and combustion of 1.0 Mt of coal from the Mine.
2. Estimate GHG emissions as CO_2e emissions from mining, transport, and combustion of 1.0 Mt of coal from the Mine.
3. Identify data, assumptions, and methods used to calculate the foregoing emissions estimates.

Mining activities, transport, and combustion locations described in Chapter 2 informed preparation of this appendix and attendant exhibits presenting emissions estimates. Emissions are estimated on a 1.0 Mt (shipped coal) basis to provide a means of comparing emissions associated with different annual production rates analyzed in the EA.

1.0 Pollutant Emissions

The EA evaluates existing air quality and future project-related air quality impacts in part by quantifying potential emissions of criteria air pollutants PM_{10}, $PM_{2.5}$, NO_x (a surrogate for NO_2), SO_2, CO, and VOCs (as a surrogate for ozone), as well as heavy metals of concern from combustion (mercury, lead, and arsenic; lead is also a criteria pollutant). This section discusses emissions of these pollutants.

1.1 Mine Operations

Potential air pollutant emission rates were calculated to support a 2014 application (SPE 2014a) to modify the Mine's MAQP (#3179, Revision 08). Although the MAQP has been revised several times since 2014 (currently revision 12; MDEQ 2016b), emission estimates prepared for the 2014 application are suitable to support this EA for the following reasons.

- No MAQP revisions have been made that would affect emissions of gaseous air pollutants.
- MAQP revisions primarily reflected changes to surface storage piles and the windblown dust emissions they create. Total coal pile surface area potentially increased by 1.5 acres resulting in estimated PM_{10} and $PM_{2.5}$ rate increases of 0.2 and 0.03 tons per year, respectively.
- MAQP revisions related to the WDAs were expected to result in a net reduction of particulate emission rates.
- Calculated emission rates were intended to conservatively represent maximum production. Actual emissions for any given time period would likely be lower.

- Historical monitoring data indicate that Mine-related emissions have resulted in acceptable air quality and that continued operation within prescribed limits would continue to produce acceptable impacts.

SPE estimated maximum potential emission rates based on an MAQP limit of 15.0 Mt of raw coal production per year (**Exhibit 1, Table 1-1**) (SPE 2014a). Historically, an average of approximately 70 tons of saleable coal is produced from 100 tons of raw mined coal, so 15.0 Mt tons of raw coal would produce approximately 10.5 Mt of saleable coal.

Total emissions from Mine operations do not have a linear relationship with coal production. While emissions from some Mining activities, such as coal crushing, are calculated based directly on coal throughput rate, emissions from many of the Mine sources are estimated based on other factors such as engine size, disturbed exposed area, or vehicle miles traveled. Because some activities would occur largely independent of production rate, the assumption would tend to underestimate emissions resulting from 5.96 Mtpy during the 2016 baseline year. Consequently, the reported difference between 5.96 and 10.0 Mtpy of production may be overestimated. Nevertheless, assuming a linear relationship is adequate for the purpose of evaluating the range of mining rates between 5.96 to 10.0 Mtpy in the EA.

Exhibit 1 summarizes the potential Mine operating emissions reported in the 2014 application and estimates emissions for each 1.0 Mt of saleable coal produced for reference in the EA.

CO_2e calculations presented in **Exhibit 1** are discussed below in **Section 2.1.**

1.2 Rail Transport

Inputs and equations used to estimate locomotive engine emissions between the Mine and Westshore Terminal (see **Section 2.1.8** of the EA) are presented in **Exhibit 2**. Calculations are based on emission factors derived from projected 2018 locomotive age distribution of BNSF's fleet as presented in a draft EIS for the proposed Tongue River Railroad (STB 2015a, Table E.1-8). Those factors were checked against generic EPA factors (EPA 2009) and found to closely agree, supporting their use in this analysis. While locomotive idling may occur in association with rail transport of coal from the Mine, specific locations and idle durations are not known; therefore, idling emissions are not included in locomotive emissions estimates.

Age-tiered pollutant emission factors prescribed by Federal rule 40 CFR Part 1033 are applied to the projected fleet age distribution to calculate weighted average factors for each air pollutant. While the 2018-based factors are expected to change over time, they are considered adequate for this analysis. The level of change that may have occurred between 2017 and 2018 is expected to be within the range of uncertainty inherent in the 2018 projection. If emissions were slightly higher in the 2016 baseline year due to older locomotives in the fleet, the result would be a minor overestimation of incremental impacts. After 2018, newer model locomotives with more stringent emissions limits will replace older models, thereby reducing fleet-wide emissions and emissions associated with coal transport.

Projected engine emission factors (STB 2015) relate the mass rate of pollutant emissions to a unit of energy expended to move coal (grams (g) of emissions per brake horsepower-hour, or bhp-hr, of energy). To use these emission factors, the energy unit is first converted to fuel usage based on the amount of energy contained in a unit of diesel fuel. Because the original emission factor is expressed in units of "brake horsepower" rather than horsepower, the calculation includes a separate factor to derive usable energy from potential energy in diesel. That factor is calculated from constants reported by the EPA (EPA 1985, Appendix A). The resulting set of pollutant-specific emission factors is presented as tons of pollutant emissions per 1,000 gallons of diesel combusted (**Exhibit 2, Table 2-1**).

The amount of fuel required to transport a ton of coal is derived from BNSF's 2015 fuel efficiency factor of 848 gross ton miles per gallon of diesel (BNSF 2015b, page 20), where "gross ton miles" is "the weight of the train (excluding the locomotive) multiplied by the miles the train has traveled." To derive pollutant-specific emission rates for transporting coal between the Mine and Westshore Terminal, this fuel efficiency factor is combined with the pollutant-specific emission factors (**Exhibit 2, Table 2-1**) and the following values:

- The distance between the Mine and Westshore Terminal, estimated to be 1,390 miles one-way (see EA **Section 2.2**);
- The typical number of cars per coal train (125) and the total mass of coal per train (15,250 tons) (SPE 2017b);
- The amount of coal one train can haul (15,250 tons) (SPE 2017b); and
- The maximum weight of a train car loaded with coal (286,000 tons) (BNSF n.d.).

The last three values are used to calculate loaded and empty train weights. Separate emissions are then calculated for a loaded train traveling to Westshore Terminal and an empty train returning to the Mine. These one-way emissions are combined to estimate total round-trip emissions per 1.0 Mt of shipped coal (**Exhibit 2, Table 2-1**). Those values are divided by the round-trip distance (2,780 miles) to estimate average pounds of emissions per round-trip mile (**Exhibit 2, Table 2-2**) for reference in the EA.

CO_2e calculations presented in **Exhibit 2** are discussed below in **Section 2.2.**

1.3 Seaport Operations

Estimated emissions related to coal handling at Westshore Terminal (see **Section 2.1.8** of the EA) are presented in **Exhibit 3**. Emissions are estimated from information presented in a 2013 Environmental Impact Assessment (EIA) evaluating planned modifications at the facility (Westshore Terminal LP 2013). The EIA projected 2018 emission rates associated with annual seaport capacity of 36 Mt (**Exhibit 3, Table 3-1**), reflecting conditions before modification (Westshore Terminal 2017a). The total emissions and seaport capacity are used to estimate the emissions attributed to each 1.0 Mt of coal transferred for reference in the EA (**Exhibit 3, Table 3-2**). If the modifications are completed as planned (currently scheduled for 2019), emissions attributed to each 1.0 Mt of coal would decrease by a minor amount in future years.

CO_2e calculations presented in **Exhibit 3** are discussed below in **Section 2.3.**

1.4 Ocean Transport

Inputs and equations used to estimate cargo vessel emissions between Westshore Terminal to the ROK and Japan (see **Section 2.1.8** of the EA) are presented in **Exhibit 4**. Calculations are based on emission factors that relate pollutant mass emissions in grams to the amount of energy a vessel's engine produces in one hour (kilowatt-hours, or kWh). Pollutant-specific factors are discussed below.

NO_x, SO_2, and Particulate Emission Factors

Exhibit D, Table D-2 shows NO_x emission limits established by the United Nations IMO for vessels manufactured after 1999. More stringent NO_x emission limits apply to ships operating within designated Emission Control Areas (ECAs), but they are not used because the only ECA within the coal shipping route extends about 200 miles from the Canadian Pacific coastline, a minor fraction of the overall ocean transport route. Vessels built before 2000 are not subject to the IMO NO_x limits. NO_x emissions from these older vessels are calculated using the larger of two fuel-dependent emission factors provided in the Westshore Terminal EIA (Westshore Terminal LP 2013, Appendix 1, page 25).

The IMO also limits the amount of sulfur a ship's fuel may contain. As with NO_x emissions limits, fuel-sulfur limits are based on vessel age and are different for ships operating within and outside an ECA. Consistent with assumptions made for NO_x, SO_2 and particulate emissions are calculated based on the limits that apply outside an ECA. The limits for three different vessel age brackets (pre-2012, 2012-2020, and post 2020) are shown in **Exhibit 4, Table 4-3**.

Calculated SO_2 emission factors are based on an average fuel consumption rate of 180 g of fuel per kWh of energy expended for 2-stroke main engines (Westshore Terminal LP 2013, Appendix 1, page 26). The amount of fuel combusted is converted into an amount of sulfur released based on the allowable sulfur content for each regulated vessel age group. An emission rate in units of grams SO_2 per kWh of energy is calculated for each age group assuming all sulfur is exhausted as SO_2.

Combustion particulate emissions are calculated from fuel sulfur content and particulate size factors using an equation provided in the Westshore Terminal EIA (Westshore Terminal LP 2013, Appendix 1, page 25).

Single emission factors for NO_x, SO_2, and particulate are calculated to represent the composite fleet of vessels that used Westshore Terminal in 2016. Age distributions are derived from 2016 vessel age data for the terminal (Olszewski 2017). These age distributions are combined with the age-group-specific emission rates to calculate emission factors (g/kWh) (**Exhibit 4, Table 4-4)**.

CO and VOC Emission Factors

The Westshore Terminal EIA (Westshore Terminal LP 2013, Appendix 1, page 25) presents CO and VOC emission factors (g/kWh) for an average ship's 2-stroke main engine.

Total Emissions

The following values are used to convert from g/kWh emission factors to emission rates per 1.0 Mt of coal shipped (**Exhibit 4, Table 4-4)**.

- The main engine power rating (13,120 kW) is derived by interpolating between average values relating ship carrying capacity and engine power rating (Man 2014).
- The engine load factor (0.8) is an average propulsion load under normal cruise speeds (Westshore Terminal LP 2013, pg 24).
- Normal cruise speed (13 knots) is the median of a range reported in the Westshore Terminal EIA (2013, page 24).
- The average weight of coal per ship (145,000 tons/ship) is calculated from the total amount of coal shipped from Westshore Terminal in 2016 (28.4 Mt) (Westshore Terminal 2017b) and the number of ship calls that year (196 calls) (Olszewski, 2017).

Estimated emissions per 1.0 Mt of shipped coal are divided by the estimated average round-trip distance (10,600 miles) to calculate pounds of emissions per mile traveled for reference in the EA (**Exhibit 4, Table 4-4**). Engine load, the primary factor determining cargo vessel air emissions, is about 10 percent lower for unloaded compared to fully loaded vessels. Vessel emissions are estimated assuming round trip loaded transport, which potentially overstates total emissions by up to approximately five percent.

CO_2e calculations presented in **Exhibit 4** are discussed below in **Section 2.4.**

1.5 Overseas Combustion

Inputs used to estimate emissions from combusting coal for power generation in the ROK and Japan (see **Section 2.1.8**) are presented in **Exhibit 4**. Emissions are estimated using a combination of EPA emission factors and representative coal quality analysis. Due to national environmental regulations in both countries, it is unlikely that a utility-scale generator would emit air pollutants without some means of emissions reduction. Therefore, calculations include estimated emissions control ranges for each non-GHG pollutant.

The EPA provides factors for emissions of criteria pollutants that result from uncontrolled coal combustion for several types of boiler and burner configurations (EPA 1998). Pulverized coal boilers are the most common boiler type used for utility-scale power generation. Therefore, pulverized coal boiler emission factors were reviewed, and the smallest and largest factors for each pollutant were used to establish ranges of potential emission rates for NO_x, SO_2, CO, filterable PM_{10}, and condensable particulate matter (C-PM). Filterable $PM_{2.5}$ emission factors are provided by EPA's Air Emissions Inventory Improvement Program (EPA 2001). Total PM_{10} and $PM_{2.5}$ emissions are the sum of filterable and condensable components. An EPA emissions background document (EPA 1993) provides a VOC emission factor for coal combustion in a pulverized coal boiler. Emission rates for trace metals are calculated assuming all metals present in the coal would be released in the exhaust (i.e., an emission factor of 1.0).

Exhibit 5, Table 5-1 estimates minimum and maximum emissions control efficiencies for each pollutant selected based on nominal capabilities of typical control technologies most likely to be applied at utility-scale power generation facilities. The efficiency rate is the percentage of air pollutant that is removed from exhaust by the control device, whereby high efficiency would yield lowest emissions.

Control efficiencies are applied to the uncontrolled emission factors to estimate the range of controlled emissions resulting from coal combustion for reference in the EA (**Exhibit 5, Table 5-2**). High emission estimates are the product of each pollutant's largest uncontrolled emission factor and its lowest control efficiency. Conversely, low emission estimates combine the smallest uncontrolled emission factor and the corresponding highest control efficiency.

CO_2e calculations presented in **Exhibit 5** are discussed below in **Section 2.5.**

2.0 Greenhouse Gas Emissions

GHG emissions are estimated for each segment, from mining to combustion, to support analyses of potential climate impacts. The three primary GHGs of concern for combustion sources are CO_2, CH_4, and N_2O. Total GHG emissions are expressed as CO_2e emissions. CO_2e emission rates are calculated using GWPs (40 CFR Part 98, Subpart A, Table A-1), whereby non-CO_2 GHG emissions are converted to CO_2e emissions based on the energy each GHG absorbs relative to CO_2. As the reference gas, CO_2 has a GWP of 1.0 by definition.

Combined GHG emissions attributable to Mine operations, rail transport, seaport operations, ocean transport, and overseas combustion are presented in **Exhibit 6, Table 6-1**, which summarizes CO_2e emissions reported in **Exhibits 1** through **5.** Additional details specific to CO_2e emissions estimates for each segment are presented in the following sections.

2.1 Mine Operations

A 2014 application to modify MAQP #3179-08 estimates potential GHG emissions resulting from Mine operations (SPE 2014a). CO_2e emissions per 1.0 Mt of saleable coal (**Exhibit 1, Table 1-2**) are estimated using the same methods used for non-GHG emissions assuming a linear relationship between annual mine production and emissions as presented in **Section 1.1**.

2.2 Rail Transport

Estimated emissions of CO_2, CH_4, and N_2O resulting from rail transport of 1.0 Mt of coal are calculated in the same manner as non-GHG emissions (see **Section 1.1.2** above) and converted to CO_2e **(Exhibit 2, Table 2-1)**.

2.3 Seaport Operations

Westshore Terminal LP (2013) presented estimated CO_2e emissions for operations in 2018. This estimate was used to estimate CO_2e emissions attributed to transferring 1.0 Mt of coal (**Exhibit 3, Table 3-2**) using the same methods used for non-GHGs (see **Section 2.3** above).

2.4 Ocean Transport

CO_2e emissions from transporting 1.0 Mt of coal from Westshore Terminal to the ROK and Japan (**Exhibit 4, Table 4-5)** are estimated using power and fuel use calculations used for non-GHG emissions (see **Section 1.4** above and **Exhibit 4**). CO_2 emissions calculations begin with an emission factor that relates emissions to fuel consumption (Westshore Terminal LP 2013, Appendix 1, page 25). CO_2 emissions are calculated based on the engine energy production using a combination of the fuel consumption factor and the CO_2 emission factor (Westshore Terminal

LP 2013, Appendix 1, page 25). Westshore Terminal LP (2013) also reports emission factors for CH_4 and N_2O based on energy production. From these factors (g/kWh of CO_2, CH_4, and N_2O) a CO_2e factor in g/kWh is calculated using GWPs as discussed above.

2.5 Coal Combustion

Inputs and formulas used to estimate CO_2e emissions from combusting 1.0 Mt of coal from the Mine are presented in **Exhibit 5**. CO_2 emissions are calculated from the typical carbon content of the Mine's coal (58.15 percent) (SPE 2018a). All but 1.0 percent of the carbon is assumed to react during combustion to become CO_2, and the molecular weights of carbon and CO_2 are used to convert carbon mass emissions to CO_2 emissions. Emission factors for CH_4 and N_2O provided in the Mandatory GHG Reporting rule (40 CFR 98.33, Table C-2) are converted to pounds of emissions per ton of coal using a typical heat content (expressed as British thermal units, Btu) for the Mine's coal (10,194 Btu/pound or Btu/lb) (SPE 2018a). Emissions are reported as tons of CO_2e emissions per 1.0 Mt of shipped coal (**Exhibit 5, Table 5-3**). These estimates are not specific to combustion overseas and would apply to any combustion location.

Appendix C, Exhibit 1

Potential Mine Operations Emissions

Input values

10.5 Mt; maximum saleable coal based on total annual coal production permit limit[a].

Table 1-1. Estimated Annual Emissions at the Mine from Mining 15 Mt Raw Coal (SPE 2014a).

