Draft Environmental Impact Statement

Rosebud Mine Area B AM5
Colstrip, Montana

September 2020

DEQ
Montana Department of Environmental Quality

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SUMMARY

S.1 BACKGROUND AND OVERVIEW

This Environmental Impact Statement (EIS) has been prepared by the Montana Department of Environmental Quality (DEQ) to analyze and disclose the potential environmental impacts of the proposed fifth amendment (AM5) to the operating permit (C1984003B) for Area B at the Rosebud Mine, an existing surface coal mine near Colstrip, Montana (**Figure 1**). On February 17, 2017, Western Energy Company, now Westmoreland Rosebud Mining, LLC (Westmoreland Rosebud), a subsidiary of Westmoreland Mining LLC (Westmoreland), submitted the AM5 amendment application (Application). The currently permitted area for Area B is 6,045 acres, of which 5,655 acres are approved for disturbance by mining and associated activities. If approved, AM5 (Project) would add 9,108 acres to the permit area, which includes 5,547 acres of disturbance. In addition, the Area B operations plan and reclamation plan would be updated to include additional mine passes and reclamation. The proposed Project would extend the life of Area B by 15 years and the life of the Rosebud Mine by 7 years.

DEQ deemed the Application complete on May 24, 2017. At the time, the Rosebud Mine was operated by Western Energy Company, a subsidiary of Westmoreland Coal Company. During the EIS development, Westmoreland Coal Company filed for bankruptcy and was acquired by Westmoreland Rosebud Mining, LLC on March 2, 2019. A minor revision was approved on March 14, 2019 for Westmoreland Rosebud Mining, LLC to be the contract miner at the Rosebud Mine. The permit transfer from Western Energy Company to Westmoreland Rosebud Mining, LLC, which was submitted on April 12, 2019, is pending. DEQ uses the name, Westmoreland Rosebud Mining, LLC, throughout this EIS to reduce confusion for the reader.

The Rosebud Mine is located adjacent to the city of Colstrip in Rosebud County. Permit Area D of the Rosebud Mine extends to the east of Colstrip for about 3.5 miles, and Permit Areas A, B, C, and F extend to the west of Colstrip (**Figure 2**). Currently, there are 30,951 permitted acres at the Rosebud Mine, which in 2018 and 2019 produced between 8.0 and 9.0 million tons of low-sulfur subbituminous coal annually, and averaged 9.9 million tons annually over the last 10 years (**see Section 2.2.2, Existing Operating Permits, Disturbance, and Reclamation**). Although mine production is expected to drop to approximately 6 million tons annually for years 2020 through 2029 (Peterson 2020b), analyses in this EIS are based on recent rather than projected production rates. All coal is combusted locally at two power plants—the Colstrip and Rosebud Power Plants.

The proposed Project area is the Area B permit area as modified by proposed AM5 (**Figure 2**) and is located about 5 miles southwest of Colstrip in Township 1 North, Ranges 40 and 41 East. The Project area has two drainages, Lee Coulee and Richard Coulee, which are divided by a tall ridge. Lee Coulee, Richard Coulee, and their tributaries flow into Rosebud Creek, a tributary of the Yellowstone River.

If the Project is approved, the Area B permit area would increase to 15,153 acres with an 11,202-acre area disturbance area. Project activities (mining, highwall reduction, soil storage, scoria pits, haul-road and ramp-road construction, etc.) would disturb 5,711 acres within the disturbance area. The surface of the Project area is owned by private parties (92 percent) and the State of Montana (8 percent). The subsurface is owned by private parties, the State of Montana, and the federal government. Westmoreland Rosebud holds private, state, and federal leases for Project area coal; Westmoreland Rosebud is not seeking to mine any federal coal leases that have not been previously approved under the Area B federal mining plan. Pre-mine land uses within and adjacent to the Project area include livestock grazing, pastureland, agricultural cropland, wildlife habitat, and industrial/commercial (i.e., public airport and ranch yards). The primary pre-mine surface land use in the Project area is livestock grazing. The eastern part of the

amendment area includes part of the Big Sky Mine permit area (C1988004B), which was previously mined and reclaimed and was released from jurisdiction in 2020. A significant portion of the acreage proposed to be added by the Project burned in 2012.

At the proposed rate of production, the Project would extend active mining in the Area B permit area by 7 years. Without the addition of the Project, the operational life of Permit Area B would be expected to end in 2030 (see **Section 2.2.4, Life of Operations**). Westmoreland Rosebud estimates that there are 104.3 million tons of recoverable coal in the Project area. For this EIS, it is assumed that Project area coal would be used in the Rosebud Power Plant and in Units 3 and 4 of the Colstrip Power Plant (Colstrip Units 3 and 4).

This EIS has been prepared to meet the requirements of the Montana Environmental Policy Act (MEPA), Title 75, chapter 1, parts 1 through 3, of the Montana Code Annotated (MCA) and its implementing rules, the Administrative Rules of Montana (ARM) 17.4.601 *et seq*. This EIS will assist DEQ to make an informed decision regarding Westmoreland Rosebud's Application (see **Appendix A**). DEQ will decide whether to approve the Application in accordance with the requirements of the Montana Strip and Underground Mine Reclamation Act (MSUMRA) (82-4-201 *et seq*., MCA) and its implementing rules (ARM 17.24.301-1309). DEQ may not withhold, deny, or impose conditions on the AM5 amendment based on MEPA under 75-1-201(4), MCA.

This EIS also will assist DEQ to make an informed decision regarding Westmoreland Rosebud's Application for a new Montana Pollutant Discharge Elimination System (MPDES) permit (MT-0032042) for 27 new outfalls in the Project area.

The decision regarding a selected alternative and supporting reasoning will be documented in a Record of Decision (ROD) and Written Findings issued at least 15 days after the Final EIS is published.

S.2 PURPOSE AND NEED

MEPA and its implementing rules, ARM 17.4.617(1), require that any EIS prepared by a state agency include a description of the purpose and benefits of the proposed Project. The purpose and benefits of the Proposed Action are described in the sections below.

S.2.1 Purpose and Need

DEQ's purpose is to make a decision on Westmoreland Rosebud's surface-mine operating permit amendment Application under MSUMRA, Section 82-4-221 *et seq*., MCA (see **Section 1.4.1.2, DEQ Decisions**). The proposed amendment to the existing Area B operating permit would allow additional mine passes, construction of the Richard and Lee haul roads, construction of ramp roads, and an extension in the operational life of the mine from 2030 to 2045. DEQ's purpose is also to review and make a decision on Westmoreland Rosebud's Application for a new MPDES permit (MT-0032042) for 27 new Project area outfalls.

S.2.2 Benefits

The Project would provide the following federal, state, and local benefits:

- An ongoing fuel source (104.3 million tons of coal) for the Colstrip Power Plant (Units 3 and 4) and the Rosebud Power Plant
- Continued employment for workers at the mine

- An ongoing tax base to federal, state, and local governments
- Ongoing royalty payments to mineral resource owners
- Continued support to local businesses

S.3 AGENCY AUTHORITY AND ACTIONS

DEQ is the lead agency responsible for the analysis of this Project. Before implementation of the proposed Project could begin, other permits, such as a MPDES permit from DEQ, as well as various other certificates, licenses, or approvals, would be required from multiple state and federal agencies. The applicable statutes and regulations, as well as the decisions to be made, are described in the EIS in **Section 1.4, Agency Authority and Actions**. **Table 1** in that section summarizes the other state and federal approvals needed for the Project.

S.4 SCOPING AND KEY ISSUE IDENTIFICATION

S.4.1 Scoping

During scoping, DEQ sought input from the public, interested organizations, tribes, and government agencies. DEQ held its public scoping period between March 30 and April 30, 2018. DEQ hosted a public open house with opportunities for public testimony in Colstrip on April 11, 2018.

The intent of the scoping process was to gather comments and concerns from those who have interest in or may be affected by the Proposed Action and to identify key issues and possible alternatives for analysis. A detailed accounting of DEQ scoping processes can be found in the Public Scoping Report (ERO 2018). The report is available on DEQ’s website: http://deq.mt.gov/Public/eis.

S.4.2 Key Analysis Issues

Six key issues were identified through the scoping process and used to guide the EIS interdisciplinary team’s analysis and alternatives development. These issues include impacts on air quality (Issue 1), impacts on surface water quality and quantity (Issue 2), impacts on ground water quality and quantity (Issue 3), impacts on wetlands (Issue 4), impacts on vegetation and reclamation success (Issue 5), and impacts on socioeconomic conditions (Issue 6). See **Section 1.5.2.1, Key Issues Identified during Public Scoping for Detailed Analysis** for a description of these issues.

S.5 ALTERNATIVES ANALYZED

Alternatives were considered based on requirements for alternatives under regulations and rules implementing MEPA. Under ARM 17.4.617(5), DEQ is required to conduct an analysis of reasonable alternatives, including a no action alternative and other reasonable alternatives. Any alternative proposed must be reasonable, in that the alternative must be achievable under current technology and the alternative must be economically feasible as determined solely by the economic viability of similar projects having similar conditions and physical locations and determined without regard to the economic strength of the specific project sponsor under 75-1-201(1)(b)(iv)(C)(I), MCA.

A No Action Alternative (Alternative 1) and the Proposed Action (Alternative 2) were considered in this EIS. Alternatives 1 and 2 are summarized below and described fully in **Chapter 2**. Alternatives that were not carried forward for detailed analysis are also summarized below.

S.5.1 Alternative 1 – No Action Alternative

Under the No Action Alternative, Westmoreland Rosebud's AM5 amendment to the Area B operating permit and the MPDES permit would not be approved by DEQ. Westmoreland Rosebud would complete mining and reclamation in the Area B permit area according to its currently approved operating permit. Specifically, the following aspects, which would have been modified under the Proposed Action, would remain as currently permitted:

1) The size of the Area B permit area would not increase to 15,153 acres but would remain at 6,045 acres;

2) The size of the disturbance area would not increase to 11,202 acres but would remain at 5,655 acres;

3) The Area B operations plan, including the location of the Area B haul road, would not be updated; and

4) The Area B reclamation plan would not be updated.

Under the No Action Alternative, mining in Area B would likely cease by 2030, and 104.3 million tons of coal would not be recovered from the Project area. Selection of the No Action Alternative would result in 5,547 acres of previously undisturbed ground not being disturbed (a total of 5,711 acres of disturbance associated with the Project would not occur, including disturbance within previously approved Area B disturbance area). The environmental, social, and economic conditions described in Chapter 3 would continue, unaffected by the construction and operation of the Project.

Selection of the No Action Alternative would not change the existing status of the other permit areas of the Rosebud Mine (**see Section 2.2, Rosebud Mine – Description of Past and Existing Mine Operations and Reclamation and Table 6**). Nor would selection of this alternative change the status of the federal coal lease MTM 80697 (tracts in Areas B and C) modification application, which is currently being evaluated by the Bureau of Land Management.

S.5.2 Alternative 2 – Proposed Action

Alternative 2 is the proposed Project (Proposed Action) as put forward by Westmoreland Rosebud in its Application to DEQ for the fifth amendment (AM5) to the existing Area B (C1984003B) operating permit. The Proposed Action, also referred to as AM5 or Alternative 2 in this EIS, would modify four primary aspects of the operating permit:

1) The size of the Area B permit area would increase to 15,153 acres (a 9,108-acre or 60 percent increase);

2) The size of the disturbance area would increase to 11,202 acres (a 5,547-acre or 50 percent increase);

3) The Area B operations plan would be updated to include additional mine passes, an construction extension of the Richard and Lee haul roads, construction of ramp roads, and an extension in operational life (mining until 2045 instead of 2030); and

4) The Area B reclamation plan would be updated to include reclamation of the additional disturbance area and an extended reclamation timeline.

The description of the Proposed Action that is provided in the sections below is based on Westmoreland Rosebud's Application. Readers desiring greater detail can review the additional descriptions, maps, and drawings contained in the Application, which is available for digital download (see **Appendix A** for links).