Source Type	PM10	PM2.5	NOx	SO2	CO	VOC	CO2e
Mobile (Surface & Underground)	3.16	3.06	62.11	26.37	106.65	24.64	19,753
Stationary	6.31	2.11	20.29	1.45	4.81	1.80	1,052
Fugitive	406.62	50.98	--	--	--	--	--
Total	**416.08**	**56.16**	**82.41**	**27.83**	**111.46**	**26.44**	**20,806**

Table 1-2. Estimated Total Mine Operations Emissions (tons) per 1.0 Mt of Saleable Coal[b]

	PM10	PM2.5	NOx	SO2	CO	VOC	CO2e
Tons Emitted per 1.0Mt Saleable Coal	39.63	5.35	7.85	2.65	10.62	2.52	1,981

Notes

General: "tons" are US short tons.

(a) Emissions estimates were prepared to represent Mine potential emissions which are based on a permit limit of 15 Mt tons of raw (unwashed) coal production per year. SPE estimates approximately 70 percent of raw coal becomes saleable coal, so 15 Mt of raw coal mined equates to approximately 10.5 Mt of saleable coal.

(b) Emission rates from many of the Mine sources are estimated based on factors other than coal throughput rates (for example: engine size, disturbed exposed area, or vehicle miles traveled). Total Mine operations emissions therefore indirectly relate to coal production. Nevertheless, assuming a direct correlation between coal production and emissions over the range of annual throughput rates evaluated in the EA (5.96 Mt to 10 Mt) adequately characterizes Mine operations emissions for the purpose of evaluating alternative actions. The resulting level of accuracy is commensurate with the level of accuracy inherent in the original estimates.

Appendix C, Exhibit 2

Potential Locomotive Air Pollution Emissions

Rail Transport from Mine to Westshore Terminal

NOTE: Values used to calculate emissions are identified by unique letters (i.e., "Value ID"). The source of values are either referenced or are calculated using the formulas provided, with inputs identified by Value ID.

Conversion Factors & Constants

Value	*ID*	Units and Notes
453.6	*A*	g/lb
2,544	*B*	Btu/hp-hr
137,000	*C*	Btu/gal diesel; diesel fuel energy content (EPA 1995)
0.39	*D*	fraction of usable power, calculated[a]
2,000	*E*	lb/ton

Global Warming Potentials (unitless) (40 CFR Part 98, Subpart A, Table A-1)

These values are used to convert CO2, CH4, and N2O emissions to CO2e

1	*F*	CO2
25	*G*	CH4
298	*H*	N2O

Train and Transport Characteristics

15,250	*I*	short tons coal/train (SPE 2017b)
125	*J*	cars/train (SPE 2017b)
286,000	*K*	lb/car, loaded (BNSF n.d.)
143	*L*	tons/car, loaded; calculated
		L = K / E
17,875	*M*	tons/train; loaded train gross weight (without locomotives), calculated
		*M = J * L*
2,625	*N*	tons/train; empty train gross weight (without locomotives), calculated
		N = M - I
1,390	*Q*	mi/one-way trip[b]
2780	*R*	mi/round trip; calculated
848	*S*	ton-mi/gal diesel, loaded gross weight basis[c] (BNSF 2015b)

Appendix C, Exhibit 2

Potential Locomotive Air Pollution Emissions
Rail Transport from Mine to Westshore Terminal

Table 2-1. Emission Factors and Estimated Round-trip Emissions from Transporting 1.0 Mt of Coal Round-Trip Between the Mine and Westshore Terminal.

	Pollutant Specific Emission Factor (g/bhp-hr)[d]	Emissions per 1,000 gallon of diesel fuel (tons)	One-way, Loaded train Emissions (tons)	One-way, Empty train Emissions (tons)	Total Round-trip Emissions (tons)
Value ID	*T*	*U*	*V*	*W*	*X*
Criteria Pollutants					
PM10	0.15	0.003	6.61	0.97	7.59
PM2.5	0.14	0.003	6.17	0.91	7.08
NOX	5.38	0.123	237	34.8	272.07
SO2	0.005	0.000	0.22	0.03	0.25
CO	1.28	0.029	56.4	8.29	64.7
VOCs	0.26	0.006	11.5	1.68	13.1
Greenhouse Gases					
CO2	493.13	11.32	21,744	3,193	24938
CH4	0.04	0.00	1.68	0.25	2
N2O	0.01	0.00	0.54	0.08	1
CO2e					25,171

Table 2-1 Equations, with reference to Value IDs

$U = (T * C * D) / (A * B * E) * 10^3$

$V = [(U * Q) / (S * I)] * M * 10^3$

$W = [(U * Q) / (S * I)] * N * 10^3$

$X = V + W$

$CO2e = (X_{CO2} * F) + (X_{CH4} * G) + (X_{N2O} * H)$

Table 2-2. Estimated Average Emissions Per Mile from Transporting 1.0 Mt of Coal Round-Trip between the Mine and Westshore Terminal.

	PM10	PM2.5	NOx	SO2	CO	VOC
Round-Trip Emissions Per Mile for each 1.0 Mt of Coal Transported (lbs)	5.46	5.09	195.73	0.18	46.57	9.46

Table 2-2 Equations, with reference to Value IDs

$Values = X * E / R$

Appendix C, Exhibit 2

Potential Locomotive Air Pollution Emissions

Rail Transport from Mine to Westshore Terminal

Notes

General: "tons" are US short tons.

(a) Theoretical energy density of diesel is 53.8 hp-hr/gal. This is derived from the following conversion factors provided in AP-42, Appendix A (EPA 1985): 3.98E-04 hp/(Btu/hr) (mechanical) and 137,000 Btu/gal of diesel. EPA 2009 provides a factor to derive the usable power from a gallon of diesel combusted in a large line-haul locomotive: 20.8 bhp-hr/gal. The ratio of the usable (bhp-hr) and theoretical (hp-hr) energy is 0.39.

(b) See EA Section 2.2.

(c) Indicates ability to move 848 tons of train (cargo plus train weight minus weight of locomotives) one mile with one gallon of diesel.

(d) Values represent 40 CFR Part 1033 emissions standards weighted for 2018 BNSF fleet make-up by locomotive manufacture date. Provided by STB (2015) .

Appendix C, Exhibit 3

Potential Coal Terminal Emissions

Westshore Terminal Operations

Input values

36 Mt; Westshore Terminal projected coal handlinga (Westshore Terminal LP 2013).

Table 3-1. Projected Westshore Terminal Emission Ratesa (Westshore Terminal LP 2013).

	PM10	PM2.5	NOx	SO2	CO	VOC	CO2e
Total Emissions From 36Mt Annual Port Throughput (tons)	119.68	24.11	189.51	8.95	51.45	10.49	22,122

Table 3-2. Estimated Westshore Terminal Emissions per 1.0 Mt of Saleable Coal Transferred.

	PM10	PM2.5	NOx	SO2	CO	VOC	CO2e
Emissions Attributed to each 1.0Mt of Coal Transferred (tons)	3.32	0.67	5.26	0.25	1.43	0.29	614.49

Notes

General: "tons" are US short tons.

(a) Coal throughput is converted to tons from reported metric tons (tonnes) in source (Westshore Terminal LP 2013). The coal throughput rate (36Mt) and emission rates are projected values for 2018 assuming the planned modifications are not implemented. The planned modifications are expected to allow for increased throughput and slightly decreased emissions per ton of coal.

Appendix C, Exhibit 4

Potential Cargo Vessel Air Pollution Emissions

Ocean Transport between Westshore Terminal and Republic of Korea

NOTE: Values used to calculate emissions are identified by unique letters (i.e., "Value ID"). The source of values are either referenced or are calculated using the formulas provided, with inputs identified by Value ID.

Conversion Factors & Constants

Value	*ID*	Units and Notes
64.07	*A*	g/g-mol; molecular weight of SO2
32.07	*B*	g/g-mol; molecular weight of sulfur
2,000	*C*	lb/ton
1.102	*D*	ton/tonne
1.15	*E*	(mi/hr)/knot
453.6	*F*	g/lb

Fleet & Terminal Attributes

196	*G*	ship calls in 2016 (Olszewski, 2017)
25.8	*H*	million tonnes coal shipped in 2016 from Westshore (Westshore Terminal 2017c)
28.4	*I*	Mt coal shipped in 2016 from Westshore, calculated *I = H * D*
0.145	*J*	Mt coal/ship *J = I / G*

Table 4-1. 2016 Fleet Age Brackets Pertaining to NO_x, SO_2, and Particulate Emissions Regulations.[a]

Year Manufactured (Age Bracket)	Number of Ships	Percent of Ships in Fleet
NO_x Age Brackets		
< 2000	5	3%
2000-2011	79	40%
≥ 2011	112	57%
SO_2 and Particulate Emissions Age Brackets		
< 2012	113	58%
2012-2020	83	42%
≥ 2020	0	0%

Appendix C, Exhibit 4

Potential Cargo Vessel Air Pollution Emissions

Ocean Transport between Westshore Terminal and Republic of Korea

CRITERIA POLLUTANT EMISSIONS CALCULATIONS

Vessel and Transport Characteristics

13,120	*K*	kW; average main engine power rating (Man 2014, pg. 17)[b]
0.8	*L*	unitless; average propulsion load under normal cruise speeds (Westshore Terminal LP 2013, pg 24)
13	*M*	knots; average normal bulk carrier cruise speed (Westshore Terminal LP 2013; pg 24)
15	*N*	miles/hr; average normal bulk carrier cruise speed, calculated. $N = M * E$
180	*O*	g fuel/kWh; average fuel consumption rate estimate, main 2-stroke engine (Westshore Terminal LP 2013; pg 26)
10,600	*P*	round trip miles; approximate average distance between Westshore Terminal and ports in Japan and ROK (see EA Section 2.1.8).

PM emission factor equation for engines: EF (g/kWh) = 0.4653(S) + 0.25 (Westshore 2013)
where EF = emission factor; S = % sulfur in fuel

0.4653	*Q*	PM emission factor equation multiplier
0.25	*R*	PM emission factor equation term
0.96	*S*	PM10/PM ratio
0.92	*T*	PM2.5/PM10 ratio

Table 4-2. NOx Emission Limits Outside an ECA.[c]

Year Manufactured (Age Bracket)	NO_x Emission Limit (g/kWh)
Value ID	*Y*
< 2000	18.1
2000-2011	17
≥ 2011	14.4

Table 4-3. Engine Particulate and SO2 Emission Factors.[d]

Year Manufactured (Age Bracket)	Fuel Sulfur (%)	PM_{10} (g/kWh)	$PM_{2.5}$ (g/kWh)	SO_x (g/kWh)
Value ID	*FS*	*V*	*W*	*X*
< 2012	4.50%	2.26	2.08	16.2
2012-2020	3.50%	1.81	1.67	12.6
> 2020	0.50%	0.47	0.44	1.80

Appendix C, Exhibit 4

Potential Cargo Vessel Air Pollution Emissions

Ocean Transport between Westshore Terminal and Republic of Korea

Table 4-3 Equations, with reference to Value IDs

$V = (S * FS * 100 * Q) + R$

$W = V * T$

$X = O * FS * (A / B)$

Table 4-4. Estimated Criteria Pollutant Emissions.[e]

Units	Value ID	PM10	PM2.5	NOx	SO2	CO	VOC[f]
Emission Rate by Engine Power Output (g/kWh)	*AA*	2.07	1.91	15.54	14.66	1.40	0.60
Total Round-Trip Ocean Transport Emissions per 1.0 Mt Coal (tons)	*BB*	117.11	107.74	878.94	829.01	79.17	33.93
Total Round-Trip Ocean Transport Emissions per 1.0 Mt Coal per mile (lb)	*CC*	22.10	20.33	165.84	156.42	14.94	6.40

Table 4-4 Equations, with reference to Value IDs

$AA = (EF * AD)_{T1} + (EF * AD)_{T2} + (EF * AD)_{T3}$ *-- for calculated values*

where EF = pollutant emission factor; TX = Tier level

$BB = AA / F * K * L / (N * J * C) * P$

$CC = BB * C / P$

Appendix C, Exhibit 4

Potential Cargo Vessel Air Pollution Emissions

Ocean Transport between Westshore Terminal and Republic of Korea

GREENHOUSE GAS EMISSIONS CALCULATIONS

Global Warming Potentials (unitless) (40 CFR 98, Subpart A, Table A-1)

For converting CO2, CH4, and N2O emissions to CO2e

1	*EE*	CO2
25	*FF*	CH4
298	*GG*	N2O

GHG Emission Factors

3,190	*HH*	kg CO2/tonne fuel; for marine distillate oil (Westshore Terminal LP 2013, pg. 25)
574	*II*	g CO2/kWh; calculated *KK = HH * O * 10^3 / (D * F * C)*
0.060	*JJ*	g CH4/kWh (Westshore Terminal LP 2013, pg. 25; 2-stroke main engine)
0.017	*KK*	g N2O/kWh (Westshore Terminal LP 2013, pg. 25; 2-stroke main engine)
581	*LL*	g CO2e/kWh; calculated *LL = (EE* * II) + (FF * JJ) + (GG * KK)
1.28	*MM*	lb CO2e/kwh; calculated *MM = LL / F*
3.10	*NN*	ton CO2e/Mt coal/mi *NN = MM * K * L / (N * J * C)*

Table 4-5. Estimated round-trip CO2e emissions per 1.0 Mt transported.

	CO_2e Emissions (tons)	**Value ID**
Round-Trip Emissions per 1.0 Mt coal shipped	32,852	*OO*

Formula: *OO = NN * P*

Appendix C, Exhibit 4

Potential Cargo Vessel Air Pollution Emissions

Ocean Transport between Westshore Terminal and Republic of Korea

Notes

General: "tons" are US short tons.

(a) Values derived from data provided by Vancouver Fraser Port Authority (Olszewski, 2017).

(b) The reference presents modeled design values for a range of vessel sizes. The values include sizes of 107,000 and 150,000 dry weight tonnage (dwt) with associated main engine Specified Maximum Continuous Rated (SMCR) power of 12,120 and 14,450 kW, respectively. The value used in these calculations was interpolated from within this range based on the average dwt of all ships calling at Westshore Terminal in 2016 (125,456 tonnes) (Olszewski 2017). Note that dwt is a measure of a vessel's carrying capacity. It is the design weight fully loaded with cargo and provisions without the weight of the ship itself.

(c) Post-2000 NOx limits per IMO Annex VI, Regulation 13. Pre-2000 NOx factor is for ships burning heavy fuel oil. Marine distillate oil combustion produces 17.0 g/kWh. (Westshore Terminal LP 2013, pg. 25)

(d) Factors calculated based on IMO Annex VI, Regulation 14 fuel sulfur limits as shown.

(e) CO and VOC emission factors in g/kWh are from Canada's Marine Emissions Inventory Tool (MEIT) Version 4.0, cited in Westshore Terminal LP 2013. Other g/kWh emission factors are weighted averages of factors from Table D2 and D3.

(f) Provided as Hydrocarbon (HC) emissions which encompass VOCs.

Appendix C, Exhibit 5

Potential Coal Combustion Air Pollution Emissions
Power Generation in Japan and Republic of Korea

NOTE: Values used to calculate emissions are identified by unique letters (i.e., "Value ID"). The source of values are either referenced or are calculated using the formulas provided, with inputs identified by Value ID.

Conversion Factors

1,000,000	*A*	µg/g
2,000	*B*	lb/ton
1,000,000	*C*	Btu/MMBtu

Typical Bull Mountains Mine Coal Characteristics

Value	ID	Units and Notes
10,194	*D*	Btu/lb coal, as-received basis (SPE 2018a)
0.44	*E*	wt % sulfur, as-received basis (SPE 2018a)
5.81	*F*	wt % ash, as-received basis (SPE 2018a)
19.57	*G*	wt % moisture, as-received basis (SPE 2018a)
58.15	*H*	wt % carbon, as-received basis (SPE 2018a)
0.03	*I*	µg/g mercury (Hg), dry basis (SPE 2018a)
2.61	*J*	µg/g arsenic (As), dry basis (SPE 2018a)
2.97	*K*	µg/g lead (Pb), dry basis (SPE 2018a)
0.03	*L*	µg/g Hg as-received basis; calculated *L= I / (1 + G/100)*
2.2	*M*	µg/g As as-received basis; calculated *M = J / (1 + G/100)*
2.5	*N*	µg/g Pb as-received basis; calculated *N = K / (1 + G/100)*

CRITICAL POLLUTANT EMISSIONS CALCULATIONS

Input Terms for Calculating Uncontrolled Emission Factors (Pulverized, Bituminous Coal)[a]

38	*O*	unitless SOx emission factor multiplier; all pulverized coal (PC) firing configurations (EPA 1998, Table 1.1-3)
2.3	*P*	unitless filterable PM_{10} emission factor multiplier; PC dry bottom firing configurations (EPA 1998, Table 1.1-3)
2.6	*Q*	unitless filterable PM_{10} emission factor multiplier; PC wet bottom firing configuration (EPA 1998, Table 1.1-4)
0.6	*R*	unitless filterable $PM_{2.5}$ emission factor multiplier; PC dry and dry bottom tangential (EPA 2001)
1.48	*S*	unitless filterable $PM_{2.5}$ emission factor multiplier; PC wet bottom (EPA 2001)
95	*T*	wt % fuel sulfur emitted as SO_2 (EPA 1998, Table 1.1-3)
0.1	*U*	Unitless total condensable particulate matter factor; PC firing without FGD [b, c,d] (EPA 1998,
0.03	*V*	Unitless total condensable particulate matter term; PC firing without FGD [b, c,d] (EPA 1998,

Appendix C, Exhibit 5

Potential Coal Combustion Air Pollution Emissions
Power Generation in Japan and Republic of Korea

Uncontrolled Emission Factors (Pulverized, Bituminous Coal)[d]

16	*W*	lb SO_2/ton coal; calculated *W = O * E * (T/100)*
9.7	*X*	lb NOx/ton coal; PC, dry bottom, tangentially-fired with low-NOx burner (EPA 1998, Table 1.1-3)
31	*Y*	lb NOx/ton coal; PC, wet bottom, wall-fired and PC dry bottom, cell burner (EPA 1998, Table 1.1-3)
0.5	*Z*	lb CO/ton coal; all pulverized coal firing configurations (EPA 1998, Table 1.1-3)
13	*AA*	lb filterable PM_{10}/ton coal; low end, calculated *AA = F * P*
15	*BB*	lb filterable PM_{10}/ton coal; high end, calculated *BB = F * Q*
3.5	*CC*	lb filterable $PM_{2.5}$/ton coal; low end, calculated *CC = F * R*
9	*DD*	lb filterable $PM_{2.5}$/ton coal; high end, calculated *DD = F * S*
0.01	*EE*	lb total condensable PM/MMBtu; calculated *EE= (E * U) - V*
0.29	*FF*	lb total condensable/ton coal; calculated *FF = EE * D * E / F*
0.000	*GG*	lb Hg/ton coal; calculated *GG = L * E / D*
0.004	*HH*	lb As/ton coal; calculated *HH = M * E / D*
0.005	*II*	lb Pb/ton coal; calculated *II = N * E / D*
0.07	*JJ*	lb VOC/ton coal; PC, dry bottom (EPA 1993)

Appendix C, Exhibit 5

Potential Coal Combustion Air Pollution Emissions
Power Generation in Japan and Republic of Korea

Table 5-1. Coal Combustion Emissions Control Efficiency Ranges.[e]

Control Efficiency Range	Filterable PM_{10}[f] (%)	Filterable $PM_{2.5}$[f] (%)	Cond. PM[f] (%)	NO_x (%)	SO_x (%)	CO (%)	VOC (%)	Pb (%)	Hg[g] (%)	As (%)
Low	98	98	0.0	75	75	75	75	98	39	98
High	99.9	99.9	0.0	98	95	98	98	99.9	90	99.9

Note: Cond. = Condensable

Table 5-2. Estimated Controlled Criteria Pollutant and HAP Emissions Ranges per 1.0 Mt of Coal Combusted.

Pollutant Emission Range	PM_{10}[h] (tons)	$PM_{2.5}$[h] (tons)	NO_x (tons)	SO_x (tons)	CO (tons)	VOC (tons)	Pb (lbs)	Hg (lbs)	As (lbs)
Low	149	144	97	397	5.0	0.70	5.0	5.0	4.4
High	294	229	3,875	1,986	63	8.8	99	31	87

Table 5-2 Example Equations

*High NOx emissions = (1 - (low NOx control efficiency / 100)) * Y * C / B*

*Low PM10 emissions = (1 - (high NOx control efficiency / 100)) * (AA+ EE) * C / B*

Appendix C, Exhibit 5

Potential Coal Combustion Air Pollution Emissions
Power Generation in Japan and Republic of Korea

<u>GREENHOUSE GAS EMISSIONS CALCULATIONS</u>

Conversion Factors

453.6	*KK*	g/lb
0.99	*LL*	unitless; carbon-CO_2 conversion factor (AP-42, Table 1.1-20)
44	*MM*	lb/lb-mol; CO_2 molecular weight
12	*NN*	lb/lb-mol; carbon molecular weight

Global Warming Potentials (unitless) (40 CFR 98, Subpart A, Table A-1)

1	*OO*	CO_2
25	*PP*	CH_4
298	*QQ*	N_2O

GHG Emission Factors

11	*RR*	g CH_4/MMBtu (40 CFR 98.33, Table C-2)
1.6	*SS*	g N_2O/MMBtu (40 CFR 98.33, Table C-2)

GHG Emissions

4,222	*TT*	lb CO_2/ton of coal, calculated $TT = L / 100 * LL * MM / NN * E$
0.49	*UU*	lb CH_4/ton of coal, calculated $UU = RR * G * E / (KK * F)$
0.072	*VV*	lb N_2O/ton of coal, calculated $VV = UU * G * E / (KK * F)$
4,255	*WW*	lb CO_2e/ton of coal, calculated

Table 5-3. Estimated CO_2e Emissions From Combusting 1.0 Mt of Coal From the Mine.

	Total Emissions (tons)	Value ID
Total CO_2e emissions from combusting 1.0 Mt of coal	2,127,741	*XX*

Formula: $XX = (WW / B * 10^6)$

Appendix C, Exhibit 5

Potential Coal Combustion Air Pollution Emissions
Power Generation in Japan and Republic of Korea

Notes

General: "tons" are US short tons.

(a) EPA 1998 provides emission factors for various pulverized coal, cyclone, stoker, and fluidized bed boiler designs. Only pulverized coal designs are used substantially for generating utility-scale electrical power.

(b) Emission factor = 0.1*S - 0.03, where 'S' is the coal sulfur content as a percent.

(c) FGD = flue gas desulfurization.

(d) The emission factors are for "all PM controls." Applicable condensable PM emissions control efficiencies are assumed to be negligible.

(e) Except as noted, values are representative estimates selected by the preparers for use in this analysis.

(f) "F-" indicates filterable fraction; "C-" indicates condensable fraction. All condensable fraction is assumed to be less than 2.5 microns.

(g) UNEP 2014, pg. 21.

(h) PM10 and PM2.5 values include filterable and condensable fractions.

Appendix C, Exhibit 6
Combined Greenhouse Gas Emissions

Table 6-1. Estimated Mine-Related CO2e Emissions per 1.0 Mt of Saleable Coal.

Segment	**CO_2e Emissions (tons)**
Mine operations	1,982
Rail transport	25,171
Seaport operations	614
Ocean transport	32,852
Coal combustion	2,127,741
Total	**2,188,359**

APPENDIX D - CLIMATE CHANGE

This appendix provides additional information related to climate change to supplement descriptions of the existing condition (recent conditions and trends) in **Section 3.3** and provides global, national, and regional context (projections) to support impact analysis in **Section 4.3**.

1.0 Recent Conditions and Trends

As the leading international body for the assessment of climate change, IPCC reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change. IPCC's fifth assessment report (IPCC 2014) presents details pertaining to observed climate changes and their causes; future climate changes, risks and impacts; future pathways for adaptation, mitigation and sustainable development; and adaptation and mitigation.

IPCC (2014) findings related to recent global conditions and trends include the following.

- Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850. The period from 1983 to 2012 was likely the warmest 30-year period of the last 1400 years in the Northern Hemisphere, where such assessment is possible.
- The globally averaged combined land and ocean surface temperature data as calculated by a linear trend show a warming of 0.85 [0.65 to 1.06] °C 2 over the period 1880 to 2012, when multiple independently produced datasets exist. It is extremely likely that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in GHG concentrations and other anthropogenic factors together.
- In recent decades, changes in climate have caused impacts on natural and human systems on all continents and across the oceans. Impacts are due to observed climate change, irrespective of its cause, indicating the sensitivity of natural and human systems to changing climate.
- Changes in many extreme weather and climate events have been observed since about 1950. Some of these changes have been linked to human influences, including a decrease in cold temperature extremes, an increase in warm temperature extremes, an increase in extreme high sea levels and an increase in the number of heavy precipitation events in a number of regions.
- In many regions, changing precipitation or melting snow and ice are altering hydrological systems, affecting water resources in terms of quantity and quality.
- Many terrestrial, freshwater and marine species have shifted their geographic ranges, seasonal activities, migration patterns, abundances and species interactions in response to ongoing climate change.
- Studies covering a wide range of regions and crops show that negative impacts of climate change on crop yields have been more common than positive impacts.
- Cascading impacts of climate change can now be attributed along chains of evidence from physical climate through to intermediate systems and then to people.

- At present the worldwide burden of human ill-health from climate change is relatively small compared with effects of other stressors and is not well quantified.

As a key part of the *Fourth National Climate Assessment*, the US Global Change Research Program (USGCRP) oversaw production of a report describing the state of science relating to climate change and its physical impacts. USGCRP (2017) concluded that the climate of the US is strongly connected to the changing global climate and provided the following statements highlighting past and recent conditions related to climate change in the US and the globe.

- Global annually averaged surface air temperature has increased by about 1.8°F (1.0°C) over the last 115 years (1901–2016). This period is now the warmest in the history of modern civilization. The last few years have also seen record-breaking, climate-related weather extremes, and the last three years have been the warmest years on record for the globe. These trends are expected to continue over climate timescales.
- Based on extensive evidence, it is extremely likely that human activities, especially emissions of GHGs, are the dominant cause of the observed warming since the mid-20th century. For the warming over the last century, there is no convincing alternative explanation supported by the extent of the observational evidence.
- In addition to warming, many other aspects of global climate are changing, primarily in response to human activities. Thousands of studies conducted by researchers around the world have documented changes in surface, atmospheric, and oceanic temperatures; melting glaciers; diminishing snow cover; shrinking sea ice; rising sea levels; ocean acidification; and increasing atmospheric water vapor.
    - For example, global average sea level has risen by about 7–8 inches since 1900, with almost half (about 3 inches) of that rise occurring since 1993. Human-caused climate change has made a substantial contribution to this rise since 1900, contributing to a rate of rise that is greater than during any preceding century in at least 2,800 years. Global sea level rise has already affected the US; the incidence of daily tidal flooding is accelerating in more than 25 Atlantic and Gulf Coast cities.
- Changes in the characteristics of extreme events are particularly important for human safety, infrastructure, agriculture, water quality and quantity, and natural ecosystems. Heavy rainfall is increasing in intensity and frequency across the US and globally and is expected to continue to increase. The largest observed changes in the US have occurred in the Northeast.
- Heatwaves have become more frequent in the US since the 1960s, while extreme cold temperatures and cold waves are less frequent. Recent record-setting hot years are projected to become common in the near future for the US, as annual average temperatures continue to rise. Annual average temperature over the contiguous US has increased by 1.8°F (1.0°C) for the period 1901–2016.
- The incidence of large forest fires in the western US and Alaska has increased since the early 1980s and is projected to further increase in those regions as the climate changes, with profound changes to regional ecosystems.
- Annual trends toward earlier spring melt and reduced snowpack are already affecting water resources in the western US and these trends are expected to continue.

- The global atmospheric carbon dioxide (CO_2) concentration has now passed 400 parts per million (ppm), a level that last occurred about 3 million years ago, when both global average temperature and sea level were significantly higher than today.
- The observed increase in carbon emissions over the past 15-20 years has been consistent with higher emissions pathways. In 2014 and 2015, emission growth rates slowed as economic growth became less carbon-intensive. Even if this slowing trend continues, however, it is not yet at a rate that would limit global average temperature change to well below 3.6°F (2°C) above preindustrial levels.

The Montana Climate Assessment (Whitlock et al. 2017) identified the following key messages about recent trends related to regional climate change in Montana.

- Annual average temperatures, including daily minimums, maximums, and averages, have risen across Montana between 1950 and 2015. The increases range between 2.0-3.0°F (1.1-1.7°C) during this period.
- Winter and spring in Montana have experienced the most warming. Average temperatures during these seasons have risen by 3.9°F (2.2°C) between 1950 and 2015.
- Montana's growing season length is increasing due to the earlier onset of spring and more extended summers, and there are more warm days and fewer cool nights. From 1951-2010, the growing season increased by 12 days. In addition, the annual number of warm days has increased by 2.0 percent, and the annual number of cool nights has decreased by 4.6 percent over this period.
- Despite no historical changes in average annual precipitation between 1950 and 2015, there have been changes in average seasonal precipitation over the same period. Average winter precipitation has decreased by 0.9 inches (2.3 cm), which can mostly be attributed to natural variability and an increase in El Niño events, especially in the western and central parts of the state. A significant increase in spring precipitation (1.3-2.0 inches [3.3-5.1 cm]) has also occurred during this period for the eastern portion of the state.

The Montana Climate Assessment (Whitlock et al. 2017) also provided findings related climate change to effects on water, forests, and agriculture, which have been and will continue to be affected by changes in climate.

2.0 Projected Climate Conditions and Effects

The most recent findings and predictions about climate change and its effects are presented in IPCC's report titled *Climate Change 2014: Synthesis Report*, the *Fourth National Climate Assessment* (USGCRP 2017), and *Montana Climate Assessment* (Whitlock et al 2017). Recent conditions and trends discussed in **Section 1** are expected to continue. Projected effects of climate change are discussed in each of these documents at varying scales covering a variety of topics and resources as summarized below in **Section 2.1** to **2.3**. In support of **Section 4.3.2** of the EA, a detailed discussion of the SCC protocol is provided in **Section 2.4**

2.1 Global Projections

Projected global climate conditions and effects identified by IPCC (2014) include the following.

- Cumulative emissions of CO_2 largely determine global mean surface warming by the late 21st century and beyond. Projections of GHG emissions vary over a wide range, depending on both socio-economic development and climate policy.
- Continued emission of GHGs will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive, and irreversible impacts for people and ecosystems.
- Surface temperature is projected to rise over the 21st century under all assessed emission scenarios. It is very likely that heat waves will occur more often and last longer, and that extreme precipitation events will become more intense and frequent in many regions. The ocean will continue to warm and acidify, and global mean sea level to rise.
- Climate change will amplify existing risks and create new risks for natural and human systems. Risks are unevenly distributed and are generally greater for disadvantaged people and communities in countries at all levels of development. Increasing magnitudes of warming increase the likelihood of severe, pervasive and irreversible impacts for people, species and ecosystems. Continued high emissions (globally) would lead to mostly negative impacts for biodiversity, ecosystem services and economic development and amplify risks for livelihoods and for food and human security.
- Many aspects of climate change and its associated impacts will continue for centuries, even if anthropogenic emissions of GHGs are stopped. The risks of abrupt or irreversible changes increase as the magnitude of the warming increases.

2.2 National Projections

The Fourth National Climate Assessment (USGCRP 2017) projects changes in temperature and precipitation, increased frequency of droughts, floods, wildfires, and extreme storms, changes in land cover and terrestrial biogeochemistry, changes in arctic conditions, sea level rise, and ocean acidification (and other ocean changes). EPA (2016a) identifies potential subsequent effects to health and society and ecosystems such as heat-related deaths and illness, disease spread, changes in growing seasons. Examples of projected effects identified by USGCRP (2017) include the following.

- Over the next few decades (2021–2050), annual average temperatures are expected to rise by about 2.5°F for the US, relative to the recent past (average from 1976-2005), under all plausible future climate scenarios.
- Global average sea levels are expected to continue to rise by at least several inches in the next 15 years and by 1 to 4 feet by 2100. A rise of as much as 8 feet by 2100 cannot be ruled out. Sea level rise will be higher than the global average on the East and Gulf Coasts of the US.
- The magnitude of climate change beyond the next few decades will depend primarily on the amount of GHGs (especially CO_2) emitted globally. Without major reductions in emissions, the increase in annual average global temperature relative to preindustrial times could reach 9°F (5°C) or more by the end of this century. With significant reductions in

emissions, the increase in annual average global temperature could be limited to 3.6°F (2°C) or less.

- Under higher scenarios, and assuming no change to current water resources management, chronic, long-duration hydrological drought is increasingly possible before the end of this century.
- Continued growth in CO_2 emissions over this century and beyond would lead to an atmospheric concentration not experienced in tens to hundreds of millions of years. There is broad consensus that the further and the faster the Earth system is pushed towards warming, the greater the risk of unanticipated changes and impacts, some of which are potentially large and irreversible.

2.3 Montana Projections

Key projections (effects) identified in the Montana Climate Assessment (Whitlock et al. 2017) include the following.

- The state of Montana is projected to continue to warm in all geographic locations, seasons, and under all emission scenarios throughout the 21st century. By mid-century, Montana temperatures are projected to increase by approximately 4.5-6.0°F (2.5-3.3°C) depending on the emission scenario. By the end-of-century, Montana temperatures are projected to increase 5.6- 9.8°F (3.1-5.4°C) depending on the emission scenario. These state-level changes are larger than the average changes projected globally and nationally.
- The number of days in a year when daily temperature exceeds 90°F (32°C) and the number of frost-free days is expected to increase across the state and in both emission scenarios studied. Increases in the number of days above 90°F (32°C) are expected to be greatest in the eastern part of the state. Increases in the number of frost-free days are expected to be greatest in the western part of the state.
- Across the state, precipitation is projected to increase in winter, spring, and fall; precipitation is projected to decrease in summer. The largest increases are expected to occur during spring in the southern part of the state. The largest decreases are expected to occur during summer in the central and southern parts of the state.
- Hydrologic impacts may include reduced snowpack; changes in runoff timing, streamflows and resultant water availability; and increased drought severity and duration.
- Forest impacts may include: variable impacts to forest-wide processes, but negative effects of extreme heat; increased forest mortality and net loss of forested areas; altered forest disturbance regimes; increase in fire risk; increase in bark beetle survival; and reduction in the amount of carbon stored in forests.
- Agricultural impacts may include both favorable and disruptive effects on crop and forage; production; less reliable irrigation water; changes to commodity prices; increases in native plains vegetation, but declines in forage quality; and an overall increase in the need for innovation and adaptation to address climate change effects.