DEQ is required to publish this Final EIS at least 15 days prior to the issuance of written findings granting or denying Westmoreland Rosebud's Application for an amendment to its permit. Westmoreland Rosebud must address all Application acceptability deficiencies identified by DEQ in order for DEQ to issue written findings approving Westmoreland Rosebud's permit amendment Application. A failure by Westmoreland to adequately address the Application acceptability deficiencies would result in DEQ's selection of the No Action Alternative. DEQ will notify Westmoreland Rosebud that the Application is acceptable under MSUMRA. In order to ensure that the review timelines mandated in MSUMRA are met, the Proposed Action is presented as if the Application has already been determined by DEQ to be complete and acceptable under MSUMRA (for a description of the permit review process, see **Section 1.4.1.1, Applicable Statutes and Regulations**).

S.5.3 Alternatives Not Carried Forward for Detailed Analysis

Alternatives considered but not carried forward for detailed analysis are also described in **Chapter 2**. Six alternatives or alternative components were suggested by the public in scoping comments or by specialists based on professional experience but were not analyzed in detail for a variety of reasons, including operational feasibility and failure to meet the Project purpose and need. Dismissed alternatives include (1) sequencing the order of mining by permit area or within the Project area, (2) maintaining wet reaches in drainages, (3) restricting mining to Lee Coulee, and (4) considering alternative land uses.

S.6 AFFECTED ENVIRONMENT

Seventeen resource areas were analyzed in detail in the EIS. The following paragraphs provide a brief summary of the resources, analysis areas, and baseline conditions described in **Chapter 3** subsections. One resource, alluvial valley floors (AVFs), was considered but was dismissed. DEQ made the determination that East Fork Armells Creek and Lee Coulee are not AVFs within the proposed Project area. A portion of the Richard Coulee watershed is in the Project area, but after DEQ evaluated it and made an AVF determination in September 2019 (DEQ 2019), the issue was not carried forward for additional analysis (see **Section 3.19, Resources Considered but Not Studied in Detail**).

Topography (Section 3.2). The analysis area for direct and secondary impacts on topography is the 15,153-acre Project area. The Project area is located in the Pine Breaks region of southeastern Montana and is characterized by open, high hills, with low to moderate relief. The mined portions of the analysis area have large topographic changes over relatively short distances. The AM5 portion of the analysis area has not previously been mined and displays a gentle topographic decline to the southeast in the valley areas with steep bluffs overlooking the valleys. Surface elevation topographic relief in the Project area ranges from 3,820 feet in the western portion of AM5 to 3,260 feet where Richard Coulee exits the analysis area.

Air Quality (Section 3.3). The analysis area for direct and secondary impacts on air quality is the area within 50 km of the Area B disturbance boundary as modified by AM5. All of the reported concentrations from monitoring sites in Montana and in the entire analysis area are well below the national and state standards.

Geology and Geochemistry (Section 3.4). The analysis area for impacts on geology is the 15,153-acre Project area. The Rosebud Mine is located in the northwestern portion of the Powder River structural

basin, a broad northeast-trending synclinal structural basin in eastern Wyoming and southeastern Montana bound on three sides by mountain uplifts. The Paleocene Fort Union Formation is the predominant bedrock unit in the vicinity of the Rosebud Mine and consists of gently dipping (less than a few degrees) sedimentary rocks. Coal targeted for removal in the analysis area is within the Tongue River Member of the Fort Union Formation. The highest coal bed in the analysis area stratigraphic sequence is the Rosebud Coal bed, which averages 22.6 feet thick over the permit area. The next coal seam located below the Rosebud Coal bed is the McKay Coal bed, which averages 7.9 feet thick.

Water Resources – Surface Water (Section 3.5). The analysis area associated with surface water impacts encompasses surface watersheds extending through and downstream from the 9,108-acre proposed permit area that receives surface water drainage from the 5,547-acre disturbance area as modified by AM5. This analysis area primarily includes the Richard Coulee and Lee Coulee drainages of the Rosebud Creek watershed, as well as disturbance areas within the existing Area B permit boundary. Surface water features were inventoried within 1 mile surrounding and 3 miles downgradient of the permit boundary. Water quality is variable in the Project area primarily due to the dominance of either direct runoff from snowmelt or rainfall or ground water discharge to surface water during various times of the year. Direct runoff has much lower dissolved solids concentrations (such as calcium, magnesium, sodium, bicarbonate, sulfate, and chloride) than ground water. Other factors affecting surface water quality are evaporation and transpiration, reactions of water with sediment, aquatic biota, impoundments and diversions for agricultural purposes, and stock watering.

Springs in the analysis area with water quality exceedances included exceedances for dissolved magnesium, dissolved calcium, dissolved sodium, sulfate, and dissolved manganese. Water quality of streams was highly variable during the monitoring period due to the ephemeral nature of flow in the drainages and was generally basic in nature. Monitoring sites along Rosebud Creek recorded exceedances for dissolved calcium, dissolved magnesium, dissolved sodium, sulfate, total dissolved solids, total chromium, and total manganese. Pond monitoring sites in the analysis area recorded exceedances for dissolved magnesium, dissolved calcium, total iron, dissolved sodium, total nitrogen, total phosphate, dissolved aluminum, and sulfate.

Water Resources – Ground Water (Section 3.6). The analysis area for direct and secondary impacts on ground water quantity and quality is the proposed 15,153-acre Project area and the surrounding area where direct impacts on ground water quantity are predicted to occur as determined by ground water modeling. Within the Project area, the Rosebud Coal would be removed in select areas, resulting in ground water drawdown within the remaining portions of the Rosebud Coal. Outside of the Project area, the analysis area includes areas where ground water drawdown is predicted to be greater than 5 feet as a result of the Proposed Action.

Water Resources – Water Rights (Section 3.7). Surface water and ground water impacts from mining activity may induce impacts on or changes to surface water rights and ground water rights. The analysis areas associated with surface water rights and ground water rights are the same impact analysis areas described and for surface water and ground water.

Vegetation (Section 3.8). The analysis area for direct impacts on vegetation is the 15,153-acre Project area. Within the Project area is an 11,202-acre disturbance area where proposed Project activities would disturb 5,711 acres. Analysis of direct vegetation impacts focuses on the 5,711 acres where Project disturbance would occur. Analysis of secondary impacts looks at the wider Project area and the area outside of the permit boundary where surface water or ground water drawdowns are anticipated. The majority of the northern section of the analysis area (within the existing Area B permit area) has been mined or disturbed by mining activities. The southern portion of the analysis area, where the AM5 expansion is proposed, has also been affected by human disturbance, primarily from livestock grazing,

agriculture, and roads. Eight major vegetation communities were identified in the analysis area: grassland, conifer/sumac, sagebrush, mixed shrub, woody draw, improved pasture, cropland, and revegetation.

Wetlands (Section 3.9). The analysis area for direct impacts on wetlands is the 15,153-acre Project area. Within the Project area is an 11,202-acre disturbance area where proposed Project activities would disturb 5,711 acres, 5,643 acres of which are vegetated. Analysis of direct wetland impacts focuses on the 5,643 vegetated acres where disturbance would occur. The analysis of secondary impacts on wetlands is the same as the surface water analysis area, which encompasses surface watersheds extending through and downstream from the Project area that receives surface water drainage from the 5,547-acre disturbance area as modified by AM5. The analysis area supports several wetlands, mainly along the drainages that cross through the analysis area. The analysis area includes the Richard Coulee, Lee Coulee, and East Fork Armells Creek drainage basins. Twenty-two wetland areas were identified in the analysis area, primarily along several small subdrainages of Richard Coulee and Lee Coulee. Overall, the 22 wetland areas comprise 14.47 acres, or 0.09 percent of the analysis area.

Fish and Wildlife Resources (Section 3.10). The analysis area for fish and wildlife resources is the 15,153-acre Project area plus a 1-mile buffer for all species addressed, except for the greater sage-grouse. For the greater sage-grouse, the analysis area is the Project area plus a 4-mile buffer, which is consistent with Montana's greater sage-grouse conservation strategy under Executive Order 12-2015. Wildlife habitat types in the analysis area consist of grasslands, conifer/sumac woodlands, and upland shrublands, which together cover about 89 percent. All other vegetation communities and land-use types in the Project area each occupy less than 5 percent of the analysis area.

Cultural and Historic Resources (Section 3.11). The direct and secondary impacts analysis area for cultural resources focuses on the area where new Project-related disturbance would occur. This includes the 5,711-acre disturbance area associated with the Project activities (**Figure 66**). The area of potential effect (APE) is defined as the 15,153-acre Project area, which includes the AM5 expansion area and the existing Area B permit area. The APE is the analysis area for cumulative impacts and includes both disturbance that has already been permitted and new disturbance that would occur as a part of the proposed Project. For example, extensive ground disturbance has occurred on about 4,601 acres in the existing Area B permit area from permitted mining and associated activities. This disturbance, which is part of the APE, is not included in the analysis area for direct and secondary impacts but is considered in the analysis of cumulative impacts. A total of 117 sites are located in the APE. Of the 117 sites, 78 are located in the analysis area where disturbance would occur. Of the 117 sites documented during the most recent surveys, 83 have been evaluated as not eligible for listing in the National Register of Historic Places (NRHP). Twenty-six sites are recommended eligible for listing in the NRHP, primarily under Criterion D, for their potential to provide information significant to the interpretation of history or prehistory. All of these are within or overlapping the analysis area. One historic district intersects the APE—the Lee Community Historic District overlaps the northern and western sections of the APE.

Socioeconomics (Section 3.12). The analysis area for direct and secondary socioeconomic impacts is Rosebud, Treasure, and Big Horn Counties. Affected incorporated municipalities in the analysis area include Colstrip, Forsyth, Hysham, and Hardin. Two reservations—the Northern Cheyenne Indian Reservation and the Crow Reservation—are also within the analysis area and comprise the majority of Big Horn County. Coal mining and agriculture both play major roles in Big Horn County's economy. Rosebud County's traditional major industries of coal mining, the railroad, and agriculture remain the driving forces of the area's economy. Rosebud County has experienced a declining economy in the last several decades. Treasure County's principal industries are farming and ranching.

Visual Resources (Section 3.13). The analysis area for direct and secondary impacts is the viewshed of the 15,153-acre Project area, including the AM5 expansion area. Based on rolling hillsides and terrain, the

viewshed is defined as the Project area plus a 5-mile buffer. This is the area where line-of-sight may allow Project activities to be viewed and the horizon does not obstruct the view of an observer.

Land Use and Recreation (Section 3.14). The analysis area for direct and secondary land-use and recreational impacts is the 15,153-acre Project area. Current surface land uses in the Project area include grazing, cropland, wildlife habitat, industrial, commercial, and developed water resources. Current recreational opportunities in the analysis area include private hunting. No public easements, trails, or recreation facilities are located in the analysis area.

Transportation (Section 3.15). The analysis area for direct and secondary impacts on access and transportation includes the 15,153-acre Project area, existing permit areas of the Rosebud Mine, and county roads. The regional transportation network is generally described as the coal transport routes to and from the Rosebud Mine and Rosebud Power Plant. The Rosebud Mine is primarily accessed from the east via Castle Rock Road, a Rosebud County road that runs west off of SH 39 about 1 mile south of Colstrip. Major mine facilities such as the mine office, the maintenance shop, and the operations and maintenance complex are located on Castle Rock Road.

Solid and Hazardous Waste (Section 3.16). The direct and secondary impacts analysis area for solid and hazardous waste includes existing Areas A, B, C, and F of the Rosebud Mine site and the proposed AM5 expansion area; Area D, which is being reclaimed, is not in the analysis area. This analysis area is appropriate because wastes generated from mining operations in the Project area would be stored in other permit areas (Areas A and C) of the Rosebud Mine. The Rosebud Mine is a Large Quantity Generator, as defined under the Resource Conservation and Recovery Act, due to its generation of greater than 2,200 pounds of waste per month. Nonhazardous waste is collected in Dumpsters throughout the Rosebud Mine and transported to the Rosebud County Landfill (located about 4 miles north of Colstrip on SH 39) by truck for final disposal. Mining-related nonhazardous waste such as nontreated wood, wooden pallets, concrete, and dragline cable and wooden cable spools can be placed in the mine pits in accordance with ARM 17.24.507. Hazardous wastes generated at the Rosebud Mine include greases, lubricants, paints, flammable liquids, solvents, and any other material that meets the definition of a hazardous waste (40 CFR 261.3). These hazardous wastes are collected in 55-gallon drums at satellite accumulation points located throughout the mine, and within 3 days of being filled, the waste drums are transported to the hazardous-waste storage area located in Area A for shipment to a treatment, storage, and disposal facility for final destruction or disposal.

Noise (Section 3.17). The analysis area for noise includes the rural areas surrounding the Rosebud Mine to the north, south, and west, and residential areas to the east in Colstrip. Within the Colstrip city limits, existing noise sources include traffic on SH 39 and other local roads, the activities of residents, operation of the Colstrip and Rosebud Power Plants (the Rosebud Power Plant is about 6 miles north of Colstrip), and the coal conveyors.

Soil (Section 3.18). The soil analysis area corresponds to the 15,153-acre Project area, which includes the existing 6,045-acre Area B permit area and the proposed 9,108-acre AM5 expansion area. According to the baseline soil study, the upper 24 inches of the soil in the analysis area is suitable for use in reclamation and revegetation, except some areas of subsoil that are very rocky and exceed DEQ's guidelines for rock fragments, or soil that has elevated pH levels.

S.7 POTENTIAL ENVIRONMENTAL IMPACTS

Table S-1 summarizes and compares the potential direct and secondary impacts on natural, cultural, and human resources associated with the alternatives. Direct, secondary, and cumulative impacts are described fully in **Chapter 3**.

Table S-1. Potential Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action
Topography (Section 3.2)	No Project impacts. Existing Permit Area B would be reclaimed 15 years earlier than in Alternative 2.	5,711 acres would be disturbed (68 acres within this area have been disturbed previously). During operations, impacts would be noticeable. Reclamation of portions of the existing Area B permit area would be delayed by 15 years due to ongoing operations in the Project area. In accordance with the reclamation plan, the postmine landscape of the analysis area would be restored after mining operations to the approximate original contour to facilitate postmine land uses. Over time, differential erosion of the spoil could occur, including the preferential erosion of the softer stone fragments and sediment relative to the harder stone fragments in created areas of drainage and hillsides.
Air Quality (Section 3.3)	No Project impacts. Existing Permit Area B would be reclaimed 15 years earlier than in Alternative 2.	Direct and secondary air quality impacts would occur as a result of the emission of air pollutants from mining and reclamation operations. Fugitive dust-generating activities such as topsoil and overburden removal and handling, coal removal and processing and transport, blasting of coal and overburden, travel on unpaved haul and access roads, and wind erosion of disturbed areas would be the primary source of PM emissions. Vehicle exhaust would also be a source of PM emissions as well as gaseous emissions of NO_x, SO_2, CO, and VOC. Explosives use in coal and overburden blasting would result in gaseous emissions of NO_x, SO_2, and CO.
Geology and Geochemistry (Section 3.4)	No Project impacts. Existing Permit Area B would be reclaimed 15 years earlier than in Alternative 2.	5,711 acres would be disturbed and an estimated 104.3 million tons of coal not currently approved under the existing Area B operating permit would be removed. The mining process would alter the overburden geology in the analysis area. The removal of overburden and the Rosebud Coal, and the subsequent replacement of spoil, would result in the alteration of the horizontal continuity of the overburden that would last until the spoil is eroded away. Spoil deposits would be created within the valley bottoms of Richard and Lee Coulees.

Table S-1. Potential Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action
Water Resources – Surface Water (Section 3.5)	No Project impacts. Existing Permit Area B would be reclaimed 15 years earlier than in Alternative 2.	Adverse impacts on surface water include the following: (1) the loss of ephemeral streams, such as Richard and Lee Coulees and their tributaries within the mine disturbance boundary; (2) the loss of existing springs and stock ponds within the mine disturbance boundary; (3) the reduction or elimination of spring flows to wetlands and stock ponds sourced from overburden or spoil ground water; and (4) Changes to in-stream and spring-fed pond water quality during mining and after mining and reclamation is completed due to the discharge of ground water from the spoil to undisturbed strata downgradient of the mine and from those undisturbed strata to streams and ponds downslope of the mine. Some surface runoff to streams would be captured in sediment ponds and discharged to streams at permitted MPDES outfalls during mining. Westmoreland Rosebud must obtain MPDES permit coverage for all discharges from the Project area to surface waters and has submitted an Application to DEQ, which is currently under review. Changes to site hydrology would continue during mining and reclamation until sedimentation ponds are removed and the watershed topography and hydrology are reclaimed to conditions similar to pre-mine conditions. After mining, reclamation would replace a drainage network that approximated the form and function of the pre-mine drainage network. Ponds and small depressions may be included in reclamation to support the postmine land use, including wildlife habitat. In the event that water quantity or quality changes caused by mining render a surface water unfit for designated beneficial uses, 82-4-253, MCA and ARM 17.24.648 require the permittee to provide replacement water both immediately on a temporary basis, and to replace water in like quality, quantity, and duration if the loss is caused by mining.

Table S-1. Potential Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action
Water Resources – Ground Water (Section 3.6)	No Project impacts. Existing Permit Area B would be reclaimed 15 years earlier than in Alternative 2.	Removing the alluvium, overburden, and Rosebud Coal within the Project area drainages during mining would likely result in reduced baseflow, if present, in nearby downstream reaches during and after mining until ground water levels have recovered. Soluble salts from spoil would dissolve into ground water, increasing TDS concentrations in ground water. Ground water levels in the unmined portions of the Rosebud Coal would decline as the mined coal is dewatered and removed; the maximum extent of 5 feet of drawdown would be about 5 feet at a distance typically about 1 to 2 miles with slightly greater distance in the downgradient southeastern direction. Up to 16 wells would be impacted by Project activities. Of these, 15 are stock wells and 1 is of unknown purpose. Of the 16 wells, 11 would be removed by mining and 5 are within the disturbance area. Eight of the 11 monitored springs in the Project area would be affected by mining. Spring flows would not be reduced or eliminated until the overburden in the vicinity of the spring was mined out. The hydrologic characteristics of the overburden would change as it becomes spoil, and there would be a slow (greater than 50 years) recovery of ground water levels in the Project area. Alluvial ground water TDS concentrations near the mine would likely increase from pre-mine concentrations due to the expected higher TDS concentration in spoil ground water. Ground water quality changes would not impact existing and viable beneficial uses to support the primary pre-mine uses of domestic and livestock watering. In the event that water quantity or quality changes caused by mining render a surface water unfit for designated beneficial uses, 82-4-253, MCA and ARM 17.24.648 require the permittee to provide replacement water both immediately on a temporary basis, and to replace water in like quality, quantity, and duration if the loss is caused by mining.

Table S-1. Potential Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action
Water Resources – Water Rights (Section 3.7)	No Project impacts. Existing Permit Area B would be reclaimed 15 years earlier than in Alternative 2.	Of the 62 surface water rights in and around the analysis area, 42 are not anticipated to be impacted due to their location in drainages or due to remaining water sources that are expected to provide adequate supply. Short -term water quantity (no water quality) impacts are possible in 12 of the 62 surface water rights; all 12 constitute stock use directly from the source. 8 are anticipated to be impacted by the Project due to their proximity location within the disturbance area including seven dams. Of the 14 spring water rights used for stock watering in the impact analysis area (Richard and Lee Coulee drainages), 13 are not likely to be impacted because of their location upgradient or outside of the mining area; and 1 may experience a temporary reduction of flow rate, nearby ground disturbance, or removal of its water source. Of the 48 wells in proximity to the Project area, 16 would be impacted by Project mining as they are either anticipated to be mined out or are in the disturbance area. No wells outside the disturbance area are anticipated to be impacted by drawdown or water quality impacts. If a water right associated with a spring, stream, stock pond, or well became inadequate or unusable for its specified beneficial use due to water quantity or water quality changes attributed to mining, and if the impact was detected and a complaint of harm was filed by a water right holder, DEQ would determine if harm had occurred, and a suitable replacement source would be provided by Westmoreland Rosebud. If a water right associated with a spring, stream, stock pond, or well was impacted during or after mining but still contained sufficient water of adequate quality to meet beneficial use needs, the impact would extend until such time that the impact was detected and a replacement water source was provided or until water quantity returned to pre-mining conditions after reclamation.

Table S-1. Potential Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action
Vegetation (Section 3.8)	No Project impacts. Existing Permit Area B would be reclaimed 15 years earlier than in Alternative 2, and Rosebud Mine facilities would be reclaimed and the areas revegetated 7 years earlier than in Alternative 2.	Vegetation communities on up to 5,643 acres would be lost during mining operations, which would result in a short-term adverse impact on vegetation. Areas that require vegetation clearing and removal would be subject to an overall loss of biodiversity and a short-term loss of productivity during the active mining period. Reclamation would reestablish plant communities, but biodiversity would be reduced and species composition would not be the same. Loss of soil structure, loss of organic matter due to mixing and storage, and loss of microorganisms due to prolonged storage of soil could lower postmining vegetation production, vigor and diversity for an extended period. Mining activities could lower the regional water table, which would adversely impact adjacent vegetation communities, especially wetland and riparian areas. Reclamation of the existing ramp roads and the Area B haul road in the existing Area B permit area would be delayed by 15 years, prolonging vegetation reestablishment in those areas.
Wetlands (Section 3.9)	No Project impacts.	Project mining activities would directly impact 12.27 acres of palustrine persistent emergent saturated wetlands and two open water features (a shallow pool and a remnant pit pond) in the analysis area. An additional 1.19 acres of wetlands would be impacted from changes to surface and ground water flows within the analysis area, and 6.3 acres of wetlands within the downstream watersheds (per the National Wetlands Inventory), may be impacted by reduction in ground water flows and ephemeral flows or changes in discharge location. All impacted wetlands are nonjurisdictional. Overall, the Proposed Action would have a short-term and long-term adverse impact on wetlands. Reclamation of wetlands onsite would achieve the same functions and values of pre-mining conditions but may not do so for a considerable amount of time. The mitigation of wetlands would provide replacement of the functions and values lost.

Table S-1. Potential Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action
Fish and Wildlife Resources (Section 3.10)	No Project impacts. Existing Permit Area B would be reclaimed 15 years earlier than in Alternative 2, and Rosebud Mine facilities would be reclaimed and the areas revegetated 7 years earlier than in Alternative 2.	5,711 acres of wildlife habitat would be disturbed in the analysis area. Additional adverse impacts would occur from surface disturbances that remove vegetation, result in direct mortality of or injury to wildlife, or cause behavioral shifts such as a change in movement or displacement to other areas due to increased human activity and noise from blasting and mining operations. Direct impacts on Montana Species of Concern would be considered moderate due to the permanent loss or modification of habitat. There would be no impacts on federally listed threatened and endangered species. Greater sage-grouse are not known to occur in the analysis area; however, mining activities would displace any greater sage-grouse that did occur from active mining areas to other areas and would remove general habitat. Mitigation and minimization measures would reduce overall impacts. Reclamation after mining disturbance would establish general habitat.
Cultural and Historic Resources (Section 3.11)	No Project-related ground disturbance within the analysis area and, therefore, no potential for adverse impacts on cultural resources.	Over the life of the Project, 31 potential historic properties would be adversely affected by ground-disturbing activities on 5,711 acres including 27 properties (primarily prehistoric camps or lithic scatters) determined eligible for listing in the NRHP, 3 that remain unevaluated for listing in the NRHP, and 1 historic district (the Lee Community Historic District). Adverse impacts on the potential historic properties would be resolved through a mitigation plan, to be developed by Westmoreland Rosebud, submitted to DEQ, and approved by DEQ in coordination with the SHPO prior to disturbance. In addition to a previous pedestrian survey, the mine is currently conducting an ethnographic study as part of ARM 17.24.304(1)(b) in order to identify any other potential historical properties or traditional cultural properties important to consulting tribal parties.