2.4 Social Cost of Carbon

A protocol to estimate what is referenced as the "social cost of carbon" (SCC) associated with GHG emissions was developed by a IWG, to assist agencies in addressing EO 12866, which requires Federal agencies to assess the domestic costs and the benefits of proposed regulations as part of their regulatory impact analyses. The SCC is an estimate of the economic damages associated with an increase in carbon dioxide emissions internationally and is intended to be used as part of a cost-benefit analysis for proposed rules. As explained in the Executive Summary of the 2010 SCC Technical Support Document "the purpose of the [SCC] estimates…is to allow agencies to incorporate the social benefits of reducing carbon dioxide (CO_2) emissions into cost-benefit analyses of regulatory actions that have small, or 'marginal,' impacts on cumulative global emissions." Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under EO 12866 February 2010 (withdrawn by EO13783). While the SCC protocol was created for regulatory impact analyses during rulemakings, there have been requests by public commenters or project applicants to expand the use of SCC estimates to project-level NEPA analyses.

The decision was made not to expand the use of the SCC protocol for this EA for a number of reasons. Most notably, this action is not a rulemaking for which the SCC protocol was originally developed. Second, on March 28, 2017, the President issued EO 13783 which, among other actions, withdrew the Technical Support Documents upon which the protocol was based and disbanded the earlier Interagency Working Group on Social Cost of Greenhouse Gases. The Order further directed agencies to ensure that estimates of the social cost of GHGs used in regulatory analyses "are based on the best available science and economics" and are consistent with the guidance contained in [Office of Management and Budget (OMB)] Circular A-4, "including with respect to the consideration of domestic versus international impacts and the consideration of appropriate discount rates" (E.O. 13783, Section 5(c)). In compliance with OMB Circular A-4, interim protocols have been developed for use in the rulemaking context. However, the Circular does not apply to project decisions, and there is no EO or other requirement to apply the SCC protocol to project decisions.

Further, the NEPA does not require a cost-benefit analysis (40 C.F.R. § 1502.23), although NEPA does require consideration of "effects" that include "economic" and "social" effects (40 C.F.R. 1508.8(b)). Without a complete monetary cost-benefit analysis, which would include the social benefits of the proposed action to society as a whole and other potential costs and positive benefits, inclusion solely of an SCC cost analysis would be unbalanced, potentially inaccurate, and not useful in facilitating an authorized officer's decision. Any increased economic activity, in terms of revenue, employment, labor income, total value added, and output, that is expected to occur with the proposed action is simply an economic impact, rather than an economic benefit, inasmuch as such impacts might be viewed by another person as negative or undesirable impacts due to potential increase in local population, competition for jobs, and concerns that changes in population will change the quality of the local community. Economic impact is distinct from "economic benefit" as defined in economic theory and methodology, and the socioeconomic impact analysis required under NEPA is distinct from cost-benefit analysis, which is not required.

Finally, the SCC, protocol does not measure the actual incremental impacts of a project on the environment and does not include all costs or benefits from carbon emissions. The SCC protocol estimates economic damages associated with an increase in CO_2 emissions—typically expressed as a one metric ton increase in a single year—and includes, but is not limited to, potential changes in net agricultural productivity, human health, and property damages from increased flood risk over hundreds of years. The estimate is developed by aggregating results "across models, over time, across regions and impact categories, and across 150,000 scenarios" (Rose et al. 2014). The dollar cost figure arrived at based on the SCC calculation represents the value of damages avoided if, ultimately, there is no increase in carbon emissions. But the dollar cost figure is generated in a range and provides little benefit in assisting the authorized officer's decision for project level analyses. For example, in a recent EIS, OSMRE estimated that the selected alternative had a cumulative SCC ranging from approximately $4.2 billion to $22.1 billion depending on dollar value and the discount rate used. The cumulative SCC for the no action alternative ranged from $2.0 billion to $10.7 billion. Given the uncertainties associated with assigning a specific and accurate SCC resulting from 9 additional years of operation under the mining plan modification, and that the SCC protocol and similar models were developed to estimate impacts of regulations over long time frames, this EA quantifies direct and indirect GHG emissions and evaluates these emissions in the context of global emissions as discussed in **Section 4.3.1** of the EA.

To summarize, this EA does not undertake an analysis of SCC because 1) it is not engaged in a rulemaking for which the protocol was originally developed; 2) the IWG, technical supporting documents, and associated guidance have been withdrawn; 3) NEPA does not require cost-benefit analysis ; and 4) the full social benefits of coal-fired energy production have not been monetized, and quantifying only the costs of GHG emissions for the project but not other costs and benefits would yield information that is both potentially inaccurate and not useful.

APPENDIX E - HYDROLOGY

1.0 Existing Condition

Surface water and groundwater hydrology and water uses are discussed in Section 3.4 of the BLM Coal Lease EA. Additional details about the hydrologic systems and water uses are presented with other baseline data in the Mine permit (SPE 2017a, Section 304).

Hydrologic monitoring, including precipitation monitoring, has continued in accordance with Mine permit requirements since the BLM Coal Lease EA was prepared; the findings of which are presented in AHRs submitted to MDEQ. Since the BLM Coal Lease EA was prepared, SPE prepared an updated PHC addressing Amendment 3 and WDA #2, including description of existing Mine impacts. As part of the written findings for Mine permit approval, MDEQ issued an updated CHIA for Amendment 3 and prepared a separate CHIA for WDA #2. The CHIAs also discussed the existing condition and relevant findings to-date. A full list of these documents and citations follows:

- AHRs
  - January to December 2011 AHR (Catena & Nicklin 2012)
  - January to December 2012 AHR (Catena & Nicklin 2013a)
  - October 2012 to September 2013 AHR (Catena & Nicklin 2013b)
  - October 2013 to September 2014 AHR (Catena & Nicklin 2014)
  - October 2014 to September 2015 AHR (Catena & Nicklin 2015)
  - October 2015 to September 2016 AHR (Catena & Nicklin 2017)
  - October 2016 to September 2017 AHR (Catena & WET 2018)
- Mine permit documents:
  - PHC (SPE 2017a, Appendix 314-5)
  - Groundwater Model (SPE 2017a, Appendix 314-6)
  - Deep Underburden Groundwater Model (SPE 2017a, Appendix 314-7)
- MDEQ CHIAs
  - Amendment 3 CHIA (MDEQ 2016a)
  - WDA #2 CHIA (MDEQ 2017b)

These documents present the most relevant information available since the BLM Coal Lease EA was prepared and are hereby incorporated into this EA by this reference. Data and interpretations most relevant to OSMRE's decision are summarized in this EA. This section provides updates based on monitoring records through September 2017.

Precipitation in 2011 (particularly in May and June) was considerably above normal, increasing spring and stream flow rates, increasing water levels in wells, and causing several ponds to discharge. Precipitation patterns in recent years have been closer to long-term averages, and the effects of the above-normal 2011 precipitation have diminished, allowing hydrologic conditions to more closely reflect the historical monitoring record.

While hydrologic conditions continue to fluctuate in response to variable precipitation patterns, the baseline hydrologic condition in areas unaffected by mining is consistent with that previously presented in the BLM Coal Lease EA. Recent monitoring indicates that impacts to streams and ponds by mining to-date are not detectable and effects to springs have been limited to those discussed in this section. In contrast, mining effects have been observed in groundwater wells in the permit area since the BLM Coal Lease EA was prepared.

Locations of active hydrologic monitoring stations (SPE 2017a, see Appendix 314-4) are shown in **Appendix A, Figure 3.4-1,** and all stations specifically referenced in this EA are labeled.

1.1 Groundwater

For discussion purposes, the monitored groundwater system is divided into four hydrogeologic units; alluvium, overburden, mammoth coal, and underburden. A thorough discussion of the stratigraphy of Mine geology, including aquifers and overburden intervals, and baseline hydrologic conditions is presented in Section 3.4 of the BLM Coal Lease EA.

<u>*Alluvium*</u>

- A majority of the alluvial monitoring wells (**Appendix A, Figure 3.4-1**) are typically dry. This was especially true before 2011. Observed changes in water levels in the alluvial deposits in the Mine vicinity for data extending from inception of mining in 2003 into 2017 are generally more responsive to natural climate events as compared to mining activity. (Catena & WET 2018).
- Groundwater levels in several wells increased beginning in approximately 2010 with the most notable increase occurring in association with May 2011 precipitation/runoff events (Catena and WET 2018, Map 4). Since 2011, water levels in most alluvial wells have attenuated toward pre-2011 levels, though some still exhibit elevated water levels compared to pre-2011 conditions. Other factors likely contributing to temporally increased water levels in the Rehder Creek alluvium include ponding in a gravel pit, use of spreader dikes, and ponding at road embankments.
- Although alluvial wells have exhibited changes in water quality in recent years, most of those changes are likely a result of natural processes rather than response to mining activities. All alluvial wells containing groundwater, both within and outside the Mine permit boundary, showed increases in TDS, sulfate, and other inorganic parameters beginning in 2011 (Catena & WET 2018). Recharge through previously unsaturated media resulting from abnormally high precipitation in 2011 likely led to dissolution of inorganic constituents and resulted in the observed concentration increases. Since 2012, the concentrations of inorganics in most alluvial wells either decreased or remained elevated but at a stable concentration relative to 2011 conditions, with the exception of BMP016. Exceptions to this include three alluvial wells located along the main stem of Rehder Creek downgradient of the Mine (Catena and WET 2018, Map 12), where water levels and TDS concentrations increased in response to 2011 precipitation and remain elevated as of September 2017, which may be mining related.

Overburden

- Four overburden wells located above or proximal to areas undermined and subsided have shown drawdown of approximately 5 to 10 feet (varies by well) in response to mining activities; three screened in overburden interval 5 (BMP007, BMP060, BMP131) and one screened in overburden interval 2 (BMP063) (Catena and WET 2018, Pages 12-13, Map 5 – Page 1 and 2).
- Overburden interval 5 contains a massive sandstone layer above the Rock Mesa coal bed that is likely fractured by mining subsidence. The net effect is that vertical permeability has increased in this sandstone resulting in increased leakage downward into the underlying fractured zone and fragmented zone. This has created a localized mining-related cone of depression in overburden interval 5 (SPE 2017a, Appendix 314-5 [see Figure 13-1 Page 2]; Catena and WET 2018, Page 13).
- There have been increases of conductivity, TDS, and sulfate in overburden wells, most notably BMP052, but also BMP002 which shows a recent minor increase in TDS. All changes thus far are within MDEQ-7 numeric water quality standards. Ongoing monitoring will be used to evaluate whether parameter increases may be mining related (MDEQ 2017b).

Mammoth coal

- Water levels in the vicinity of longwall mining have declined in response to mine dewatering in the Mammoth coal. The maximum drawdown is projected to be approximately 57 feet near well BMP008, in the north central portion of the underground mine plan area (**Appendix A, Figure 3.4-2**, Catena and WET 2018**).**
- Maximum observed drawdown outside the LOM boundary occurs at an observation well (BMP132) located approximately 500 feet north of the permit boundary and 0.4 miles northwest of the East Mains near Panel 5; the closest active mining area (Catena & WET 2018). The magnitude of drawdown at this well presently extends to approximately 17 feet. The magnitude of drawdown has likely been influenced (reduced) by recharge associated with the above-average precipitation/runoff that occurred in 2011.
- Water quality data show that sulfate is the most dominant anion in Mammoth coal groundwater and sodium is the most dominant cation. This is consistent with the general geochemistry of area groundwater as described by Slagle et al. (1986). The average specific conductivity of water produced by Mammoth coal wells is higher than the alluvial and overburden hydrogeologic units. Mammoth coal wells produce Class II or III water and there have been no persistent trends upward or downward in Mammoth coal water quality since data collection began in 1989.
- No exceedances of MDEQ-7 numeric water quality standards for monitored parameters, as approved by MDEQ (SPE 2017a, Appendix 314-4, Tables 314-4.6 and 314-4.7), have been observed for any of the Mammoth coal wells between 2003 and September 2017.
- Elevated TDS values have been observed in BMP008 and it is not clear what caused the temporary increase. Elevated TDS has also been observed at four wells near the northeastern Mine permit boundary (BMP014, BMP074, BMP092 and BMP123). The

cause of the increase in TDS in these four wells is also unknown (Catena and WET 2018), but is unlikely related to mining due to the distance of the wells from current longwall mining (over 1.8 miles see MDEQ 2017b, Figure 9-25).

Underburden

- Water levels in upper portions of the underburden (i.e., shallow underburden) have declined in the vicinity of active mining in response to mine dewatering**.** The greatest drawdowns (exceeding 60 feet in some places) have been observed in the northern and central portions of the mined area (**Appendix A, Figure 3.4-3**, Catena and WET 2018). Drawdown at the northern permit boundary is estimated to be approximately 5 to 10 feet, extending northward.
- For the upper underburden groundwater, sulfate is the dominant anion. Sodium and magnesium are the dominant cations. The highest sulfate concentrations exist near the western permit boundary, as is the case for the alluvial wells. There have been no persistent trends in groundwater quality in the upper underburden at wells within the area mined to-date.
- Increases in TDS have been observed in two wells within the permit boundary but outside the area mined (BMP009 and BMP056) as well as at least two wells outside the permit boundary (BMP006 and BMP079). TDS levels at BMP056 have returned to baseline levels, and TDS levels at BMP009 and BMP079 have decreased recently, but remain elevated above baseline. The TDS increase at BMP006 is not paired with an increase in any of the major ion concentrations suggesting that the recently observed increase may be an outlier. As such, these changes in TDS do not appear to be related to mining activities conducted to date and underburden groundwater classification has remained within the historically observed range for each well (Catena and WET 2018, Page 17 and Map 15).
- The deep underburden is hydraulically separated from mined Mammoth coal by over 350 feet of multilayered low permeability strata, and groundwater levels and quality in lower portions of the underburden (deep underburden consisting of a massive sandstone) are likely not affected by mining or the Mine's public water supply use to date.

1.2 Springs

The following observations have been made about springs undermined to-date (SPE 2017a, Appendix 314-5; Catena and WET 2018):

- Spring 17185, overlying Panel 3 (**Appendix A, Figure 3.4-1**), showed a brief cessation in flow as longwall mining passed underneath but commenced flowing at normal rates within two weeks after mining was complete in this area. This suggests that strata bounding/underlying this spring "resealed" after subsidence. There is no evidence of a long-term adverse effect to this spring from mining.
- Spring 17145 (Bull Spring), overlying the gate road between Panels 2 and 3 (**Appendix A, Figure 3.4-1**), ceased flowing in July 2014. Longwall mining beneath this spring (Panel 3) occurred in April 2014. Although dry conditions were occasionally observed at this spring before mining, dry and non-flowing conditions observed since July 2014 indicate

that cessation of flow is associated with mining in Panel 3 (Catena and WET 2018). Additional data are needed to evaluate long-term effects on water quantity and quality at this spring.

- Spring 17275, overlying Panel 4 (**Appendix A, Figure 3.4-1**), showed a possible water quality response to longwall mining. A spike in TDS and electrical conductivity (EC) occurred after undermining in July 2014. Timing of the increases followed by subsequent decreases suggests that subsidence may have temporarily influenced water quality at this location. No obvious change in measured flow was observed at this spring; additional data are needed to evaluate long-term water quality changes at this spring.

The remaining undermined springs continue to exhibit flows within historical (pre-mining) ranges, although conclusive evaluations cannot be completed for two springs undermined by longwall mining (17165 and 17415) due to the lack of consistent and comparable historical data; therefore, it is possible that mining related impacts have occurred at these two springs (MDEQ 2017b, p. 9-7). Based upon water quality data collected to date, there is no evidence of transitions in water quality associated with mining activity at any springs other than 17275, noted above.

Two new springs (1701S and 1702S, **Appendix A, Figure 3.4-1**) have emerged after longwall mining undermined and subsided the surrounding terrain. These springs have been added to the monitoring plan in 2016 (SPE 2017a, Appendix 314-4) to assess flow rates, water quality, and permanence. Monitoring records presented in AHRs indicate that both springs have created small pools of water where flow cannot be measured. Spring 1701S has been dry during the summers while Spring 1702S has had water present every month. Water quality of 1701S is comparable to other springs in the Mine permit area. In contrast, EC at 1702S is higher than other springs, possibly reflecting influence of frequently observed heavy cattle use rather than discharge water quality.