Table S-1. Potential Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action
Socioeconomics (Section 3.12)	Economic impacts would be the same as the Proposed Action but would end in 2038 due to mine closure, seven years earlier than under the Proposed Action.	The Rosebud Mine would be expected to operate until 2045. While operating, the Rosebud Mine would support: 316 direct jobs (62 on the Northern Cheyenne Indian Reservation); 70 indirect jobs (13 on the Northern Cheyenne Indian Reservation); 91 induced jobs (19 on the Northern Cheyenne Indian Reservation); $154 million in annual direct economic output ($30 million on the Northern Cheyenne Indian Reservation); $18 million in annual indirect economic output ($3.2 million on the Northern Cheyenne Indian Reservation); $11.7 million in annual induced economic output ($2.1 million on the Northern Cheyenne Indian Reservation); $27 million in annual state revenues; and $8 million in annual taxes and royalties.
Visual Resources (Section 3.13)	No Project impacts. Existing Permit Area B would be reclaimed 15 years earlier than in Alternative 2.	No direct visual impacts would occur from Project area mining operations on residences in the city of Colstrip, commercial sites (Key Observation Point (KOP) 7—gas station), local recreation areas such as Winchester Park and Castle Rock Lakes, or locations along SH 39 (KOP 5) in the analysis area. There would be short-term adverse impacts during the life of the mine on vehicular drivers traveling along Airport Road (KOP 3) and limited long-term visual impacts at KOPs 1 and 2. Existing visual impacts on KOP 4 from ramp roads and the haul roads in the existing Area B permit area would continue for an additional 15 years while mining occurs in the AM5 expansion area. Implementation of the Proposed Action would also delay reclamation of mine support facilities in Areas A and C, extending those visual impacts by 7 years.
Land Use and Recreation (Section 3.14)	Existing Permit Area B would be reclaimed and postmining land uses would be achieved 15 years earlier than in Alternative 2.	All current land uses (primarily grazing) and recreation (hunting) within the analysis area would be temporarily disturbed and devoted to mining and associated activities during the 30 years of mining operations. After reclamation, impacts on grazing land and cropland would be long-term, moderate, and beneficial.

Table S-1. Potential Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action
Transportation (Section 3.15)	Existing Permit Area B, including haul roads, would be reclaimed 15 years earlier than in Alternative 2. Westmoreland Rosebud would continue to plow county roads in the analysis area during large snowstorms when the county may be overwhelmed, until mine closure (2030).	No long-term transportation impacts would be expected from construction of the haul and ramp roads as the overall transportation system would not be disrupted, and any adverse impacts on other resources would be short-term and limited to the period of construction and mine operations in the Project area. Public roads, such as SH 39 and the Castle Rock Road, would continue to be maintained and plowed by Westmoreland Rosebud for local and regional traffic until mine closure (estimated to be 2047). Employees traveling to and from the Rosebud Mine would contribute to local traffic, but impacts would not change from current conditions.
Solid and Hazardous Waste (Section 3.16)	No Project impacts. Existing Permit Area B would be reclaimed 15 years earlier than in Alternative 2, and Rosebud Mine facilities, including those used for solid and hazardous waste, would be reclaimed 7 years earlier than in Alternative 2.	Alternative 2 would extend the operational life of the Area B permit area by 15 years and the life of the Rosebud Mine and associated facilities, including those used for solid and hazardous waste, by 7 years. As is current practice for Area B and other permit areas, hazardous wastes would be collected in 55-gallon drums at satellite accumulation points within the Project area and transported to the hazardous waste storage area located in Area A for shipment to a TSDF. Final disposal of non-coal solid wastes, if encountered, would be either at the Rosebud County Landfill or in the mine pits in an approved landfill site for solid wastes. Mining-related nonhazardous waste such as nontreated wood, wooden pallets, concrete, and dragline cable and wooden cable spools would be placed in the mine pits.
Noise (Section 3.17)	No Project impacts. Existing Permit Area B would be reclaimed 15 years earlier than in Alternative 2, and Rosebud Mine facilities would be reclaimed 7 years earlier than in Alternative 2, eliminating those noise sources.	The primary sources of noise from the Project area would be blasting, excavation, and hauling of the coal offsite. Blasting within the Project area is expected to occur with similar frequency (coal: 1 to 3 days per week and overburden: 4 to 6 times per month) to what is ongoing today in the existing Area B permit area and other actively mined permit areas. Noise from other mining activities in the Project area would be expected to remain the same or become less for some residences. For others, the worst-case mining noise could become 5 to 6 dB louder than it has been in the past when no barriers were between the source and the receiver.

Table S-1. Potential Environmental Impacts.

Resource	Alternative 1 – No Action	Alternative 2 – Proposed Action
Soil (Section 3.18)	No Project impacts. Existing Permit Area B would be reclaimed 15 years earlier than in Alternative 2, and Rosebud Mine facilities would be reclaimed 7 years earlier than in Alternative 2.	A maximum of 5,711 acres would be disturbed by Project activities in the analysis area. Areas cleared of vegetation would be susceptible to soil erosion from wind and water. Soil erosion would also occur as a result of soil removal and storage during mine operations and soil exposure during respreading and stabilization. Erosion impacts would be short-term and adverse and would return to pre-mine erosion rates within 2 years once vegetation stabilizes the surface. Loss of soil structure through mechanical handling followed by tillage to relieve compaction would alter the native soil profile. Degradation of chemical properties in stockpiled soil may include changes in available nutrients, accumulation of ammonium, and the loss of organic carbon through heat and leaching. Impacts on physical, chemical, and biological soil characteristics would be long-term and adverse. It would be many years before these soil characteristics return to pre-mine conditions.

S.8 WHERE TO OBTAIN MORE INFORMATION

More information on the proposed Project can be found on DEQ's website http://deq.mt.gov/Public/eis or http://deq.mt.gov/Public/publiccomment. If you have any additional questions or concerns, please contact:

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ABBREVIATIONS AND ACRONYMS

AADT	annual average daily traffic
ACHP	Advisory Council on Historic Preservation
ACI	ACI Energy
ACS	American Community Survey
AHR	Annual Hydrology Report
AML	abandoned mine lands
AMM	abandoned mine methane
AMPD	U.S. Environmental Protection Agency Clean Air Markets Program Data
AMRF	Abandoned Mine Reclamation Fund
AOC	Administrative Order of Consent
APE	area of potential effect
AQS	Air Quality Service
AR5	Fifth Assessment Report of the IPCC
ARM	Administrative Rules of Montana
ARMP	Approved Resource Management Plan
asl	above sea level
ASLM	Assistant Secretary for Land and Minerals
AUM	animal unit month
AVF	alluvial valley floor
BACT	Best Available Control Technology
BART	Best Available Retrofit Technology
BGEPA	Bald and Golden Eagle Protection Act of 1940
BLM	Bureau of Land Management
BLM-MT/DK	Bureau of Land Management Montana/Dakotas
BLS	U.S. Department of Labor, Bureau of Labor Statistics
BP	before present
BTCA	best technology currently available
BTU	British thermal units
CAA	Clean Air Act
CAMx	Comprehensive Air Quality Model with Extensions
CAP	criteria air pollutant
CASTNET	Clean Air Status and Trends Network
CCAC	Climate Change Advisory Committee
CCR	coal combustion residuals
CDC	Center for Disease Control
CEMS	Continuous Emissions Monitoring System
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERP	Contingency and Emergency Response Plan
CFB	circulating fluidized bed
CFR	Code of Federal Regulations
cfs	cubic feet per second
cf/t	cubic feet per short ton
CH_4	methane
CHIA	cumulative hydrologic impacts assessment
CMM	coal mine methane
CO	carbon monoxide
CO_2	carbon dioxide

CO_2e	carbon dioxide equivalent
COPC	chemicals of potential concern
Corps	U.S. Army Corps of Engineers
CPRD	Colstrip Park and Recreation District
CSAPR	Cross-State Air Pollution Rule
CWA	Clean Water Act
dB	decibel
dBA	decibel (A-weighted)
DEQ	Montana Department of Environmental Quality
DNRC	Montana Department of Natural Resources and Conservation
DOI	U.S. Department of the Interior
DPM	diesel particulate matter
dv	deciview
DV	design value
EC	electrical conductivity
Eco-SSL	ecological soil screening level
EHP	effluent holding pond
EIA	Energy Information Administration
EIS	Environmental Impact Statement
ELG	effluent limit guidelines
EO	Executive Order
EPRI	Electric Power Research Institute
ERA	ecological risk assessment
ERO	ERO Resources Corporation
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FGDM	flue gas desulfurization material
FLIGHT	Facility Level Information on Greenhouse Gases Tool
FLPMA	Federal Land Policy and Management Act
Forest Service	USDA Forest Service
FR	*Federal Register*
FWP	Montana Fish, Wildlife & Parks
FY	fiscal year
GHG	greenhouse gas
GIS	geographic information systems
GNP	Great Northern Properties LP
gpm	gallons per minute
Gt	gigatons
Guidelines	Clean Water Act Section 404(b)(1) Guidelines
GWP	Global Warming Potential
HAP	hazardous air pollutant
HFC	hydrofluorocarbons
Hg	mercury
HHRA	human health risk assessment
HI	hazard index
HVTL	high voltage transmission line
HWC	Hazardous Waste Coordinator
ICMM	International Council on Mining and Metals
IMPROVE	Interagency Monitoring of Protected Visual Environments
IPAC	USFWS Information, Planning, and Conservation System
IPCC	Intergovernmental Panel on Climate Change

kg/ha	kilograms per hectare
kV	kilovolt
L_{dn}	day-night average noise level
L_{eq}	equivalent noise level
LANL	Los Alamos National Laboratory
LBA	lease by application
LBM	lease by modification
LOAEL	lowest observed adverse effect level
LQG	Large Quantity Generator
m/s	meters per second
MAAQS	Montana Ambient Air Quality Standards
MAQP	Montana Air Quality Permit
MBTA	Migratory Bird Treaty Act
MCA	Montana Code Annotated
MCFO	Miles City Field Office
MDA	Montana Department of Agriculture
MDHHS	Montana Department of Health and Human Services
MDN	Mercury Deposition Network
MDSL	Montana Department of State Lands
MDT	Montana Department of Transportation
MEGAN	Model of Emissions of Gases and Aerosols in Nature
MEIC	Montana Environmental Information Center
MEMS	Mercury Emissions Monitoring System
MEPA	Montana Environmental Policy Act
MFSA	Major Facility Siting Act
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
MLA	Mineral Leasing Act
MMT	million metric tons
$MMtCO_2e$	million metric tons of carbon dioxide equivalent
MNHP	Montana Natural Heritage Program
MOA	memorandum of agreement
MOVES	Motor Vehicle Emissions Simulator
MP	milepost
MPDD	Mining Plan Decision Document
MPDES	Montana Pollutant Discharge Elimination System
mph	miles per hour
MQAP	Monitoring and Quality Assurance Plan
MSGWG	Montana Sage Grouse Working Group
MSHA	Mine Safety and Health Administration
MSU	Montana State University
MSUMRA	Montana Strip and Underground Mine Reclamation Act
MW	megawatts
MWAM	Montana Department of Transportation Wetland Assessment Method
MYED	Mid Yellowstone Electric Cooperative Inc.
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NADP	National Atmospheric Deposition Program
NCA	National Climate Assessment
NCAR	National Center for Atmospheric Research

NCCV	National Climate Change Viewer
ND	normalized difference
NEI	National Emissions Inventory
NEPA	National Environmental Policy Act
NLEB	northern long-eared bat
NO_x	nitrogen oxide
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no observed adverse effect level
NOI	Notice of Intent
NHPA	National Historic Preservation Act
NRC	National Research Council
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSPS	New Source Performance Standards
NSR	New Source Review
NTN	National Trends Network
NWR	National Wildlife Refuge
O_3	ozone
OEA	Office of Environmental Analysis
OSAT	Ozone Source Apportionment Technology
OSHA	Occupational Safety and Health Administration
OSMRE	Office of Surface Mining Reclamation and Enforcement
PA	programmatic agreement
PAP	permit application package
PCI	per-capita income
PD	Preliminary Determination
PFYC	Potential Fossil Yield Classification
PHC	probable hydrologic consequences
PM	particulate matter
PLS	pure live seed
PMT	postmine topography
ppb	parts per billion
PPE	personal protective equipment
PPL	Colstrip Power Plant
ppm	parts per million
ppt	parts per trillion
PSAT	Particulate Source Apportionment Technology
PSD	Prevention of Significant Deterioration
PTE	potential to emit
QA	quality assurance
QC	quality control
RCP	representative concentration pathway
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
RRA	Resource Recovery Act
RRPP	Resource Recovery and Protection Plan
RMP	Resource Management Plan
SAR	sodium adsorption ratio
scf	standard cubic feet
SCORP	Montana State Comprehensive Outdoor Recreation Plan

SEDCAD	Sediment, Erosion, Discharge by Computer Aided Design
SFHA	Special Flood Hazard Area
SH	State Highway
SHPO	State Historic Preservation Office
SHWMP	Solid and Hazardous Waste Management Plan
SIP	State Implementation Plan
SMCRA	Surface Mining Control and Reclamation Act
SOC	Species of Concern
SO_2	sulfur dioxide
SPCCMP	Spill Prevention Control and Counter Measure Plan
SSL	soil screening level
STEP	stage two evaporation pond
T&E	Threatened and Endangered
TBTU	trillion British thermal units
TCLP	Toxicity Characteristic Leaching Procedure
TCP	traditional cultural property
THC	total hydrocarbon
TMDL	Total Maximum Daily Load
tpy	tons per year
TRI	Toxic Release Inventory
TRRC	Tongue River Railroad Company Inc.
TRV	toxicity reference value
TSDF	treatment, storage, and disposal facility
UCL	Upper Confidence Limit
UDP	Unanticipated Discovery Plan
USC	United States Code
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UWPHI	University of Wisconsin Population Health Institute
VER	valid existing rights
VOC	volatile organic compound
VRM	Visual Resource Management
Water Rights Bureau	Montana Department of Natural Resources and Conservation, Water Resources Division, Montana Water Rights Bureau
W/m^2	watts per square meter
WCI	Western Climate Initiative
WEPP	USDA Water Erosion Prediction Project
WGIII	Working Group III
WRAP	Western Regional Air Partnership
WRI	World Resources Institute
$\mu g/m^3$	micrograms per cubic meter
µS/cm	microSiemens/centimeter

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GLOSSARY

active mining period	Areas in a surface mining operation where mining is taking place or areas where mining is complete and reclamation activities are taking place.
air pollutant	Any substance in air that could, in high enough concentration, harm animals, humans, vegetation, and/or materials. Such pollutants may be present as solid particles, liquid droplets, or gases. Air pollutants fall into two main groups: (1) those emitted from identifiable sources and, (2) those formed in the air by interaction between other pollutants.
air quality	A measure of the health-related and visual characteristics of the air, often derived from quantitative measurements of the concentrations of specific injurious or contaminating substances.
air quality modeling	A mathematical simulation of how air pollutants disperse and react in the atmosphere to affect ambient air quality.
air quality related values	Air quality related values (AQRVs) are resources sensitive to air quality and include a wide array of vegetation, soil, water, fish and wildlife, and visibility.
alkalinity	The capacity of water to resist changes in pH, which would make the water more acidic.
alluvium	Unconsolidated material that is deposited by flowing water.
alternative	A MEPA term defined in ARM 17. 4.603(2)(a): (i) an alternate approach or course of action that would appreciably accomplish the same objectives or results as the proposed action; (ii) design parameters, mitigation, or controls other than those incorporated into a proposed action by an applicant or by an agency prior to preparation of an EA or draft EIS; (iii) no action or denial; and (iv) for agency-initiated actions, a different program or series of activities that would accomplish other objectives or a different use of resources than the proposed program or series of activities. The agency is required to consider only alternatives that are realistic, technologically available, and that represent a course of action that bears a logical relationship to the proposal being evaluated (ARM 17. 4.603(2)(b).
ambient	Surrounding, existing. Of the environment surrounding a body, encompassing on all sides. Most commonly applied to air quality and noise.
anaerobic decomposition	The decomposition of organic material without oxygen, resulting in the release of methane and other anaerobic products.
analysis area	The geographical area being targeted in the analysis as related to the area of the proposed project.
annuals	Plants that complete their life cycle and die in one year or less.
anthropogenic	Impacts originating in human activity.
appropriation	Per 85-2-102, MCA, the act of diverting, impounding, or withdrawing, including by stock for stock water, a quantity of water for a beneficial use.
aquifer	Per 82-4-203(5), MCA, any geologic formation or natural zone beneath the earth's surface that contains or stores water and transmits it from one point to another in quantities that permit, or have the potential to permit, economic development as a water source.

attainment area	An area that the U.S. Environmental Protection Agency has designated as being in compliance with one or more of the National Ambient Air Quality Standards (NAAQS) for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. An area may be in attainment for some pollutants but not for others.
backfilling and grading	The operation of refilling an excavation and finishing the surface.
Bald and Golden Eagle Protection Act	An act enacted in 1940 that prohibits “take” of a bald or golden eagle without a permit from the Secretary of the Interior. “Take” is defined as “take, possesses, sell, purchase, barter, offer to sell, export, or import, at any time or in any manner, any bald eagle … [or any golden eagle], alive or dead, or any part, nest, or egg thereof.”
baseflow	The contribution of near-channel alluvial ground water and deeper bedrock ground water to a stream channel.
baseline	The existing conditions against which impacts of the alternatives are compared.
Best Technology Currently Available	Structural, non-structural, and managerial techniques that are recognized to be the most effective and practicable means to reduce or prevent water pollution.
bioavailable	The state of a toxicant such that there is increased physicochemical access to the toxicant by an organism. The less the bioavailability of a toxicant, the less its toxic effect on an organism.
biodiversity	A term that describes the variety of life-forms, the ecological role they perform, and the genetic diversity they contain.
blasting	The act of removing, opening, or forming by or as if by an explosive.
bond liability	The time period consisting of four reclamation phases that correspond to bond release. See Section 1.6.4 for definitions of the four reclamation phases in the bond liability period.
bond release	Return of a performance bond to the coal operator after the regulatory agency has inspected and evaluated the completed reclamation operations and determined that all regulatory requirements have been satisfied.
borrow materials	Soil or rock dug from one location to provide fill at another location.
box cut	The initial mine cut made through the overburden to expose a portion of a coal seam.
broadcast seeding	A means of planting where seed is distributed on the ground surface mechanically or by hand.
call survey	A method to ID amphibians by sound from a fixed point during a specified period of time (1–2 minutes)—usually conducted in evenings or nighttime hours.
candidate species	Those species under consideration for possible listing as “endangered” or “threatened” in accordance with the 1973 Endangered Species Act.
carcinogenic parameters	Elements or compounds capable of causing cancer.
carrying capacity	The maximum number of animals that can be sustained over the long term on a specified land area.
catchment	A geographic area that collects rain or snowfall.

Class I area	A specifically designated area where the degradation of air quality is stringently restricted (e.g., many national parks, wilderness areas).
climate	The average weather conditions over lengthy periods of time. Typically quantified using mean and variability of temperature, precipitation, and wind over a 30 year period.
clinker	Baked sedimentary rock that developed where coal seams exposed at or near the surface have burned. Also known locally as “scoria.”
colluvial	Rock detritus and soil accumulated at the foot of a slope.
colluvium	A general term applied to deposits on a slope or at the foot of a slope that were moved there chiefly by gravity.
confluence	The point where two streams meet.
corridor	A defined tract of land, usually linear, through which a species must travel to reach habitat suitable for reproduction and other life-sustaining needs.
Cretaceous	The third and latest of the periods included in the Mesozoic Era. Also, the system of strata deposited in the Cretaceous period and related most commonly to the age of the dinosaurs.
criteria pollutant	An air pollutant that is regulated by the National Ambient Air Quality Standards (NAAQS). Criteria pollutants include sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and two size classes of particulate matter, less than 10 micrometers (0.0004 inch) in aerodynamic diameter, and less than 2.5 micrometers (0.0001 inch) in aerodynamic diameter. Pollutants may be added to, or removed from, the list of criteria pollutants as more information becomes available. Note: Sometimes pollutants regulated by state laws also are called criteria pollutants.
critical load	Quantitative estimate of the level of exposure of natural systems to pollutants below which significant harmful impacts on specified sensitive elements of the environment do not occur
cumulative impact	A MEPA term defined in ARM 17.4.603(7): the collective impacts on the human environment of the proposed action when considered in conjunction with other past and present actions related to the proposed action by location or generic type. Related future actions must also be considered when these actions are under concurrent consideration by any state agency through preimpact statement studies, separate impact statement evaluation, or permit processing procedures.
day-night average noise level or L_{dn}	A noise metric that reflects a 24-hour A-weighted noise dose. Also equivalent to a 24-hour A-weighted L_{eq}.
dBA or decibels A scale	A logarithmic unit for measuring sound intensity, using the decibel A-weighted scale, which approximates the sound levels heard by the human ear at moderate sound levels, with a 10-decibel increase being a doubling in sound loudness.
deep rip	Breaking up compacted soil or overburden, to a depth below normal tillage.

degradation	Per 75-5-103, MCA, a change in water quality that lowers the quality of high-quality waters for a parameter. The term does not include those changes in water quality determined to be nonsignificant pursuant to 75-5-301(5)(c), MCA. Under ARM 17.30.702(3), degradation also means any increase of a discharge that exceeds the limits established under or determined from a permit or approval issued by the department prior to April 29, 1993.
dendritic	The branching of natural drainage systems.
deposition	Deposition is the process whereby aerosols and gases move from the atmosphere to the earth's surface.
dilution	The reduction of a concentration of a substance in air or water.
direct impact	An impact caused by an action and that occurs at the same time and place as the action.
disturbed area	An area where vegetation, topsoil, or overburden is removed or upon which topsoil, spoil, and processed waste is placed as a result of mining.
downgradient	The direction that ground water flows, which is from areas of high ground water levels to areas of low ground water levels.
drill seeding	A mechanical method for planting seed in soil.
drilling	The act of boring or driving a hole into something solid.
edge effects	An edge is the boundary or interface between two biological communities or between different landscape elements. Edges exist, for instance, where older forested patches border newly harvested units. The intensity of edge microclimatic gradients, or the “edge contrast,” depends on how sharply the two adjacent habitats differ. Edge effects, broadly defined, are the influences of one patch type on a neighboring patch type. Edge effects on organisms are both positive and negative; they cause some species to increase and others to decrease.
effluent	Liquid waste or sewage discharged into water.
electrical conductivity (EC)	A measure of soluble salts in soil or water (salinity of a soil).
embeddedness	The degree to which rocks are covered by the substrate material (sand, clay, silt, etc.).
emission	Effluent discharged into the atmosphere, usually specified by mass per unit time, and considered when analyzing air quality.
emissions inventory	An emission inventory is an accounting of the amount of pollutants discharged into the atmosphere.
endangered species	Any species of plant or animal that is in danger of extinction throughout all or a significant portion of its range. Endangered species are identified by the Secretary of the Interior in accordance with the 1973 Endangered Species Act.
Endangered Species Act	An act of Congress, enacted in 1973, to protect and recover threatened or endangered plant or animal species and their habitats. The Secretary of the Interior, in accordance with the act, identifies or lists the species as “threatened” or “endangered.”
environmental consequences	Environmental impacts of project alternatives, including the proposed action, which cannot be avoided; the relationship between short-term uses of the human environment, and any irreversible or irretrievable commitments of resources which would be involved if the proposal should be implemented.