1.3 Surface Water

The BLM Coal Lease EA (Section 3.4.4) provides a comprehensive description of surface water resources (streams and ponds) in the Mine permit area and vicinity. Surface water flow at the Mine occurs in response to rainfall and snowmelt events and, to a lesser and more localized extent, as a result of spring discharge. A majority of stream channels situated within the permit boundary are normally dry and flow only in response to substantial rainfall and runoff events, the most notable of which occurred in response to high precipitation in May and June 2011 (Catena and Nicklin 2012). Detailed analysis and establishment of typical numeric baseline streamflow conditions are precluded due to predominantly ephemeral conditions, which in combination with periodic sampling frequencies also resultant high variability in available water quality monitoring data (MDEQ 2016a).

"Ponds in the Bull Mountains consist of stock ponds constructed solely for the storage of water for livestock watering. The location of stock ponds is limited to where spring inputs provide water, or where in-stream impoundments capture and store runoff water from precipitation or snowmelt events" (MDEQ 2016a). "Where ponds are located down gradient from spring issue points, pond volumes are directly related to spring flows, and may dry up as seasonal spring flows diminish or cease. Pond reliant solely on water from runoff events are less reliable and may only hold water for short periods of time." Livestock use is marginally supported as "some parameters, particularly magnesium and sodium, are naturally elevated above the livestock use criteria." "Nonetheless, livestock utilize stock ponds for watering in the absence of better water quality alternatives. In most cases, livestock use has affected water quality in most ponds, with the highest nitrate-nitrite and ammonia concentrations reported for ponds that see consistent livestock use."

1.4 Hydrologic Conditions Surrounding the Existing WDA

Detailed discussion of WDA features are available in Ch. 2, and WDA#1 was analyzed in detail in the BLM Coal Lease EA. Monitoring wells (BMP052 [overburden] and BMP033 [alluvium]) downgradient of WDA#1 have exhibited elevated levels of radium and fluoride most likely due to the use of deep Madison well water for coal processing, but concentrations would not cause impacts to downstream surface water or groundwater resources as no human health standards have been exceeded (MDEQ 2017b, Section 9.2.3.1). Additionally, BMP033 has exhibited single samples with elevated selenium in exceedance of significance criteria; however, concentrations are near the baseline range, and it is likely that these results represent the variability of the natural condition (MDEQ 2017b, Section 9.2.3.2). These impacts are limited, presumably due to the low permeability of both compacted waste and the underlying strata, which limit infiltration.

Ephemeral runoff from WDA #1 is detained in a down-gradient pond and discharge is approved and regulated by MDEQ under an existing MPDES permit. Since construction of WDA #1 and an associated sediment pond, several discharge events have occurred following significant precipitation events or to facilitate pond sediment cleanout in preparation for significant precipitation events.

Unplanned discharges have only occurred as a result of infrequent large precipitation events, such as the previously mentioned May 2011 event that resulted in flood conditions throughout Musselshell County. During this precipitation event, WDA #1's pond spillway suddenly eroded while discharging. In response to this event, SPE increased the pond's storage capacity and strengthened the pond spillway with a concrete footer and gabion baskets to ensure the spillway would not erode during future discharges.

Another series of major (infrequent) precipitation events occurred during May 2013 and August 2014; both of which resulted in discharge violations for exceedance of settleable solids criteria. The August 2014 event also resulted in a violation for pH. Pond discharge tends to be small in comparison to Rehder Creek's overall flow rate, and there is no evidence that surface disturbance has impacted surface water resources off the permit area (MDEQ 2017b, Section 9.2.3.1).

The August 2014 discharge event sample also showed elevated values for organic nitrogen, phosphorus, and several metals (iron, lead, nickel, copper and zinc) (MDEQ 2017b, Section 9.2.3.1). However, since May 2013, whole effluent toxicity testing has been conducted on WDA #1 effluent and no "significant" aquatic toxicity (i.e., mortality of tested organisms) has been observed to-date (data presented in recent AHRs).

1.5 Waters of the U.S., including Wetlands

Wetlands have not been formally delineated in the Mine permit area. The BLM Coal Lease EA describes wetlands as occurring in association with springs and describes their vegetative characteristics (Section 3.6.1) and utility for wildlife (Section 3.7). Historically flowing channel segments and sites exhibiting wetland characteristics have primarily been found in association with monitored springs and ponds and occur on the surface overlying the underground mine plan area (**Appendix A, Figure 3.4-1**). The US Army Corps of Engineers (USACE) has not made an official determination as to whether water courses or wetlands occurring within the permit area are jurisdictional under Section 404 of the CWA. If jurisdictional waters of the US are present, such features would most likely occur along drainage channels and would include connected wetlands.

Most sites that would satisfy criteria for wetlands under the CWA are expected to occur at springs and ponds and downgradient positions receiving water from those features. Although formal wetland delineations have not been completed, ponds and springs are included in the approved hydrology monitoring program specified in the Mine permit (SPE 2017a, Appendix 314-4). Additionally, SPE conducts hydrophytic vegetation monitoring to document natural variability and evaluate potential effects on vegetative conditions at sites that include wetlands (hydrophytic vegetation discussed in **Section 3.6** of the EA).

1.6 Spring and Well Impact Mitigation

As discussed elsewhere in this document and the BLM Coal Lease EA, the Mine permit specifies mitigation measures to be employed in response to observed effects to water resources. SPE has proposed a site-specific mitigation plan for Spring 17145, previously used for livestock watering, that is currently being reviewed by MDEQ. Additional monitoring will be conducted to assess long-term spring affects and the need for permanent mitigation.

One stock water well (BMP064) completed in the deep underburden and located in Panel 3 was abandoned before mining. After mining progressed beyond the original well location, a replacement well was drilled and completed in the same aquifer. No other water resources have required mitigation in accordance with permit requirements.

2.0 Environmental Consequences of Alternatives

Predicted hydrologic impacts of the Proposed Action are presented in the Mine permit and further evaluated in MDEQ's cumulative hydrologic impact assessments (MDEQ 2013 and 2017). These analyses concluded that proposed mining activities are designed to "minimize disturbance to the hydrologic balance both inside and outside the permit area and to prevent material damage outside the permit area" (MDEQ 2017b). The hydrologic monitoring program approved by MDEQ as part of the Mine permit (SPE 2017a, Appendix 314-4) is designed to identify impacts to wells, springs, streams, and ponds, which may differ from predictions. The Mine permit specifies mitigation measures to be employed to address mining-related hydrologic impacts in a manner consistent with applicable regulations (SPE 2017a)

Information in this section updates expected impacts to water quantity and quality based on recent monitoring observations and modeling completed since the BLM Coal Lease EA was prepared. Additional information pertaining to hydrologic impacts, particularly water quality impacts and mitigation are presented in Section 4.2.4 of the BLM Coal Lease EA. Most observations to-date are in reasonable conformance to projections made in the BLM Coal Lease

EA. The main exception relates to projected drawdown in the Mammoth coal and upper underburden from mine dewatering, which is superseded by modeling outputs set forth in the Mine permit (SPE 2017a, Appendix 314-6) and discussed in this section under the Proposed Action.

2.1 Direct & Indirect Effects

No Action

For the No Action scenario, the response of the underlying groundwater system is anticipated to be similar to, but slightly greater in magnitude than observations to date (see **Section 1.4**, above). Effects that would occur in association with mining and associated subsidence under the No Action scenario are discussed below.

Expected Groundwater Impacts

- Drawdown would occur in the following stratigraphic units:
  - Lower portions of the overburden strata – mainly overburden interval 5 and near active longwall mining;
  - Mammoth coal – a majority of drawdown would occur in the northern central portion of the underground mine plan area and in areas adjacent to and north of the permit area;
  - Upper underburden – a majority of drawdown, would occur in the northern central portion of the permit area and in areas to the north of the underground mine plan area; and,
  - Deep underburden aquifer – a maximum drawdown would be less than 3ft;
- The effective cones of depression in the Mammoth coal and shallow underburden would expand slightly beyond that which is presently observed (**Appendix A, Figures 3.4-2 and 3.4-3**, Catena and WET 2018). The effects would be long term but would not rise to the level of major impact as impacts to water uses would be mitigated in accordance with the Mine permit (SPE 2017a, Appendix 3-13.2).
- There is the potential that groundwater supply sources dependent upon the deeper overburden, Mammoth coal, or upper underburden, could be adversely affected by mining. If such impacts occur, mitigation would be implemented in accordance with the Mine permit and replacement water would likely be sourced from a well completed in the deep underburden aquifer.
- Impacts to groundwater quality are projected to be limited to the mine gob and to strata immediately underlying and/or immediately adjacent to the gob (SPE 2017a, Appendix 314-5). Water quality impacts could also occur in other overburden strata, although limited impacts have been observed to-date (see spring impacts below).
- Impacts to groundwater quality and quantity would occur in the long-term but would not rise to the level of major impact as impacts to water uses would be mitigated in accordance with the Mine permit and ARM 17.24.648.

Expected Spring Impacts

- Some springs may be affected by mining in the short-term as observed at 17145 and 17275 (discussed in Section 3.4). Based on the limited effects observed at springs in response to mining to-date long-term effects to spring water quality or quantity are considered unlikely at most springs in response to mining under the No Action.
- Long-term effects to springs and associated intermittent stream reaches, if any, would be mitigated in accordance with the Mine permit (SPE 2017a, Appendix 3-13.3) as discussed in the BLM Coal Lease EA (Section 4.2.4.3) and **Section 2.1.5** of the EA, resulting in minor long-term effects to water availability for existing uses.

Expected Surface Water Impacts

- Surface water downstream of disturbances and overlying the mining area would potentially be affected in the manner described in Section 4.2.4.2 of the BLM Coal Lease EA.
- Surface water quantity effects are considered unlikely. Some limited detention (ponding) may occur if ridges develop and would be mitigated as described in the Mine permit (SPE 2017a, Appendix 313-3). For example, minor grading was performed at the north end of Panel 4 to restore stream flow in an unnamed ephemeral tributary of Rehder Creek. Small unmitigated storage associated with ponding, if it occurs, would be negligible, though possibly long-term. Surface water runoff would continue to be affected by impoundment in the Surface Facilities Area, consistent with the current condition. Such effects would be minor and short-term as ponds would be removed after other mine facilities are decommissioned and reclamation is complete.
- Subsidence would not be expected to affect surface water quality. Surface water quality in the vicinity of the Surface Facilities Area would potentially be affected in the short-term, but compliance with MPDES permits would ensure those effects are minor.

As discussed in the BLM Coal Lease EA, mitigation measures described in the Mine permit have been developed to address spring and groundwater (well) impacts. Implementation of those measures, including measures implemented to date (see **Section 2.2** of the EA and **Section 1.4**, above), ensures that long-term impacts to water quality and quantity would not be major.

<u>Proposed Action</u>

Expected Groundwater Impacts - Alluvium

Mining is not expected to impact alluvial groundwater either in terms of water quantity or water quality.

Expected Groundwater Impacts - Overburden

Primary impacts to saturated zones in the overburden would occur in the fragmented and fractured zones for strata in subsidence areas. In subsided areas, the fractured zone extends into the sandstone above the Rock Mesa coal (in overburden interval 5). Given that multilayered sequences of claystones, siltstones, shale and sandstone are present throughout the overburden section, lower permeability strata fractures would likely "reseal" following subsidence, meaning effects to relatively shallower overburden intervals would be less likely (SPE 2017a, Appendix 314-5). Impacts to shallower overburden groundwater levels, if they occur, are projected to be negligible and short-term. In contrast, impacts to the deeper overburden portions that are within the fragmented/fractured zones are projected to be moderate and long-term, potentially requiring mitigation of affected wells and springs in accordance with the Mine permit to ensure effects do not rise to the threshold of significance. "Any changes in water quality are likely to be localized over the longwall panels. There will be no measurable effects on existing or anticipated uses, and no changes in water quality which will be harmful detrimental or injurious to the listed uses." (MDEQ 2016a).

Expected Groundwater Impacts - Mammoth Coal and Underburden

Two groundwater models were recently developed to provide better estimates of Mine effects on the Mammoth coal and underburden aquifers. These models supersede the prior model discussed in the BLM Coal Lease EA Section 4.2.4.1 (pages 4-13 through 4-21). The "Groundwater Model" (SPE 2017a, Appendix 314-6) is a three-dimensional model representing strata extending from the overburden to the upper underburden. This groundwater model focuses on quantitative water level changes in the Mammoth coal and the upper underburden as they would be affected by mining under the Proposed Action. It also provides simulation results that allow prediction of flows in response to such mining. Key predictions of this model with regard to the Proposed Action include the following:

- Maximum drawdown in the Mammoth coal and upper underburden at the end of the mining is projected to be up to 90 feet within the permit boundary (**Appendix A, Figure 4.4-1**).
- The cone of depression and magnitude of drawdown of the Mammoth coal and upper underburden aquifers outside the permit boundary are predicted to be greatest to the north northwest, with the maximum drawdown outside and immediately adjacent and northwest of the permit boundary projected to reach approximately 50 feet by the end of mining. Drawdown would decrease progressively with distance from the Mine. The cone of depression extents and drawdown magnitudes are projected to be much more limited (ranging from less than 5 feet to just over 20 feet) beyond the permit boundary to the east, south and west (**Appendix A, Figure 4.4-1**).
- Following cessation of mining, water levels would begin to recover. The nature of recovery would depend upon the behavior of the constructed gate roads following mining the adjacent panels (discussed in SPE 2017a, Appendix 314-6, Attachment 3M). Under modelled Scenario 1, gate roads would collapse (cave in) following mining (**Appendix A, Figure 4.4-2**). Under modelled Scenario 2, gate roads remain generally intact (**Appendix A, Figure 4.4-3)**. If gate roads remain generally intact for an extended time after mining (Scenario 2), the tendency would be for greater mine pooling in northern portions mined area. If gate roads cave soon after mining (Scenario 1), the degree of mine pooling would be less; this scenario is considered to be the most likely long-term condition. While some gate roads have remained intact in mined out portions of the Mine, others are caving as designed. For either scenario, residual drawdown is projected to occur within the permit boundary with portions of the

Mammoth coal remaining unsaturated in the long-term (at least 50 years) (**Appendix A, Figures 4.4-4** and **4.4-5**). If gate roads remain intact, the model predicts that groundwater levels would increase relative to baseline groundwater levels both within and just beyond the northern permit boundary (**Appendix A, Figure 4.4-5**).

The "Deep Underburden Groundwater Model" (SPE 2017a, Appendix 314-7) is a three-dimensional model focused on the underburden strata, especially the deep underburden sandstone. The model provides a tool for evaluating the hydraulic capacity of this deep underburden sandstone to serve existing uses and potential use for replacement water to mitigate mine impacts, if needed. The model predicts that the maximum drawdown at the end of mining in the deep underburden sandstone would be 3 feet, a minor change.

While effects to the Mammoth Coal, upper underburden, and overburden would be long-term, impacts to affected uses would be mitigated in accordance with the Mine permit, ensuring that water is replaced and overall impacts of the Proposed Action do not rise to the level of major impact. Impacts to the deep underburden as a result of mining would be minor in the long-term, so it would remain a viable source of replacement water for mitigation, as discussed below (SPE 2017a, Appendix 314-7).

Expected Spring Impacts

The massive sandstone above the Rock Mesa coal in overburden interval 5 is the interpreted source of overburden groundwater contributions to mine gob and gate roads following subsidence. Springs sourced by this sandstone would be at a greater risk of impacts compared to springs located in relatively higher portions of the overburden strata. However, shallower springs may be impacted (e.g., Spring 17145 discussed in **Section 1.4**, above). The most likely effect to impacted springs would be reduced discharge rates including the cessation of discharge, which could persist in the long-term. Water quality of some springs may also be affected in the short and long-term. Mitigation measures employed in accordance with the Mine permit (SPE 2017a, Appendix 313-2 and 313-3), as noted below and in the BLM Coal Lease EA, would ensure impacts to water quality and availability for existing uses are not major.

Expected Surface Water Impacts

Surface water impacts are expected, as discussed below. Mitigation measures employed in accordance with the Mine permit, as noted below and in the BLM Coal Lease EA, would ensure long-term impacts to ponds, stream channels, and surface water quality and availability are not major.

The Proposed Action is unlikely to have measurable effects to channel flows. Some very limited ponding in stream reaches may occur if ridges develop as a result of uneven subsidence in the vicinity of gate roads. Storage associated with that ponding, if it occurs would be negligible, but potentially long-term.

Intermittent and ephemeral stream reaches dependent upon spring discharges for flow were identified in the baseline monitoring and discussed in the BLM Coal Lease EA. Such reaches would only be affected if the source spring(s) are affected by mining subsidence. Adverse long-term effects to intermittent and ephemeral stream reaches would potentially occur, but mitigation (SPE 2017a, Appendix 313-3) would ensure that those impacts are not major.

Ponds in the mining area may be affected by subsidence, potentially resulting in leakage. However, observations to-date show that surface cracking is less evident in valley bottoms where ponds are constructed. This is because gentle slopes and unconsolidated surficial materials allow soil to displace and cover underlying fractured rock (Personal Communication between Roberta Martínez Hernández, Environmental Engineer, OSMRE, and Martin Van Oort, Hydrologist, MDEQ, February 8, 2018). Affected ponds would be repaired soon after impacts are detected in accordance with the Mine permit requirements, ensuring that adverse long-term impacts would not occur.

Expected Hydrology Effects of WDA #2

Hydrologic effects of WDA#2 would be very similar to WDA#1 and are discussed in the Mine's PHC (SPE 2017a, Appendix 314-5) and MDEQ's CHIA (MDEQ 2017b). Such effects include the following.

- Shallow strata that would underlie or be adjacent to WDA#2 tend to be unsaturated and the vertical permeability of the compacted waste material would be extremely low, reducing the potential for impacts to groundwater quality or quantity as a result of WDA#2 construction.
- There are no springs within the proposed WDA#2 footprint and springs historically identified in the vicinity were typically dry from 1989 to 2014 and are no longer monitored (MDEQ 2017b); therefore, no impacts to springs or associated wetlands are projected.
- Detention of storm-water and snowmelt runoff during occasional runoff events would occur in WDA#2, but given that WDA#2 disturbance constitutes approximately 2 percent of the Rehder Creek basin, effects to surface water flows would be negligible relative to total stream flow. Effects on surface water quantity would be negligible in the long-term as WDA #2 would be reclaimed in a manner that does not impound water.
- Surface water discharge from the WDA#2 pond during significant precipitation events could affect downgradient surface water quality in the short-term. However, the size of the catchment is small relative to Rehder Creek drainage as a whole. Water quality impacts, if they occur, would be negligible or minor. The MPDES discharge permit would further ensure hydrologic control structures associated with WDA#2 are designed, constructed, and operated in a manner protective of the receiving drainage. The facility would be fully reclaimed and stabilized following mine closure, resulting in negligible water quality effects in the long-term.

Potential Future Mitigation Requirements

SMCRA, MSUMRA, and attendant Montana regulations (ARM 17.24.648) require replacement of water supplies used for domestic, agricultural, industrial, or other legitimate uses if such supply has been affected by contamination, diminution, or interruption as a result of mining operations.

Impacts to wells, springs, streams, and ponds would potentially occur and be mitigated in accordance with the Mine permit. Mitigation requirements are consistent with those described in the BLM Coal Lease EA, except as noted in this section.

Potential exists for some mined-out wells to require replacement and drawdown caused by mine dewatering could reduce the static water column in some wells. If such effects would occur, the most appropriate mitigation measure would be to drill a replacement well into the deep underburden sandstone, a reliable source of groundwater in the immediate vicinity of the Mine (SPE 2017a, Appendix 314-5). As discussed in **Section 2.1.5** of the EA**,** the Mine bond includes a "Trust Fund" to address potential long-term costs associated with maintenance and operation of any necessary water replacement facilities in accordance with ARM 17.24.301.

The Mine permit (SPE 2017a) includes plans for spring impact analysis (Appendix 314-2) and impact detection (Appendix 314-3) that would identify springs affected by mining and subsequent mining subsidence. Mitigation described in the Mine permit (SPE 2017a, Appendix 313-2) would be implemented if a given spring is affected to the degree that it cannot meet the use that existed prior to mining. The two most practical means of mitigation for spring flows include (in order of priority) spring redevelopment (e.g., repair) and construction of a replacement water source.

If spring redevelopment proves to be infeasible, then the lost water supply would most likely be mitigated through construction of a new well and water distribution system (i.e., pipeline and storage tanks), whereby impacts to more than one spring could be mitigated by a single well feeding multiple water tanks. Wells would most likely be drilled into the deep underburden sandstone, although the mine pool and overburden aquifers may also provide suitable water. The rate of flow from such a water supply well(s) would be constrained by State law pertaining to water rights (MCA 85-2-343, Musselshell River Basin is closed to new appropriations), likely precluding pumping for direct discharge down channel in the manner comparable to spring discharge. Other methods described in the BLM Coal Lease EA would remain available for spring impact mitigation.

Intermittent stream reach flows dependent upon spring flow sources may be affected by mining and may require repair or replacement. Mitigation measures presented in the Mine permit (SPE 2017a, Appendix 313-3) and described in the BLM Coal Lease EA would be implemented to repair or replace damaged water sources; with a notable exception being that options to replace springs with continuously pumping and discharging wells are limited by State law. Depending on the site and degree of impact to spring discharge, some channel segments may not exhibit intermittent or perennial flow after mining. However, all water sources necessary to support the postmining land uses would be replaced in accordance with applicable regulations, thereby ensuring long-term Mine-related impacts to hydrologic conditions are not major.

Potential Impacts to Waters of the U.S., including Wetlands

As noted in **Section 1.4** (above), the USACE has not yet made formal determinations of jurisdiction under the CWA. The Mine permit specifies methods for handling hydric soil and revegetating non-jurisdictional wetlands (SPE 2017a, Volume 2, Section 313) as part of the reclamation plan evaluated by the BLM Coal Lease EA. The Mine permit also states that before construction activities begin within jurisdictional waters, SPE would consult with MDEQ, obtain appropriate permits from USACE and revise the Mine permit, as necessary, to specifically address the associated construction activity. Such requirements would apply to surface disturbance for roads, drill pads, WDA #2 construction, and subsidence repairs. While waters of the US, including wetlands, may occur within the areas to be disturbed in association with the Proposed Action, existing regulations and permit conditions would require impact avoidance or mitigation (e.g., replacement or reclamation) of any construction-related impacts to waters of the US, including wetlands. State regulations and permitting administered by USACE would ensure that impacts would be short-term and would not be major.

2.2 Cumulative Effects

Cumulative effects of the Proposed Action and No Action Alternative on groundwater would be similar to the direct and indirect effects discussed in **Section 2.1** of the EA, which account for the entire water system including natural variability and existing uses.

MDEQ (2016a) states that "[t]he primary non-mining impact on the hydrologic balance in the Bull Mountains is from agriculture. Cattle grazing impacts the quantity and quality of surface water resources, and springs are impacted by alterations to their issue points to support cattle watering." Agricultural uses of groundwater will continue and new spring developments may be constructed. New wells may be drilled for agricultural or domestic use purposes. While such developments could have localized effects on shallow aquifers they are not expected to have major effects on existing uses or the groundwater system as a whole. Most reliable wells would likely be drilled into the deep underburden aquifer, a reliable source of water in the Mine vicinity. The deep underburden aquifer is capable of supporting mitigation uses discussed in Section 4.4.1 and other foreseeable agricultural and domestic uses in the area without major impact to water availability in the long-term, although some drawdown would occur in the long-term.

Agricultural uses, fires, and minor construction activities (e.g., residential subdivisions and roadways) will continue to affect surface waters. The degree of impact is expected to be comparable to the existing condition, although short-term effects of fires or overgrazing on surface water quantity may be more severe if followed by intense precipitation events resulting in substantial runoff. Local watersheds would be affected by construction of ponds for agricultural use, but the requirement to permit water rights would ensure overall impacts to watersheds do not become major in the long-term. In general, surface water quantity and quality in the postmining landscape is expected to be highly variable, as it is in the existing condition. Major, irremediable impacts to the quality and quantity of surface water resources are not expected from continued underground mining.

Mitigation of mining effects on groundwater and surface water uses conducted in accordance with the Mine permit (SPE 2017a) would ensure that long-term effects of mining in combination with these other activities are not major in the long-term.

APPENDIX F – WILDLIFE SPECIES LIST

APPENDIX F

Species Recorded or Potentially Occurring in Wildlife Monitoring Area[1] (Catena 2017b)

Species[2]	SOC[2]	BLM Sensitive[3]	1989-1996	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
BIRDS																			
American coot (*Fulica americana*)			X										X	X	X	X	X	X	X
American crow (*Corvus brachyrhynchos*)			X	X	X		X	X	X	X	X	X	X	X	X			X	X
American goldfinch (*Carduelis tristis*)			X								X		X	X	X	X	X		
American green-winged teal (*Anas crecca*)			X									X	X	X	X				X
American kestrel (*Falco sparverius*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
American pipit (*Anthus rubescens*)															X				
American redstart (*Setophaga ruticilla*)																			
American robin (*Turdus migratorius*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
American tree sparrow (*Spizella arborea*)																			
American wigeon (*Anas americana*)			X																
Baird’s sandpiper (*Calidris bairdii*)			X																
Baird's sparrow (*Ammodramus bairdii*)	SOC	S																	
Bald eagle (*Haliaeetus leucocephalus*)		S	X			X			X	X				X		X	X	X	X
Bank swallow (*Riparia riparia*)			X	X		X							X	X	X	X			
Barn swallow (*Hirundo rustica*)			X								X		X	X	X				X
Barred owl (*Strix varia*)													X						
Belted kingfisher (*Ceryle alcyon*)			X																
Black-billed cuckoo (*Coccyzus erythropthalmus*)	SOC																		
Black-billed magpie (*Pica pica*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Black-capped chickadee (*Poecile atricapillus*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Black-headed grosbeak (*Pheucticus melanocephalus*)			X								X	X	X	X	X	X	X		
Blue-winged teal (*Anas discors*)																X		X	
Bobolink (*Dolichonyx oryzivorus*)	SOC																		
Bohemian waxwing (*Bombycilla garrulus*)			X													X			
Brewer's blackbird (*Euphagus cyanocephalus*)			X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
Brewer's sparrow (*Spizella breweri*)	SOC	S	X							X	X	X	X	X	X	X	X	X	X
Brown thrasher (*Toxostoma rufum*)															X	X	X	X	X
Brown-headed cowbird (*Molothrus ater*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Bullock’s oriole (*Icterus bullockii*)			X					X		X	X	X	X	X	X	X	X	X	X
Burrowing owl (*Athene cunicularia*)	SOC	S																	
Canada goose (*Branta canadensis*)			X							X		X	X	X	X	X		X	X
Canyon wren (*Catherpes mexicanus*)															X			X	X
Cassin’s kingbird (*Tyrannus vociferans*)					X			X	X	X	X	X	X	X	X	X	X	X	X
Cassin's Finch (*Carpodacus cassinii*)	SOC													X					
Cedar waxwing (*Bombycilla cedrorum*)			X										X	X	X			X	
Chestnut-collared longspur (*Calcarius ornatus*)	SOC	S	X												X				
Chipping sparrow (*Spizella passerina*)			X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
Cinnamon teal (*Anas cyanoptera*)																			
Clark's nutcracker (*Nucifraga columbiana*)	SOC		X		X								X	X	X	X		X	X

APPENDIX F

Species Recorded or Potentially Occurring in Wildlife Monitoring Area[1] (Catena 2017b)

Species[2]	SOC[2]	BLM Sensitive[3]	1989-1996	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
BIRDS cont…																			
Clay-colored sparrow (*Spizella pallida*)					X					X	X	X				X			
Cliff swallow (*Petrochelidon pyrrhonota*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Common grackle (*Quiscalus quiscula*)			X												X	X	X	X	X
Common nighthawk (*Chordeiles minor*)			X	X	X	X	X	X	X	X			X	X	X	X	X		X
Common poorwill (*Phalaenoptilus nuttallii*)			X									X	X	X	X	X			
Common raven (*Corvus corax*)			X					X	X	X	X	X	X	X	X	X	X	X	X
Common redpoll (*Carduelis flammea*)			X																
Common yellowthroat (*Geothlypis trichas*)			X		X	X		X							X	X	X	X	
Cooper's hawk (*Accipiter cooperii*)			X										X			X			
Cordilleran flycatcher (*Empidonax occidentalis*); formerly western flycatcher (*Empidonax difficilis*)			?[j]										X	X	X				
Dark-eyed junco (*Junco hyemalis*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Dickcissel (*Spiza americana*)																			
Downy woodpecker (*Picoides pubescens*)			X										X	X	X	X	X	X	X
Dusky flycatcher (*Empidonax oberholseri*)													X	X	X	X	X		
Eastern Bluebird (Sialia sialis)																X			
Eastern kingbird (*Tyrannus tyrannus*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Eastern phoebe (*Sayornis phoebe*)			X[j]																
Eastern screech-owl (*Otus asio*)																			
Eastern wood-pewee (*Contopus virens*)			?[j]																
European starling (*Sturnus vulgaris*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Evening grosbeak (*Coccothraustes vespertinus*)	SOC		X													X	X	X	
Ferruginous hawk (*Buteo regalis*)	SOC	S	X										X						
Gadwall (*Anas strepera*)																X			
Golden eagle (*Aquila chrysaetos*)	SOC	S	X		X		X	X	X	X	X	X	X		X	X	X	X	X
Grasshopper sparrow (*Ammodramus savannarum*)			X		X				X	X	X					X			
Gray catbird (*Dumetella carolinensis*)													X	X	X	X	X	X	X
Gray partridge (*Perdix perdix*)													X		X				
Gray-crowned rosy-finch (*Leucosticte tephrocotis*)	SOC		X													X			
Great blue heron (*Ardea herodias*)	SOC		X										X						
Great horned owl (*Bubo virginianus*)			X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X
Greater sage-grouse (*Centrocercus urophasianus*)	SOC	S																	
Green-tailed Towhee (Pipilo chlorurus)	SOC															X			
Green-winged Teal (Anas crecca)																X		X	X
Hairy woodpecker (*Picoides villosus*)			X												X	X	X	X	X
Hermit Thrush (Catharus guttatus)																X			
Hooded Merganser (Lophodytes cucullatus)																X			
Hoary redpoll (*Carduelis hornemanni*)																			

APPENDIX F

Species Recorded or Potentially Occurring in Wildlife Monitoring Area[1] (Catena 2017b)

Species[2]	SOC[2]	BLM Sensitive[3]	1989-1996	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
BIRDS cont…																			
Horned lark (*Eremophila alpestris*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X			
House finch (*Carpodacus mexicanus*)																			
House sparrow (*Passer domesticus*)			X			X	X	X	X	X						X			
House wren (*Troglodytes aedon*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Indigo bunting (*Passerina cyanea*)																			
Killdeer (*Charadrius vociferus*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Lapland longspur (*Calcarius lapponicus*)																			
Lark bunting (*Calamospiza melanocorys*)			X			X					X				X				
Lark sparrow (*Chondestes grammacus*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Lazuli bunting (*Passerina amoena*)													X	X	X	X			
Lesser Scaup (Aythya affinis)																X			
Least flycatcher (*Empidonax minimus*)			X	X	X	X	X	X	X				X	X					
Lewis' woodpecker (*Melanerpes lewis*)	SOC	S	X						X	X	X		X		X	X	X	X	X
Loggerhead shrike (*Lanius ludovicianus*)	SOC	S	X																
Long-billed curlew (*Numenius americanus*)	SOC	S	X													X			
Mallard (*Anas platyrhynchos*)			X		X	X			X	X	X	X	X	X	X	X	X	X	X
Marbled Godwit (Limosa fedoa)																X	X	X	
McCown’s longspur (*Calcarius mccownii*)	SOC	S																	
Merlin (*Falco columbarius*)			X										X			X			
Mountain bluebird (*Sialia currucoides*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Mountain chickadee (*Poecile gambeli*)			X									X	X	X	X	X			
Mourning Dove (*Zenaida macroura*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Northern flicker (*Colaptes auratus*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Northern goshawk (*Accipiter gentilis*)	SOC		X										X	X					
Northern harrier (*Circus cyaneus*)			X							X					X	X			X
Northern mockingbird (*Mimus polyglottos*)																			
Northern pintail (*Anas acuta*)																			
Northern pygmy-owl (*Glaucidium gnoma*)			?[j]												X				
Northern rough-winged swallow (*Stelgidopteryx serripennis*)											X		X	X	X				
Northern saw-whet owl (*Aegolius acadicus*)													X	X					
Northern shoveler (*Anas clypeata*)																X			
Northern shrike (*Lanius excubitor*)														X		X			
Olive-sided flycatcher (*Contopus cooperi*)																			
Orchard oriole (*Icterus spurious*)																			
Ovenbird (*Seiurus aurocapillus*)													X	X					
Peregrine falcon (*Falco peregrinus*)	SOC	S																	
Pine grosbeak (*Pinicola enucleator*)			X																
Pine siskin (*Carduelis pinus*)			X		X			X	X		X				X		X		

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Species Recorded or Potentially Occurring in Wildlife Monitoring Area[1] (Catena 2017b)