Environmental Impact Statement (EIS)	A detailed written statement required by 75-1-201, MCA. It is prepared to analyze the impacts on the environment of a proposed action and released to the public for review and comment. An EIS must meet the requirements of MEPA and the directives of the agency responsible for the proposed action.
ephemeral drainageway	Per 82-4-203(17), MCA, a drainageway that flows only in response to precipitation in the immediate watershed or in response to the melting of snow or ice and is always above the local water table. Except in the case of drainage devices that intercept ground water, flows along drainageways are typically very brief.
ephemeral stream	Under ARM 17.30.362(10), an "ephemeral stream" means a stream or part of a stream that flows only in direct response to precipitation in the immediate watershed or in response to the melting of a cover of snow and ice, the channel bottom of which is always above the local water table. Streams differ primarily from drainageways in that they typically transmit surface and ground water flows over some prolonged period of time.
equivalent noise level or L_{eq}	An environmental noise metric of the exposure resulting from the accumulation of sound levels over a particular period.
evaporation	The physical process by which a liquid is transformed to a gaseous state.
evapotranspiration	The water lost from an area through the combined impacts of evaporation from free surfaces and transpiration from plants.
factor-of-safety	Forces causing sliding divided by forces resisting sliding (e.g., at a factor-of-safety of 1.0, the forces causing sliding are the same as those resisting sliding).
fault	A fracture or fracture zone where there has been displacement of the sides relative to one another.
forb	Any herbaceous plant, usually broadleaved, that is not a grass or grass-like plant.
fugitive emissions	1. Emissions that do not pass through a stack, vent, chimney, or similar opening where they could be captured by a control device. 2. Any air pollutant emitted to the atmosphere other than from a stack. Sources of fugitive emissions include pumps; valves; flanges; seals; area sources such as ponds, lagoons, landfills, piles of stored material (e.g., coal); and road construction areas or other areas where earthwork is occurring.
genus	A group of related species used in the classification of organisms (plural = genera).
habituate	Become accustomed to.
hardness	A measure of the amount of calcium and magnesium dissolved in the water.
harmful parameters	Elements and compounds that threaten human and other animal health and safety.

hazardous air pollutants (HAPs)	Air pollutants not covered by the National Ambient Air Quality Standards (NAAQS) but which may present a threat of adverse human health impacts or adverse environmental impacts. Those specifically listed in 40 CFR 61.01 are asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride. More broadly, HAPs are any of the 189 pollutants listed in or pursuant to section 112(b) of the Clean Air Act. Very generally, HAPs are any air pollutants that may realistically be expected to pose a threat to human health or welfare.
haze	A form of air pollution caused when sunlight encounters tiny pollution particles in the air, which reduce the clarity and color of what we see, and particularly during humid conditions.
heavy metals	Metallic elements with high molecular weights, generally toxic in low concentrations to plants and animals.
highwall	The face of exposed overburden and mineral in surface mining operations or for entry to underground mining operations.
historic properties	Cultural resources that are listed on or eligible for listing on the NRHP.
home range	An area in which an individual animal spends most of its time doing normal activities.
hydraulic conductivity	A measure of the ability of a geologic material to transmit water.
hydric soil	A soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part.
hydrophytic	Growing either partly or totally submerged in water.
hydrostratigraphic unit	A body of rock having considerable lateral extent and composing a geologic framework for a reasonably distinct hydrologic system.
hyporheic exchange	The mixing of surface and shallow subsurface water through porous sediment surrounding a river, driven by spatial and temporal variations in channel characteristics (streambed pressure, bed mobility, alluvial volume, and hydraulic conductivity)
incised stream	A narrow, steep-sided watercourse. Typically indicative of a past or present erosive environment.
indirect impact	See definition for Secondary Impact
intermittent stream	Per 82-4-203(28), MCA, a stream or reach of a stream that is below the water table for at least some part of the year and that obtains its flow from both ground water discharge and surface runoff.
land farming	A process by which petroleum-contaminated soil is bioremediated aboveground by stimulating aerobic microbial activity within the soil through aeration and/or the addition of minerals, nutrients, and moisture. It is a proven, effective technology for reducing concentrations of nearly all the constituents of petroleum products typically found at petroleum-contaminated sites.

land use	Per 82-4-203(29), MCA, specific uses or management-related activities, rather than the vegetative cover of the land. Land uses may be identified in combination when joint or seasonal uses occur and may include land used for support facilities that are an integral part of the land use. Land use categories include cropland, developed water resources, fish and wildlife habitat, forestry, grazing land, industrial or commercial, pastureland, land occasionally cut for hay, recreation, or residential.
lek	An assembly area where animals, especially grouse, carry on display and courtship behavior.
life-of-mine	Length of time after permitting during which coal is extracted and mine-related activities can occur.
lithology	The structure and composition of a rock formation.
loading	The quantity of material or chemicals entering the environment, such as a receiving stream, over a set time period.
long-term impact	A change in a resource or its condition that does not immediately return the resource to pre-mine condition, appearance, or productivity; long-term impacts would apply to changes in condition that continue beyond the bond liability period but would be expected to eventually return to pre-mine condition, or as required under MSUMRA.
macroinvertebrates	Small animals without backbones that are visible without a microscope (e.g., insects, small crustaceans, and worms).
macrophytes	Plants visible to the unaided eye. In terms of plants found in wetlands, macrophytes are the conspicuous multicellular plants.
mainstem	The primary channel in a stream or river.
mean	The average number of a set of values.
median	A numerical value in the midpoint of a range of values with half the value points above and half the points below.
mesic	Having intermediate or moderate moisture or temperature; or reference to organisms adapted to moderate climates.
metapopulation	Multiple populations of an organism within an area in which interbreeding can occur, but is limited due to geographic barriers.
metasedimentary	A rock type that is composed of formerly small-sized particles ("sedimentary," like the grains of sands on lakeshores) that are then exposed to high pressures or temperatures and are altered physically and/or chemically.
metric	A value calculated from existing data and used for summarization purposes.
Migratory Bird Treaty Act	Enacted in 1918 between the United States and several other countries. The act forbids any person without a permit to "pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird, included in the terms of this Convention…for the protection of migratory birds…or any part, nest, or egg of any such bird."
mitigation	An action to avoid, minimize, reduce, eliminate, replace, or rectify the impact of a management practice.

mixing zone	A limited area of a surface waterbody or a portion of an aquifer where initial dilution of a discharge takes place and where water-quality changes may occur and where certain water-quality standards may be exceeded.
Montana Natural Heritage Program	The Montana Natural Heritage Program provides information on Montana's species and habitats, emphasizing those of conservation concern.
mycorrhizae	Important structures that develop when certain fungi and plant roots form a mutually beneficial relationship where energy moves primarily from plant to fungus and inorganic resources (principally phosphate) move from fungus to plant.
National Ambient Air Quality Standards (NAAQS)	The allowable concentrations of air pollutants in the ambient (public outdoor) air. National ambient air quality standards are based on the air quality.
National Emissions Standards for Hazardous Air Pollutants (NESHAPs)	Emissions standards set by the Environmental Protection Agency for air pollutants which are not covered by NAAQS and which may, at sufficiently high levels, cause increased fatalities, irreversible health impacts, or incapacitating illness. These standards are found in 40 CFR Parts 61 and 63.
nitrogen cycle	The process by which nitrogen circulates among the air, soil, water, plants, and animals of the earth, and undergoes many different transformations in the ecosystem, changing from one form to another as organisms use it for growth and, in some cases, energy.
No Action Alternative	An alternative in which the proposed action is not taken. The No Action Alternative represents a scenario in which current conditions and trends are projected into the future in which the proposed action does not take place and the project is not implemented.
nonattainment area	An area that the U.S. Environmental Protection Agency has designated as not meeting (i.e., not being in attainment of) one or more of the National Ambient Air Quality Standards (NAAQS) for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. An area may be in attainment for some pollutants, but not for others.
noncriteria pollutants	The entire range of contaminants other than criteria air contaminants (see "criteria air contaminants" definition), including other toxic and hazardous pollutants.
noxious weed	Any exotic plant species established or that may be introduced in the state that may render land unfit for agriculture, forestry, livestock, wildlife, or other beneficial uses, or that may harm native plant communities.
opportunistic species	A species that can adapt to, and take advantage of, a variety of habitats or situations. This ability provides a benefit to the species in its distribution, numbers, and survival during changing conditions.
overburden	Per 82-4-203(37), MCA: (a) all of the earth and other materials that lie above a natural mineral deposit; and (b) the earth and other material after removal from their natural state in the process of mining.
overpressure	Noise from blasting activities, which is assessed using flat-weighted decibels (dB) rather than dBA. Also, blast overpressure.

particulate matter (pm)	A complex mixture of extremely small particles and liquid droplets that get into the air. Once inhaled, these particles can affect the heart and lungs and cause serious health impacts. PM10 includes only those particles equal to or less than 10 micrometers (0.0004 inch) in aerodynamic diameter; PM2.5 includes only those particles equal to or less than 2.5 aerodynamic micrometers (0.0001 inch) in diameter.
peak flow	The maximum flow of a stream in a specified period of time.
perennial stream	Per 82-4-203(39), MCA, a stream or part of a stream that flows continuously during all of the calendar year as a result of ground water discharge or surface runoff.
perennials	Plants that live longer than 2 years.
periphyton	Organisms (as some algae) that live attached to underwater surfaces.
permeable	Allowing the passage of fluids.
pH	A method of expressing the acidity or basicity of a solution; the pH scale runs from 0 to 14, with a value of 7 indicating a neutral solution. Values greater than 7 indicate basic or alkaline solutions, and those below 7 indicate acidic solutions.
phreatic surface	The boundary between saturated and unsaturated soil zones or rock in ground water.
piezometer	A small well used to measure the ground water surface.
piping	Creation of tunnels or cavities from the movement of water in soil.
Pleistocene	The first epoch of the Quaternary Period in the Cenozoic Era with respect to the age of Earth. Characterized by the spreading and recession of the ice sheets, and by the appearance of modern humans.
point count survey	A tally of birds identified by sight and sound from a fixed position during a specified period of time (e.g., 3 minutes).
population	A collection of individuals that share a common gene pool. In this document, local population refers to those breeding individuals within the analysis area.
postmining land use	The specific use or management-related activity to which a disturbed area is restored after completion of mining and reclamation.
postmining topography	The relief and contour of the land that remains after backfilling of the mine pit, grading, and recontouring have been completed.
potentiometric surface	An imaginary surface representing the total head of ground water in a confined (often bedrock) aquifer that is defined by the level to which water will rise in a well.
Precambrian	The period of time that extends from about 4.6 billion years ago (the point at which Earth began to form) to the beginning of the Cambrian Period, 541 million years ago.
prevention of significant deterioration (of air quality) (PSD)	Regulations established to prevent significant deterioration of air quality in areas that already meet NAAQS. Specific details of PSD are found in 40 CFR 51.166.
prime farmland	Land that (a) meets the criteria for prime farmland prescribed by the United States Secretary of Agriculture in the *Federal Register* and (b) historically has been used for intensive agricultural purposes.
probable maximum flood	The largest flood that may be expected from a combination of the most severe weather and hydrologic conditions that are reasonably possible in a drainage basin.

Proposed Action	A MEPA term used for the action put forth by an applicant to be analyzed in an EIS. An action is defined in ARM 17.4.603(1) and includes "a project or activity involving the issuance of a lease, permit, license, certificate, or other entitlement for use or permission to act by the agency, either singly or in combination with other state agencies."
raptors	Birds of prey (e.g., hawks, owls, vultures, eagles).
reclamation	Per MSUMRA at 82-4-203(44), MCA, reclamation means backfilling, subsidence stabilization, water control, grading, highwall reduction, topsoiling, planting, revegetation, and other work conducted on lands affected by surface mining or underground mining under a plan approved by the department to make those lands capable of supporting the uses that those lands were capable of supporting prior to any mining or to higher or better uses.
recontouring	The movement of quantities of earth, usually by mechanical means, to reconfigure the relief and contour of the land.
regeneration	Regrowth of a tree crop or other vegetation, whether by natural or artificial means.
reporting values	Values listed as reporting values in DEQ Circular WQB-7, and that are the detection levels that must be achieved in reporting ambient monitoring results to the department unless otherwise specified in a permit, approval, or authorization issued by DEQ.
residuum	Unconsolidated and partly weathered mineral materials disintegrated of consolidated rock in place.
revegetation	Plant growth that replaces original ground cover following land disturbance.
riparian areas	Areas with distinct resource values and characteristics that comprise an aquatic ecosystem, and adjacent upland areas that have direct relationships with the aquatic system. This includes floodplains, wetlands, and lake shores.
rip, ripping, or ripped	Mechanically breaking up compacted soil layers using heavy machinery with tines working at depth.
saline soil	A nonsodic soil containing sufficient soluble salt to adversely affect the growth of most plants.
saturation percent	The water content of a saturated soil paste, expressed as a dry weight percentage.
scoria (clinker)	Baked and fused rock resulting from in-place burning of coal deposits. See the definition of clinker above.
scree	An accumulation of broken rock fragments lying on a slope or at the base of a hill or cliff.
secondary impact	A MEPA term defined in ARM 17.4.603(18): "a further impact to the human environment that may be stimulated or induced by or otherwise result from a direct impact of the action."
sedge	A grass-like plant, often associated with moist or wet environments.
sediment-control pond/sediment trap	A sediment-control structure, including a barrier, dam, or excavated depression, that slows down runoff water to allow sediment to settle out.
seep	A place where ground water flows slowly out of the ground, often over a diffuse area.
segregation	The separation of water from sources of contamination in a mine.