Species[2]	**SOC[2]**	**BLM Sensitive[3]**	**1989-1996**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
BIRDS cont…																			
Pinyon jay (*Gymnorhinus cyanocephalus*)	SOC		X										X	X	X	X	X	X	X
Plumbeous vireo (*Vireo plumbeus*) (formerly Solitary Vireo)			X										X	X	X	X	X		X
Prairie falcon (*Falco mexicanus*)			X	X					X	X	X	X	X	X	X	X	X		X
Pygmy nuthatch (*Sitta pygmaea*)																X			
Red crossbill (*Loxia curvirostra*)			X	X	X					X			X	X	X	X	X		X
Red phalarope (*Phalaropus fulicaria*)																			
Red-breasted nuthatch (*Sitta canadensis*)			X		X		X						X	X	X	X	X	X	X
Red-eyed vireo (*Vireo olivaceus*)																			
Red-headed woodpecker (*Melanerpes erythrocephalus*)	SOC	S	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Red-naped sapsucker (*Sphyrapicus nuchalis*)																			X
Red-necked phalarope (*Phalaropus lobatus*)																			
Red-tailed hawk (*Buteo jamaicensis*)			X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
Red-winged blackbird (*Agelaius phoeniceus*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Ring-necked pheasant (*Phasianus colchicus*)																			
Rock Pigeon (*Columba livia*)			X					X	X	X	X	X	X	X	X	X	X	X	X
Rock wren (*Salpinctes obsoletus*)			X		X		X	X	X	X			X	X	X	X	X	X	X
Rose-breasted grosbeak (*Pheucticus ludovicianus*)																			
Rough-legged hawk (*Buteo lagopus*)			X			X			X	X	X			X	X	X	X		
Ruffed grouse (*Bonasa umbellus*)																			
Rufous Hummingbird (*Selasphorus rufus*)																			
Sage thrasher (*Oreoscoptes montanus*)	SOC	S													X				
Sandhill crane (*Grus canadensis*)																X			
Savannah sparrow (*Passerculus sandwichensis*)			X							X		X	X	X	X	X			
Say's phoebe (*Sayornis saya*)			X			X	X	X		X			X	X	X	X	X	X	X
Scissor-tailed flycatcher (*Tyrannus forficatus*)																			
Sharp-shinned hawk (*Accipiter striatus*)			X[j]					X[j]							X	X			
Sharp-tailed grouse (*Tympanuchus phasianellus jamesi*)			X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X
Short-eared owl (*Asio flammeus*)																			
Snow bunting (*Plectrophenax nivalis*)			X														X		
Snowy owl (*Nyctea scandiaca*)																			
Song sparrow (*Melospiza melodia*)			X												X		X		
Sora (*Porzana carolina*)			X							X		X	X	X	X		X		
Spotted sandpiper (*Actitis macularia*)								X			X	X		X		X	X	X	X
Spotted towhee (*Pipilo maculatus*)			X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
Sprague's pipit (*Anthus spragueii*)	SOC	S																	
Steller's jay (*Cyanocitta stelleri*)																			
Stilt sandpiper (*Calidris himantopus*)			X																
Swainson's hawk (*Buteo swainsoni*)			X																

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Species Recorded or Potentially Occurring in Wildlife Monitoring Area[1] (Catena 2017b)

Species[2]	SOC[2]	BLM Sensitive[3]	1989-1996	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
BIRDS cont…																			
Swainson's thrush (*Catharus ustulatus*)			X																
Townsend's solitaire (*Myadestes townsendi*)			X				X			X			X	X	X	X	X	X	X
Tree swallow (*Tachycineta bicolor*)			X	X	X	X			X	X	X	X	X	X	X	X			
Trumpeter Swan (Cygnus buccinator)	SOC															X			
Tundra Swan (Cygnus columbianus)																X			
Turkey vulture (*Cathartes aura*)			X	X	X			X	X		X	X	X	X	X	X	X	X	X
Unidentified flycatcher																	X	X	
Unidentified Empidonax Flycatcher																X			
Upland sandpiper (*Bartramia longicauda*)				X							X	X	X	X		X	X	X	
Veery (*Catharus fuscescens*)	SOC	S																	
Vesper sparrow (*Pooecetes gramineus*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Violet-green swallow (*Tachycineta thalassina*)			X	X	X	X	X					X	X	X	X	X	X	X	X
Virginia rail (*Rallus limicola*)																			
Warbling vireo (*Vireo gilvus*)			X										X	X	X	X	X	X	
Western bluebird (*Sialia mexicana*)												X					X		
Western kingbird (*Tyrannus verticalis*)			X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	
Western meadowlark (*Sturnella neglecta*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Western tanager (*Piranga ludoviciana*)			X		X				X	X	X	X	X	X	X	X	X		
Western wood-pewee (*Contopus sordidulus*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Whimbrel (*Numenius phaeopus*)																			
White-breasted nuthatch (*Sitta carolinensis*)			X			X		X	X	X		X				X	X	X	X
White-crowned sparrow (*Zonotrichia leucophrys*)																X			
White-throated Sparrow (Zonotrichia albicollis)																			X
White-throated swift (*Aeronautes saxatalis*)			X								X	X	X	X	X	X	X	X	
White-winged crossbill (*Loxia leucoptera*)			?[i]																
Whooping crane (*Grus americana*)	SOC																		
Wild turkey (*Meleagris gallopavo*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Willow flycatcher (*Empidonax trailii*)																			
Willet (Tringa semipalmata)																			X
Wilson's phalarope (*Phalaropus tricolor*)												X							
Wilson's Snipe (Gallinago delicata), formerlly common snipe			X			X		X	X							X	X	X	X
Wood duck (*Aix sponsa*)																X			
Yellow warbler (*Dendroica petechia*)			X	X	X	X	X	X				X	X	X	X	X	X	X	X
Yellow-breasted chat (*Icteria virens*)															X				
Yellow-headed blackbird (*Xanthocephalus xanthocephalus*)			X																
Yellow-rumped warbler (*Dendroica coronata*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	

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Species Recorded or Potentially Occurring in Wildlife Monitoring Area[1] (Catena 2017b)

Species[2]	SOC[2]	BLM Sensitive[3]	1989-1996	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
MAMMALS																			
Badger (*Taxidea taxus*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X			X
Beaver (*Castor canadensis*)																			
Big brown bat (*Eptesicus fuscus*)			X	X	X	X	X	X	X								X+	X+	X+
Black Bear (*Ursus americanus*)																			X
Black-tailed prairie dog (*Cynomys ludovicianus*)	SOC	S																	
Bobcat (*Felis rufus*)			X			X	X				X		X		X	X	X	X	X
Bushy-tailed woodrat (*Neotoma cinerea*)			X	X	X		X	X	X		X		X	X	X				
Cottontail (Sylvilagus spp.)																X	X	X	X
Coyote (*Canis latrans*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Deer mouse (*Peromyscus maniculatus*)			X				X	X			X			X	X				X
Desert cottontail (*Sylvilagus audubonii*)			X	X	X	X	X	X	X	X	X	X	X	X	X				
Dwarf shrew (*Sorex nanus*)	SOC																		
Eastern Red bat (*Lasiurus borealis*)																			
Elk (*Cervus elaphus*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Fringed myotis (*Myotis thysanodes*)	SOC	S							X?+										
Hayden's shrew (*Sorex haydeni*)																			
Hoary bat (*Lasiurus cinereus*)	SOC		X			X			X								X+	X+	X+
House mouse (*Mus musculus*)																			
Least chipmunk (*Tamias minimus*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Little brown myotis (*Myotis lucifugus*)			X			X			X								X+	X+	X+
Long-eared myotis (*Myotis evotis*)			X						X								X+	X?+	
Long-legged myotis (*Myotis volans*)			X						X										X?+
Long-tailed vole (*Microtus longicaudus*)			X																
Long-tailed weasel (*Mustela frenata*)			X												X				X
Meadow vole (*Microtus pennsylvanicus*)			X										X	X	X				
Merriam shrew (*Sorex merriami*)	SOC																		
Mink (*Mustela vison*)																			
Mountain cottontail (*Sylvilagus nuttallii*)			X		X	X	X				X			X	X				
Mountain lion (*Felis concolor*)										X		X	X		X	X			X
Mule deer (*Odocoileus hemionus*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Muskrat (*Ondatra zibethicus*)			X											X	X				
Northern grasshopper mouse (*Onychomys leucogaster*)			X											X					
Northern myotis (*Myotis septentrionalis*)		T							X?+										
Northern pocket gopher (*Thomomys talpoides*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
Olive-backed pocket mouse (*Perognathus fasciatus*)			X																
Ord's kangaroo rat (*Dipodomys ordii*)																			
Pallid bat (*Antrozous pallidus*)	SOC	S							X								X?+	X?+	
Porcupine (*Erethizon dorsatum*)			X	X	X	X	X	X	X	X	X		X	X	X	X	X		

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Species Recorded or Potentially Occurring in Wildlife Monitoring Area[1] (Catena 2017b)

Species[2]	SOC[2]	BLM Sensitive[3]	1989-1996	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
MAMMALS cont…																			
Prairie vole (*Microtus ochrogaster*)																			
Preble shrew (*Sorex preblei*)	SOC																		
Pronghorn (*Antilocapra americana*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Raccoon (*Procyon lotor*)			X	X	X	X	X	X											
Red fox (*Vulpes vulpes*)			X									X			X				
Red squirrel (*Tamiasciurus hudsonicus*)																		X	X
Richardson’s ground squirrel (*Urocitellus richardsonii*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Sagebrush vole (*Lammiscus curtatus*)																			
Silver-haired bat (*Lasionycteris noctivagans*)			X						X		X						X+	X+	X+
Spotted bat (*Euderma maculatum*)	SOC	S	X						X				X	X				X+	X+
Striped skunk (*Mephitis mephitis*)			X									X			X				
Thirteen-lined ground squirrel (*Ictidomys tridecemlineatus*)			X																
Townsend's big-eared bat (*Corynorhinus townsendii*)	SOC	S	X						X										
Unidentified *Myotis*							X	X	X	X	X		X?+	X?+	X?+				
Western harvest mouse (*Reithrodontomys megalotis*)																			
Western jumping mouse (*Zapus princeps*)																			
Western small-footed myotis (*Myotis ciliolabrum*)			X						X								X?+		X?+
White-footed mouse (*Peromyscus leucopus*)																			
White-tailed deer (*Odocoileus virginianus*)			X					X	X	X	X	X				X			
White-tailed jackrabbit (*Lepus townsendii*)			X						X	X		X	X	X	X				
Yellow-bellied marmot (*Marmota flaviventris*)			X		X			X				X	X	X	X	X		X	
Yellow-pine chipmunk (*Tamias amoenus*)															X	X			
AMPHIBIANS																			
Boreal chorus frog (*Pseudacris maculata*)			X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X
Great Plains toad (*Bufo cognatus*)	SOC	S	X													X			
Northern leopard frog (*Rana pipiens*)			X	X	X	X	X	X						X					
Plains spadefoot (*Spea bombifrons*)	SOC	S																	
Tiger salamander (*Ambystoma tigrinum*)			X	X	X	X	X	X	X		X		X	X	X	X	X		
Woodhouse's toad (*Bufo woodhousii*)			X		X	X				X	X		X	X	X				X
REPTILES																			
Common garter snake (*Thamnophis sirtalis*)			X[m]																X
Common Sagebrush lizard (*Sceloporus graciosus*)			X																
Eastern racer (*Coluber constrictor*)			X										X						
Gopher snake (*Pituophis catenifer*)			X				X			X				X		X			X
Greater short-horned lizard (*Phrynosoma hernandesi*)	SOC	S																	
Milk snake (*Lampropeltis triangulum*)	SOC	S																	
Painted turtle (*Chrysemys picta*)			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Plains garter snake (*Thamnophis radix*)													X						
Rubber Boa (Charina bottae)																X			

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Species Recorded or Potentially Occurring in Wildlife Monitoring Area[1] (Catena 2017b)

Species[2]	**SOC[2]**	**BLM Sensitive[3]**	**1989-1996**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
REPTILES cont...																			
Spiny softshell (*Apalone spinifera*)	SOC	S																	
Western hog-nosed snake (*Heterodon nasicus*)	SOC	S																	
Western rattlesnake (*Crotalus viridis*)			X		X	X	X	X	X		X								X
Western Terrestrial garter snake (*Thamnophis elegans*)			X												X				

(1) Species recorded in a given year are noted with a "X". Species of questionable identification are identified with a "?". Species recorded by acoustic survey only are identified with a "+".

(2) Montana species of concern ("SOC") (MTNHP 2016).

(3) BLM sensitive ("S") species (BML 2014). Red Knot and Northern Myotis are listed as Threatened under the ESA and are flagged with a "T" in this column.

APPENDIX G – SOCIOECONOMICS

This appendix provides supporting data and statistics to supplement description of the current condition as presented in **Section 3.11** and **Section 3.12** of the EA, including 2015 population, housing, and employment estimates, recent (2016) Mine-related revenue data and updated census tract information. This appendix also provides a regional economic impact analysis that describes effects of the Proposed Action and No Action Alternative on economic conditions and local economic activity to support the description of environmental consequences in **Section 4.11** of the EA.

1.0 Current Socioeconomic Conditions

1.1 Local Economy

The general business economies of Musselshell and Yellowstone Counties differ by orders of magnitude as presented in **Table G-1.**

Table G-1. Comparison of County Business Patterns, 2015

County and category[1]	Number of Establishments[2]	Number of Paid Employees	Annual Payroll ($1,000)
Musselshell County			
Total for All Sectors	116	937	47,494
Mining, quarrying, and oil and gas extraction (NAICS 21)	10	185	16,513
Yellowstone County			
Total for All Sectors	5,565	69,990	2,982,038
Mining, quarrying, and oil and gas extraction (NAICS 21)	64	581	81,031

Source: US Census Bureau 2017
(1) NAICS = North American Industry Classification System
(2) An establishment is a single physical location at which business is conducted or services or industrial operations are performed.

A summary of payrolls, expenditures, tax revenues (hereafter collectively referred to as "revenues") for 2016 and associated rates are provided in **Table G-2**. In that same year (2016), the Mine produced 5.96 Mt of saleable coal with an approximate value of $23 per ton. Additional information about select revenue categories is provided below.

In 2016, Mine payroll totaled approximately $31 million, with over $23.5 million reported in taxable wages and $7.5 million attributed to benefits such as vacation, sick leave, medical insurance, retirement plan contributions, workers' compensation insurance and unemployment taxes. Approximately 29 percent of the 260 Mine employees resided in Musselshell County while the remaining 71 percent resided in Yellowstone County. However, Yellowstone County and the City of Billings are proportionally affected less by Mine employment due to their larger and more diverse economy, as shown in **Table G-1.**

Table G-2. Estimated Revenues for 2016.

Revenue Source/Category	Rate	Musselshell County	Yellowstone County	State of Montana	Federal Government
Mine Expenditures, including Payroll					
Wages and Benefits[1]		$8,990,000	$22,010,000		
Local Business Transactions		$4,000,000	$36,000,000		
Community Foundation		$350,000			
Taxes and Fees					
Montana Severance Taxes	4% of saleable value			$3,940,000	
Resource Indemnity Trust Fund and Groundwater Assessment Tax	0.4% of gross value (i.e., saleable value)			$400,000	
Gross Proceeds Tax	2.5% of saleable value. 50% to State, 50% to County (increases after 2020)	$1,155,000	$82,000	$1,237,000	
State Land Surface Annual Lease				$3,839	
State Mineral Royalties				$260,000	
Federal Land Surface Annual Lease	$3/acre annually				$8,819
Federal Mineral Royalties	8% of saleable value (50% to State, 50% to Federal Gov't.)			$86,000	$86,000
Abandoned Mine Reclamation	$0.12 per saleable ton (underground rate)				$698,000
Free on Board (FOB) /Black Lung	Lesser of 4.4% or $1.10 per saleable ton (underground rate), paid on domestic sales only.				$176,000
	Totals	$14,495,000	$58,092,000	$5,926,839	$968,819

Source: SPE 2017c. All values are approximate.
(1) County portions estimated from the portion of the Mine's 260 employees residing in Yellowstone County (71%) and Musselshell County (29%). Includes the portion that would be paid as State and Federal income tax.

SPE pays both State and Federal corporate taxes; individual employees pay State and Federal income taxes. The Mine was an "existing underground coal mine producing coal from the mine as of December 31, 2010", qualifying it for a gross proceeds tax rate of 2.5 percent through 2020, after which the rate will increase to 5 percent [MCA 15-23-703(1)(c)]. Fifty percent of the gross proceeds tax is returned to the counties. In the case of the Mine, the entire annual distribution goes to the county where the longwall is positioned on the last day of the year. In 2016, $1,237,000 was returned to the counties, a majority of which was distributed to Musselshell County and Roundup Public School District 55-55H. In addition to revenues generated annually as a result of mine operations, in 2012 SPE paid one-time bonus bid payments associated with the Federal coal lease ($11 million) and State coal lease ($4 million) in the Amendment 3 area (SPE 2017c).

Due to the presence of the Mine and potential growth-related issues, Musselshell County has applied for and received Coal Board grants funded by the Coal Severance Tax and administered by the Montana Department of Commerce. The first grants began in 2009 when the Mine was reopening. The Coal Board funded 10 projects in Musselshell County, the City of Roundup, and Roundup Public School District 55-55H. The awards totaled $2.5 million for projects valued at $3.8 million. Multiple awards were made between 2010 and 2016, when Yellowstone County received an award of $60,000 to help fund renovation of the fire hall in the Broadview Fire District. Also in 2016, Musselshell County was awarded $500,000 for a social services facility and $300,000 for equipment at the Roundup Memorial Healthcare facility (DOC 2018).

1.2 Population.

Musselshell County experienced a 3.5 percent loss in population between 2000 and 2010, but a 6.5 percent increase from 2010 to 2015 (**Table G-3**). Estimates from the US Census Bureau (2015a) indicate nearly 40 percent of the County population resides in the City of Roundup, which experienced a decline in population from 2000 to 2010, followed by a near-equal rise in population from 2010 to 2015. By comparison, Yellowstone County and Billings have experienced sustained growth since 2000, with more than a 20 percent growth rate from 2010 to 2015. Yellowstone County and Billings are the largest county and city in Montana, respectively.