seismic	Of or produced by earthquakes. Of or relating to an earth vibration caused by something else (e.g., an explosion).
sensitive species	Those species, plant and animal, identified by the Montana Natural Heritage Program for which population viability is a concern, as evidenced by (1) significant current or predicted downward trends in population numbers or density or (2) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.
short-term impact	A change that within a short period would no longer be detectable as the resource is returned to its pre-mine condition, appearance, or use. In this EIS a "short period" is defined as the length of the Area B AM5 bond liability period (see **Chapter 1, Section 1.6, Financial Assurance** for a description of the bond liability period).
slopewash alluvium	Soil and rock material that has been moved down a slope predominantly by the action of gravity assisted by the action of running water that is not concentrated into channels.
sodic soil	A nonsaline soil containing sufficient exchangeable sodium to adversely affect plant growth and soil structure.
sodium adsorption ratio (SAR)	A relation between soluble sodium and soluble divalent cations (magnesium and calcium) that can be used to predict the exchangeable sodium percentage of soil equilibrated with a given solution.
soil erodibility	A measure of the inherent susceptibility of a soil to erosion, without regard to topography, vegetation cover, management, or weather conditions.
soil pH	The negative logarithm of the hydrogen ion activity of a soil. The degree of acidity or alkalinity.
soil texture	Soil textural units are based on the relative proportions of sand, silt, and clay.
soil threshold concentration	The metal concentration that equals 1 percent of the 95 percent Upper Confidence Limit (95 percent UCL) on the mean of the background concentration.
spoil	Overburden that has been removed during surface or underground mining operations.
spring	A localized point of discharge where ground water emerges onto the land or into a surface waterbody.
stratigraphy	The arrangement of strata.
stratum	A section of a formation that consists of primarily the same rock type.
subpopulation	A well-defined set of interacting individuals that comprise a portion of a larger, interbreeding population.
sustainability	The ability of a population to maintain a relatively stable population size over time.
taxon	Any formal taxonomic group such as genus, species, or variety.
temporary reclamation	Revegetation of mine facilities (e.g., soil stockpiles and dam embankments) conducted during operations to reduce erosion, sedimentation, noxious weed invasion, and visual impacts. The revegetation will be redisturbed upon mine facility removal.
Tertiary	The earlier of two geologic periods in the Cenozoic Era, in the classification generally used. Also, the system of strata deposited during that period.

threatened species	Any species likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range, as identified by the Secretary of the Interior in accordance with the 1973 Endangered Species Act.
total dissolved solids (TDS)	A measure of the amount of material dissolved in water (mostly inorganic salts).
total suspended solids (TSS)	A measure of the amount of undissolved particles suspended in water.
Toxicity Characteristic Leaching Procedure (TCLP)	An analytical test to determine the mobility of both organic and inorganic analytes present in liquid, solid, and multiphasic wastes. This test is usually to determine if a waste meets the definition of toxicity under RCRA.
transect	A line, strip, or series of plots from which biological samples, such as vegetation, are taken.
trigger value	A value listed in DEQ Circular WQB-7 for a toxic parameter, used to determine if proposed activities will cause degradation.
unconsolidated deposits	Sediment not cemented together, containing sand, silt, clay, and organic material.
ungulate	An animal having hooves.
upgradient	The direction from which ground water flows.
viability	Ability of a population to maintain sufficient size so that it persists over time in spite of normal fluctuations in numbers; usually expressed as a probability of maintaining a specific population for a specific period.
viewshed	The portion of the surrounding landscape that is visible from a single observation point or set of points.
visibility	The distance to which an observer can distinguish objects from their background. The determinants of visibility include the characteristics of the target object (shape, size, color, and pattern), the angle and intensity of sunlight, the observer’s eyesight, and any screening present between the viewer and the object (i.e., vegetation, landform, even pollution such as regional haze).
visibility extinction	Reduction of visibility due to light extinction caused by the absorption and scattering of ambient particulate matter.
visual quality objective	A desired level of scenic quality based on physical and sociological characteristics of an area. Refers to the degree of acceptable alterations of the characteristic landscape.
waterbar	A small berm across a road at an angle to prevent excessive flow down the road surface and erosion of road surface materials.
water-dependent ecosystems	Parts of the environment in which the composition of species and natural ecological processes are determined by the permanent or temporary presence of flowing or standing surface water or ground water. These include the instream areas of rivers, riparian vegetation, springs, wetlands, floodplains, estuaries, karst systems, and ground water–dependent terrestrial vegetation.
waters of the U.S.	Waters that include the following: all interstate waters, intrastate waters used in interstate and/or foreign commerce, tributaries of the above, territorial seas at the cyclical high-tide mark, and wetlands adjacent to all the above.

wetlands	Areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated-soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.
wetted area	The area at a stream cross-section that contains water.
windrose	A graphic tool use to illustrate prevailing wind patterns (speed and direction) over a given period of time at a particular location.

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CHAPTER 1. PURPOSE AND NEED

1.1 INTRODUCTION

This Environmental Impact Statement (EIS) has been prepared by the Montana Department of Environmental Quality (DEQ) to analyze and disclose the potential environmental impacts of the proposed fifth amendment (AM5) to the operating permit (C1984003B) for Area B at the Rosebud Mine, an existing surface coal mine near Colstrip, Montana (**Figure 1**). On February 17, 2017, Western Energy Company, now Westmoreland Rosebud Mining, LLC (Westmoreland Rosebud), a subsidiary of Westmoreland Mining LLC (Westmoreland), submitted the AM5 amendment application (Application). The currently permitted area for Area B is 6,045 acres, of which 5,655 acres are approved for disturbance by mining and associated activities. If approved, AM5 (Project) would add 9,108 acres to the permit area, which includes 5,547 acres of disturbance. In addition, the Area B operations plan and reclamation plan would be updated to include additional mine passes and reclamation. The proposed Project would extend the life of Area B by 15 years and the life of the Rosebud Mine by 7 years.

DEQ deemed the Application complete on May 24, 2017. At the time, the Rosebud Mine was operated by Western Energy Company, a subsidiary of Westmoreland Coal Company. During the EIS development, Westmoreland Coal Company filed for bankruptcy and was acquired by Westmoreland Rosebud Mining, LLC on March 2, 2019. A minor revision was approved on March 14, 2019 for Westmoreland Rosebud Mining, LLC to be the contract miner at the Rosebud Mine. The permit transfer from Western Energy Company to Westmoreland Rosebud Mining, LLC, which was submitted on April 12, 2019 is pending. DEQ uses the name, Westmoreland Rosebud Mining, LLC, throughout this EIS to reduce confusion for the reader.

The Rosebud Mine is located adjacent to the city of Colstrip in Rosebud County. All coal is combusted locally at two power plants—the Colstrip and Rosebud Power Plants. Permit Area D of the Rosebud Mine extends to the east of Colstrip for about 3.5 miles, and Permit Areas A, B, C, and F extend to the west of Colstrip (**Figure 2**). Currently, there are 30,951 permitted acres at the Rosebud Mine, which in 2018 and 2019 produced between 8.0 and 9.0 million tons of low-sulfur subbituminous coal annually, and averaged 9.9 million tons annually over the last 10 years (see **Section 2.2.2, Existing Operating Permits, Disturbance, and Reclamation**). Although mine production is expected to drop to approximately 6 million tons annually for years 2020 through 2029 (Peterson 2020b), analyses in this EIS are based on recent rather than projected production rates.

The proposed Project area is the Area B permit area as modified by proposed AM5 and is located about 5 miles southwest of Colstrip in Township 1 North, Range 40 and 41 East. The Project area has two drainages, Lee Coulee and Richard Coulee, which are divided by a tall ridge. Lee Coulee, Richard Coulee, and their tributaries flow into Rosebud Creek, a tributary of the Yellowstone River.

If the Project is approved, the Area B permit area would increase to 15,153 acres with an 11,202-acre area disturbance area. Project activities (mining, highwall reduction, soil storage, scoria pits, haul-road and ramp-road construction, etc.) would disturb 5,711 acres within the disturbance area. The surface of the Project area is owned by private parties (92 percent) and the State of Montana (8 percent). The subsurface is owned by private parties, the State of Montana, and the federal government. Westmoreland Rosebud holds private, state, and federal leases for Project area coal; Westmoreland Rosebud is not seeking to mine any federal coal leases that have not been previously approved under the Area B federal mining plan. Pre-mine land uses within and adjacent to the Project area include livestock grazing, pastureland, agricultural cropland, wildlife habitat, and industrial/commercial (i.e., public airport and ranch yards). The primary pre-mine surface land use within the Project area is livestock grazing. The eastern part of the

Project area includes part of the Big Sky Mine permit area (C1988004B), which was previously mined, and reclaimed, and released from DEQ jurisdiction in 2020. A significant portion of the acreage proposed to be added by the Project burned in 2012.

At the proposed rate of production, the Project would extend active mining in the Area B permit area by 15 years. Without the addition of the Project, the operational life of Area B would be expected to end in 2030 (see **Section 2.2.4, Life of Operations**). Westmoreland Rosebud estimates that there are 104.3 million tons of recoverable coal in the Project area. For this EIS, it is assumed that Project area coal would be used in the Rosebud Power Plant and in Colstrip Units 3 and 4.

This EIS has been prepared to meet the requirements of the Montana Environmental Policy Act (MEPA), Title 75, chapter 1, parts 1 through 3 of the Montana Code Annotated (MCA), and its implementing rules, the Administrative Rules of Montana (ARM) 17.4.601, *et seq*. This EIS will assist DEQ to make an informed decision regarding Westmoreland Rosebud's Application (see **Appendix A**). DEQ will decide whether to approve the Application in accordance with the requirements of the Montana Strip and Underground Mine Reclamation Act (MSUMRA) (82-4-20,1 *et seq*., MCA) and its implementing rules (ARM 17.24.301-1309). DEQ may not withhold, deny, or impose conditions on AM5 based on MEPA under 75-1-201(4), MCA.

This EIS also will assist DEQ to make an informed decision regarding Westmoreland Rosebud's Application for a new Montana Pollutant Discharge Elimination System (MPDES) permit (MT-0032042) for 27 new outfalls in the Project area.

The decision regarding a selected alternative and supporting reasoning will be documented in a Record of Decision (ROD) and Written Findings issued at least 15 days after the Final EIS is published.

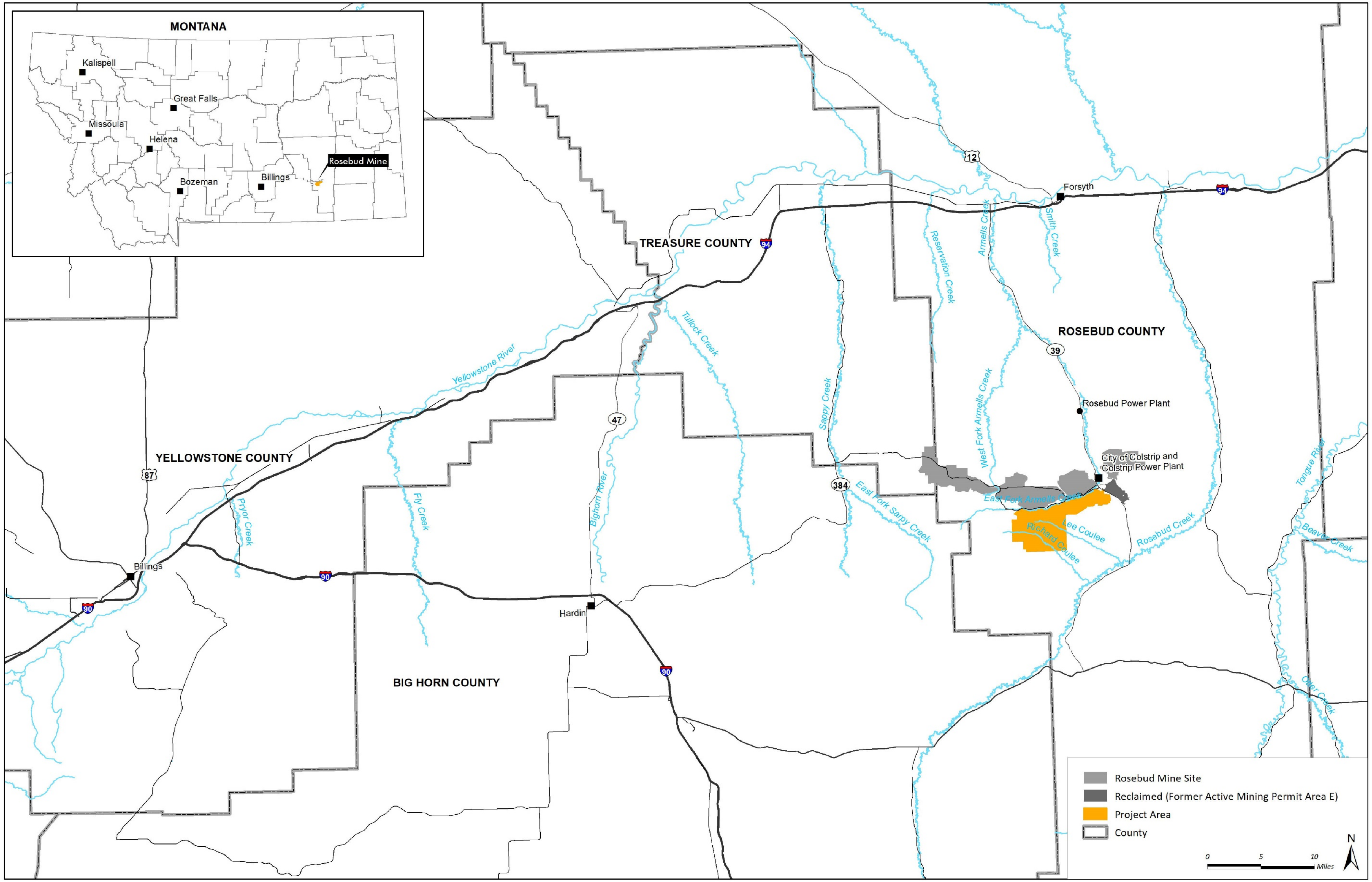

Figure 1. Project Location.