Table G-3. Study Area Population Characteristics, 2000 to 2010, 2000 to 2015

Population Statistic	Musselshell County	City of Roundup	Yellowstone County	City of Billings	Montana
2000 Population[1]	4,497	1,931	129,352	89,847	902,195
2010 Population[2]	4,339	1,790	144,050	101,549	973,739
Percent Change, 2000-2010	-3.5	-7.3	11.4	13.0	7.9
2015 Population Estimate	4,790	1,900	153,692	108,134	1,014,699
Percent Change, 2000-2015[3]	6.5	-1.6	18.8	20.4	12.5

1 US Census Bureau, 2000a.
2 US Census Bureau, 2010.
3 US Census Bureau, 2015a.

1.3 Employment

Table G-4 presents employment data from 2000 and 2015, during which time total employment in Montana increased by nearly 14 percent while employment in Musselshell County decreased by 1.2 percent (26 jobs) and Yellowstone County employment increased by more than 19 percent. The unemployment rate in both counties and the State fell between 2000 and 2015 (US Census Bureau 2000b, 2015b). The unemployment rate for August 2017 (Not Seasonally Adjusted) is reported as 3.6 percent in Musselshell County, 3.2 percent in Yellowstone County and 3.4 percent for the State of Montana (MTDLI 2017a), indicating further increases in employment.

Mining, categorized as part of an industry which includes agriculture, forestry, fishing, hunting and mining, was responsible for 21.1 percent of the 2015 civilian labor force in Musselshell County (US Census 2015b). This compares to 3.5 percent in Yellowstone County, and 7.3 percent for the State of Montana as a whole. The mining industry accounted for approximately 4,500 jobs in Montana in 2015 (MTDLI 2017b). Based on these statistics, SPE's 260 employees account for approximately 5.7 percent of the State's mining industry employment.

Table G-4. Study Area Employment Characteristics, 2000 to 2015

Year and Employment Statistic	Musselshell County	Yellowstone County	Montana
2000[1]			
Number in the Civilian Labor Force	2,088	68,620	454,687
Unemployment Rate	7.6	4.5	6.3
Percent employed in Agriculture, Forestry, Fishing, Hunting and Mining	20.6	3.0	7.9
2015[2]			
Number in the Civilian Labor Force	2,062	81,943	517,807
Unemployment Rate	4.6	4.1	6.2
Percent employed in Agriculture, Forestry, Fishing, Hunting and Mining	21.1	3.5	7.3
Percent Change in Civilian Labor Force, 2000 - 2015	-1.2	19.4	13.9

1 US Census Bureau 2000b.
2 US Census Bureau 2015b.

1.4 Housing

Table G-5 presents a summary of housing characteristics in the Study Area in both 2000 and 2015. The 2015 American Community Survey (US Census 2015c) estimated a total of 68,500 housing units in 2015 in both Musselshell and Yellowstone counties, collectively, with approximately 760 unoccupied units in Musselshell County and 4,340 unoccupied units in Yellowstone County. The relative low percentage of housing occupied in Musselshell County and the City of Roundup indicate that there is still surplus housing in both jurisdictions, but especially in the county, which is consistent with the findings of the BLM Coal Lease EA. Yellowstone County and the City of Billings continue to have an active housing market as indicated by statistics in **Table G-5**.

Table G-5. Study Area Housing Units and Change, 2000[1] to 2015[2]

Year and Housing Statistic	Musselshell County	City of Roundup	Yellowstone County	City of Billings	Montana
2000 Housing Units	2,317	977	54,563	39,151	412,633
2000 Percent Occupied	81.1	85.3	95.5	95.8	86.9
2015 Housing Units Estimate	2,708	995	65,792	47,044	488,845
2015 Percent Occupied	72.0	81.5	93.4	93.7	83.7
Percent Change in Housing Units, 2000-2015	16.9	1.8	20.6	20.2	18.5

1 US Census Bureau 2000c.
2 US Census Bureau 2015c.

1.5 Environmental Justice Populations

Census tract records were examined to determine if any environmental justice populations are present within the 12 census tracts within 1 mile of the Mine or rail segments between the Mine and Laurel (**Table G-6**). None of the tracts meet the meaningfully greater criteria for environmental justice populations.

Table G-6. Environmental Justice Populations within Study Area

Jurisdiction	2015 Population[1]	Percent Minority[1]	Percent Poverty[2]
State of Montana	1,014,699	13	15.2
Yellowstone County	153,692	12.6	11.5
301110014012	*2,191*	*4.2*	*7.4*
301110014021	*3,326*	*3.7*	*4.5*
301110014014	*2,143*	*3.2*	*4.2*
301110014016	*3,626*	*1.0*	*2.3*
301110015021	*1,041*	*1.0*	*8.0*
301110018011	*1,697*	*15.3*	*0*
301110018012	*2,730*	*0.9*	*1.7*
301110014023	*1,390*	*7.6*	*17.3*
301110019021	*1,158*	*1.0*	*1.2*
301110019023	*1,602*	*6.2*	*18.5*
Musselshell County	4790	7.5	16.4
300650001002	*847*	*0.7*	*10.5*
300650001003	*1,095*	*5*	*21.6*

1 US Census Bureau 2015d.
2 US Census Bureau 2015e.

2.0 Regional Economic Analysis

This section provides a regional economic analysis to describe the alternatives' effects on economic conditions and local economic activity, generally expressed as projected changes in employment, labor income, and economic output (Watson et al. 2007). Employment and income are not considered measures of benefits but are descriptors of the distribution of potential impacts on local or regional economics and populations. As noted in **Section 3.11** of the EA, the monetary contributions to the economy resulting from Mine activities are generally termed "revenue" for purposes of this analysis.

Table G-7 compares total estimated revenue under Proposed Action and No Action Alternative based on current tax and revenue rates as discussed in **Section 3.11** of the EA (see **Table 3.11-2**), mining duration (years) and total tons of saleable coal shown in **Table 2.2-1** of the EA. All values are reported in 2016 dollars, not inflation adjusted. For purposes of this assessment, employment was assumed to be constant at 260 employees for the duration of mining. However, some increase in employment is expected to achieve a mining rate of 10.0Mtpy for both alternatives. Employment would decline as the Mine enters closure (for both alternatives) and some employment would continue during the closure and reclamation phases that occur for approximately 18 months after mining ceases. The portions of employee wages and health benefits that would be paid as Federal and State income taxes were not separately estimated but were instead included in the county and local portion for tabulation.

Table G-7 Difference between the Total Estimated Revenues of the No Action and Proposed Action Alternatives.

Revenue Source / Category	No Action Revenue ($1,000)	Proposed Action Revenue ($1,000)	Difference between Alternatives ($1,000)
Estimated Local and County Revenue from Mine Activities			
Wages and Benefits[1]			
Musselshell County	22,475	103,385	80,910
Yellowstone County	253,115	414,000	160,885
Local Business Transactions			
Musselshell County	10,000	46,000	36,000
Yellowstone County	90,000	414,000	324,000
Gross Proceeds Tax (County Share)[2]			
Musselshell County	6,767	56,486	49,719
Yellowstone County	2,021	16,872	14,851
Community Foundation[3]	$350	$4,025	3,675
Subtotal	***384,728***	***1,054,768***	***670,040***
Estimated State Revenue from Mine Activities[4]			
Severance Tax	28,121	140,961	112,840
Gross Proceeds Tax (State Share)	8,788	73,358	64,570
Resource Indemnity Trust Fund	2,812	14,096	11,284
State Land Surface Lease	12	46	35
State Coal Mineral Royalty[5]	2,324	20,140	17,816
Federal Coal Royalty (State Share)	2,088	38,806	36,718
Subtotal	***44,144***	***287,408***	***243,263***
Estimated Federal Revenue from Mine Activities[4]			
Federal Surface Lease	26	106	79
Federal Coal Royalties	2,088	38,806	36,718
Abandoned Mine Reclamation	204	3,624	3,420
FOB/Black Lung[6]	1,008	4,827	3,819
Subtotal	***3,326***	***47,363***	***44,037***
Total	432,198	1,389,538	957,341

(1) Includes the portion that would be paid as State and Federal income tax. Wages would increase from this amount if employment rises to achieve production of 10.0Mtpy under either alternative.
(2) Estimated allocations to Musselshell County (77%) and Yellowstone County (23%) Source: SPE 2017c.
(3) Musselshell County only. Source: SPE 2017c.
(4) Excludes the portion that would be paid as State and Federal income tax.
(5) Source: SPE 2017c.
(6) Assumes 4 percent of total saleable coal is sold domestically with a $1.10 per ton tax rate.

SPE (2017c) estimates the value of each saleable ton to be $28 in 2017 and $32.50 in 2018. Coal values from 2019 to 2028 would be subject to fluctuations in market conditions. The US Energy Information Administration (USEIA reports that global coal consumption is expected to remain "roughly the same between 2015 and 2040…with decreasing consumption in China and the United States offsetting growth in India." Asia is expected to remain the world's largest importer of coal (USEIA 2017b), and coal consumption by Asia (including Japan and South Korea) is expected to remain relatively constant between 2017 and 2028 (USEIA 2017c). Mine mouth (i.e., at the mine before transport) coal prices are also expected to remain relatively constant (USEIA 2017d). Based on this information, a value of $32.50 per saleable ton was used to estimate revenues from 2019 to 2028.

As noted in **Section 3.11** of the EA, gross proceeds tax is allocated to the county where the longwall miner is located at the end of the year. This assessment assumed that the distribution of gross proceeds tax revenues to counties would be proportional to the amount of coal mined in each county (i.e., 77 percent to Musselshell County and 23 percent to Yellowstone County).

APPENDIX H – CONSULTATION AND COORDINATION

Consultation & Coordination

A full discussion of the consultation and coordination efforts made during preparation of the application for the existing State-approved mining permit and the preparation of the BLM Coal Lease EA is presented in Chapter 5 of that EA. The BLM is a cooperator in preparation of this EA, completing technical review and providing assistance in the analysis.

As described in Chapter 1, OSMRE conducted a scoping process from October 20 to November 20, 2017 during which public comments were solicited to identify issues of concern. OSMRE published legal notices in the Billings Gazette on October 20, 2017 and the Roundup Record Tribune on October 25, 2017 describing the project in summary form and informed the public that scoping comments would be accepted until November 20, 2017. Public outreach letters describing the EA and soliciting scoping comments were mailed on October 20, 2017 to State, county and city governments; adjacent landowners; and other interested parties. OSMRE also sent letters of notification to tribes/tribal representatives via certified letters on October 20, 2017. OSMRE made a project website available that provided project information and comment opportunities available at the following link.

https://www.wrcc.osmre.gov/initiatives/bullMountainsMine.shtm.

Scoping letters were received from individuals and representatives of private and public entities during the public scoping period. A description of issues analyzed in this EA are summarized in **Section 1.3.** Comment letters received during the public review period for this EA will be considered during the ASLM approval process.

Preparers and Contributors

OSMRE and BLM personnel that contributed to the development of this EA include the following:

Table 5.2-1. OSMRE and BLM personnel.

Name	Organization	Project Responsibility
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Jeremy Iliff	OSMRE	Cultural Resources Review
Greg Fesko	BLM	Cooperating Agency Review

Third party contractors who contributed to the development of this EA are identified in Table 5.2-2.

Table 5.2-2. Third party contractor personnel.

Name	Organization	Project Responsibility
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Kevin Mathews	Bison Engineering	Document Preparation and Technical Review - Air Quality and Climate
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Distribution of the EA

This EA will be distributed to individuals who specifically request a copy of the document. It will also be made available electronically on the OSMRE website at the following link.

https://www.wrcc.osmre.gov/initiatives/bullMountainsMine.shtm

APPENDIX I – ACRONYMS, ABBREVIATIONS, AND REFERENCES

I.0 Acronyms and Abbreviations

µg	microgram
µg/g	microgram per gram
µg/m^3	microgram per cubic meter
AADT	annual average daily traffic
AHR	annual hydrology report
AQO	Ambient Air Quality Objective
ARM	Administrative Rules of Montana
As	arsenic
ASLM	Assistant Secretary, Land and Mineral Management (DOI)
BCME	British Columbia Ministry of Environment
BGEPA	Bald and Golden Eagle Protection Act
bhp-hr	break horsepower-hour
BLM	Bureau of Land Management
BNSF	BNSF Railway
Btu	British thermal unit
Btu/gal diesel	British thermal units per gallon of diesel
Btu/hp-hr	British thermal units per horsepower-hour
Btu/lb	British Thermal units/lb
C	celsius
CAA	Clean Air Act
CAAQS	Canadian Ambient Air Quality Standard
CARB	California Air Resources Board
CCS	Center for Climate Strategies
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	methane
CHIA	cumulative hydrologic impacts
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
C-PM	condensable particulate matter
CPW	coal processing waste
CWA	Clean Water Act
dBA	adjusted decibels, a logarithmic unit of sound levels
DM	Departmental Manual
DOI	US Department of the Interior
DPM	diesel particulate matter

dwt	dry weight tonnage
EA	Environmental Assessment
EC	electrical conductivity
ECA	Emissions Control Area
EEDI	Energy Efficiency Design Index
EF	pollutant emission factor
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FCLAA	Federal Coal Leasing Act Amendment (1976)
FGD	Flue gas desulfurization
FOB	free on board
FONSI	Finding of No Significant Impact
FRA	Federal Railroad Administration
FTA	Federal Transit Authority
g	grams
g/bhp-hr	grams per brake horsepower-hour
g/g-mol	grams per gram-mole
g/kWh	Gram per kilowatt-hour
g/lb	grams per pound
gal	gallon
GHG	Greenhouse gas
g-mol	gram-mole
GWP	global warming potential
HAP	hazardous air pollutant
HC	hydrocarbon
Hg	mercury
hp	horsepower
hp-hr	horsepower-hour
hp-hr/gal	horsepower-hour per gallon
IEA	International Energy Agency
IMO	International Maritime Organization
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
ITD	Idaho Transportation Department
IWG	Federal Interagency Working Group
JANRE	Japan's Agency for Natural Resources and Energy
JMOE	Japan Ministry of the Environment
kg	kilogram
kW	kilowatt
kWh	kilowatt-hours
lb	pound
lb/lb-mol	pound per pound-mole
lb/ton	pound per ton

LBA	lease by application
lbs/mile	pounds per mile
Ldn	day-night noise level
LLC	Limited Liability Company
LOM	life of mine
LOS	level of service
LSE	London School of Economics and Political Science
MAAQS	Montana Ambient Air Quality Standards
MAQP	Montana Air Quality Permit
MARPOL	International Convention for the Prevention of Pollution from Ships (Maritime Pollution)
MATS	Mercury and Air Toxic Standards
MBEWG	Montana Bald Eagle Working Group
MBTA	Migratory Bird Treaty Act of 1918, as amended
MCA	Montana Code Annotated
MDA	Montana Department of Agriculture
MDEQ	Montana Department of Environmental Quality
MDSL	Montana Department of State Lands
MDT	Montana Department of Transportation
MEIT	Canada's Marine Emissions Inventory Tool
$mg/m^2/day$	milligrams per square meter per day
mi	mile
MLA	Mineral Leasing Act (1920)
MMBtu	million British thermal units
MPDD	Mining Plan Decision Document
MPDES	Montana Pollutant Discharge Elimination System
MSUMRA	Montana Strip and Underground Mine Reclamation Act
Mt	million tons
Mt-CO2e	million tons of carbon dioxide equivalent emissions
Mtpy	million tons per year
N_2O	nitrous oxide
NAAQO	National Ambient Air Quality Objective
NAAQS	National Ambient Air Quality Standards
NAICS	North American Industry Classification System
NEPA	National Environmental Policy Act (1969)
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NO_x	nitrogen oxides
NRHP	National Register of Historic Places
OMB	Office of Management and Budget
OSMRE	Office of Surface Mining Reclamation and Enforcement
PAP	permit application package
Pb	lead
PC	pulverized coal

PHC	probable hydrologic consequences
PM	particulate matter
PM_{10}	particulate matter with aerodynamic diameters less than or equal to 10 microns
$PM_{2.5}$	particulate matter with aerodynamic diameters less than or equal to 2.5 microns
PMM	Principal Meridian, Montana
ppb	parts per billion
ppm	parts per million
PRB	Powder River Basin
PSD-NSR	Prevention of Significant Deterioration New Source Review
QA/QC	Quality Assurance/ Quality Control
R2P2	Resource Recovery and Protection Plan
RFD	Reasonably Foreseeable Development
ROK	Republic of Korea
SCC	Social Cost of Carbon
SHPO	State Historic Preservation Office
SMCR	Specified Maximum Continuous Rated
SMCRA	Surface Mining Control and Reclamation Act (1977)
SO_2	sulfur dioxide
SOC	Species of Concern
SPE	Signal Peak Energy, LLC
STB	Surface Transportation Board
TDS	total dissolved solids
tonnes	metric tons
tons	US short tons
TRCC	Tongue River Railroad Company
T_X	tier level
USACE	U.S. Army Corps of Engineers
USC	United States Code
USDOT	US Department of Transportation
USEIA	U.S. Energy Information Administration
USFWS	U.S. Fish and Wildlife Service
USGCRP	US Global Change Research Program
USGS	U.S. Geological Survey
VOC	volatile organic compound
WDA	waste disposal area
WDOE	Washington Department of Ecology
WSDOT	Washington State Department of Transportation
wt %	Weight percentage of pollutant

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