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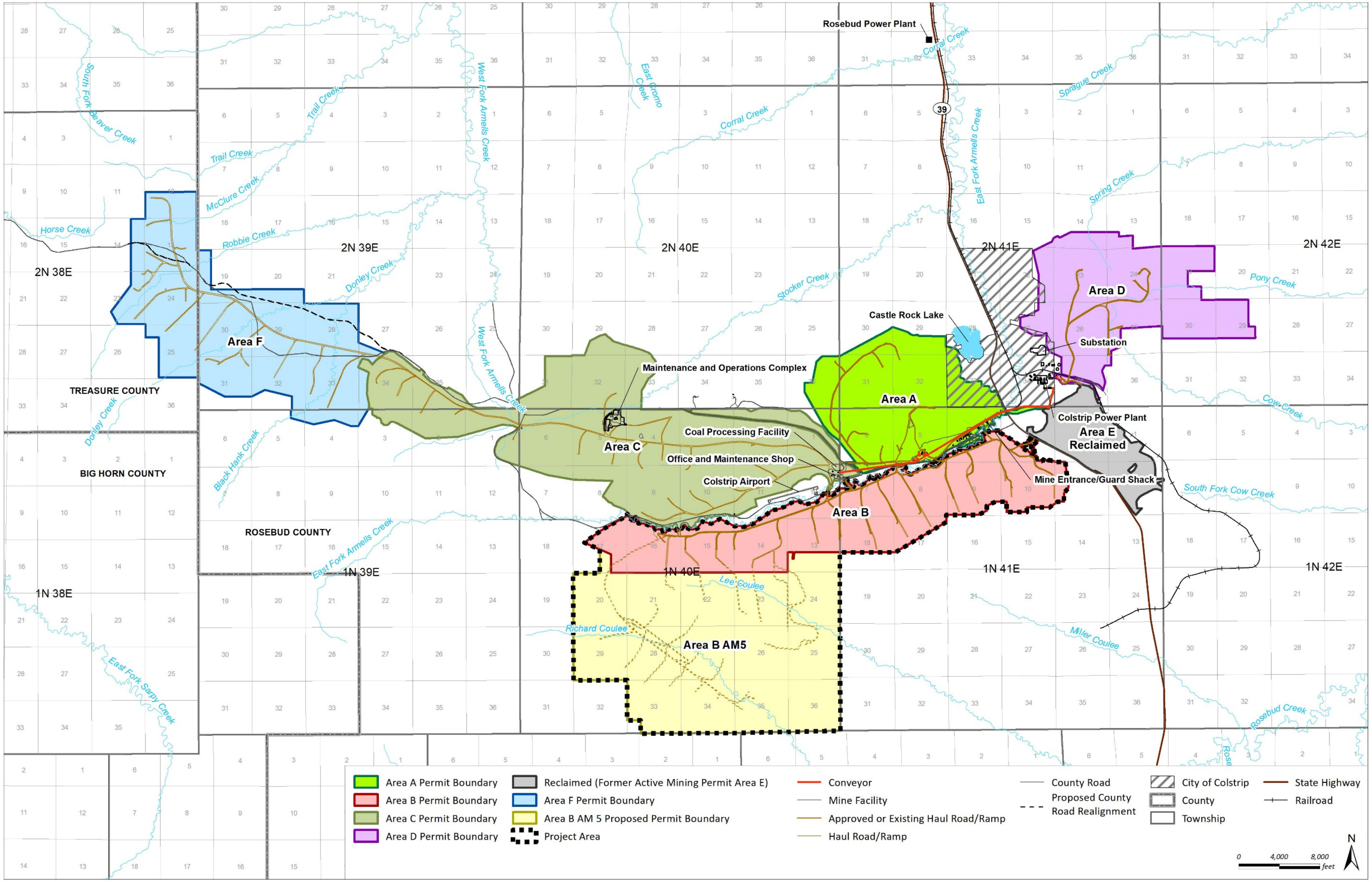

Figure 2. Location of Mine Facilities and Permit Areas.

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This EIS discloses the potential direct, secondary, and cumulative environmental impacts that would result from the proposed Project and alternatives. The document is organized into eight chapters:

- Executive Summary – The summary provides a brief overview of the proposed Project, alternatives, and impacts. It also includes a list of acronyms, a glossary, and the table of contents (including lists of figures and tables).
- Chapter 1. Purpose and Need – Chapter 1 includes the following: background and overview of the proposed Project; the purpose and benefits of the proposed Project; DEQ's role, responsibilities, and decisions; an overview of public notice and participation; identification of the key scoping issues; and a description of the bond process for surface coal mines (financial assurance).
- Chapter 2. Description of Alternatives – Chapter 2 describes existing operations at the Rosebud Mine and provides a detailed description of Westmoreland Rosebud's Proposed Action (Alternative 2) as well as the No Action Alternative (Alternative 1). Chapter 2 also includes a description of alternatives that were considered but not carried forward for detailed analysis.
- Chapter 3. Affected Environment and Environmental Consequences – Chapter 3 describes the existing conditions and analysis areas used for the resource-specific impacts analyses; discloses the direct, secondary, and cumulative environmental impacts of implementing the Proposed Action or No Action alternative; and discloses irreversible and irretrievable commitments of resources.
- Chapter 4. Regulatory Restrictions – Chapter 4 includes a Regulatory Restriction Analysis pursuant to 75-1-201(3)(iii), MCA, which is an analysis of impacts on Westmoreland Rosebud's private property rights and whether alternatives that reduce, minimize, or eliminate the regulation of those rights have been analyzed.
- Chapter 5. Coordination and Consultation – Chapter 5 provides a list of preparers and agencies consulted during the development of the EIS and describes consultation with Indian tribes.
- Chapter 6. List of Preparers – Chapter 6 provides the names and credentials of DEQ specialists and third-party consultants.
- Chapter 7. References – Chapter 7 includes a list of references cited in the analysis.

The following appendices provide more detailed information to support the analyses presented in the Final EIS:

- Appendix A – List of all Westmoreland Rosebud's Area B (C1984003B) AM5 Application documents for the Project with electronic links for digital download
- Appendix B – List of Surface Water and Ground Water Rights
- Appendix C – Rosebud Coal Mine Greater Sage-Grouse Mitigation Plan
- Appendix D – Comments on the Draft EIS and Responses (Final EIS only)

1.2 BACKGROUND AND OVERVIEW

Coal has been mined at Colstrip for more than 90 years. The Northern Pacific Railway established the city of Colstrip and its associated mine in the 1920s to access coal from the Fort Union Formation. Coal mining began in 1924, providing fuel for the railway's steam locomotive trains. During the initial 34 years of mining, 44 million tons of coal were mined. By 1958, diesel-powered locomotives replaced steam engines, and mining ceased in the Colstrip area.

In 1959, the Montana Power Company purchased rights to the Rosebud Mine and the city of Colstrip with plans to build power-generation facilities. The Rosebud Mine operation began production in 1968. In 2001, Westmoreland Coal Company purchased the Rosebud Mine; its subsidiary, Western Energy operated the mine. In 2019, Westmoreland Coal Company sold the Rosebud Mine to its creditors as part of bankruptcy proceedings. The mine is now operated by Westmoreland Rosebud Mining, LLC, a subsidiary of Westmoreland Mining LLC. Currently, three active mine areas at the Rosebud Mine operate under permits issued by DEQ: Area A, Area B, and Area C. Area D is no longer actively mined and is being reclaimed. Area E has received full bond release and is no longer a Montana coal mine. Past and current mine operations at the Rosebud Mine are described in **Section 2.2, Rosebud Mine – Description of Past and Existing Mine Operations and Reclamation**.

Area B (C1984003B) has been mined since 1976 (see **Section 2.2.2.1, Permit Area B**). For purposes of analysis, Area B mining and reclamation described in the EIS as "existing conditions" (see **Figure 3**) are based on Western Energy's 2019 Area B Annual Report. Westmoreland Rosebud will continue to actively mine and reclaim Area B according to the approved operating permit throughout the environmental review process for the proposed Project.

Westmoreland Rosebud's Proposed Action is summarized in **Section 2.4, Alternative 2 – Proposed Action**. This EIS references the most recent MEPA document prepared for the Rosebud Mine, the Area F EIS (OSMRE and DEQ 2018); this document is available on DEQ's website: http://deq.mt.gov/Public/eis. Other MEPA documents for the Rosebud Mine can be obtained at DEQ's Centralized Service Division upon request.

1.3 PURPOSE AND NEED

MEPA and its implementing rules require that any EIS prepared by a state agency include a description of the purpose and benefits of the proposed Project, which are described in the sections below.

1.3.1 Purpose and Need

DEQ's purpose in conducting this environmental review is to act upon Westmoreland Rosebud's Application to amend the Area B operating permit. The proposed amendment to the existing Area B operating permit would allow additional mine passes, construction of the Richard and Lee haul roads, construction of ramp roads, and an extension in the operational life of the mine from 2030 to 2045. DEQ's actions on Westmoreland Rosebud's surface-mine operating permit amendment application must be in accordance with MSUMRA, 82-4-221 *et seq*., MCA (see **Section 1.4.1.2, DEQ Decisions**). DEQ's purpose in conducting this environmental review is also to act on Westmoreland Rosebud's Application for a new MPDES permit (MT-0032042) for 27 new Project area outfalls.

Westmoreland Rosebud's purpose is to develop its additional coal reserves at the Rosebud Mine and to receive all necessary regulatory authorizations to develop and operate the proposed Project.

1.3.2 Benefits

The Project would provide the following federal, state, and local benefits:

- An ongoing fuel source (104.3 million tons of coal) for the Colstrip Power Plant (Units 3 and 4) and the Rosebud Power Plant
- Continued employment for workers at the mine
- An ongoing tax base to federal, state, and local governments

- Ongoing royalty payments to mineral resource owners
- Continued support to local businesses

1.4 AGENCY AUTHORITY AND ACTIONS

The major decisions to be made by DEQ are described below. Other permits, certificates, licenses, or approvals would be required as well before implementation of the proposed Project could begin. **Table 1** provides a summary of state requirements. **Table 1** is not a comprehensive list of all permits, certificates, or approvals needed but list the primary state agencies with permitting responsibilities. Agency decision-making is governed by state and federal laws, including statutes, rules, and regulations, that form the legal basis for the conditions that the Project must meet to obtain necessary permits, approvals, or licenses. In addition, these laws set forth the conditions under which each agency could deny Westmoreland Rosebud the necessary permits or approvals. The regulatory framework governing agency decision-making is briefly introduced below and described in detail in each **Chapter 3** resource section under the heading “Regulatory Framework.”

Table 1. State Permits, Licenses, and Approvals That May Be Required for the Project.

Permit, License, or Approval	Regulation	Purpose
Montana Department of Environmental Quality (DEQ)		
Surface Mine Operating Permit	Montana Strip and Underground Mine Reclamation Act (82-4-201 *et seq*., MCA)	To allow surface coal mining. Proposed activities must comply with state environmental standards and criteria. Approval may include stipulations for final design of facilities and monitoring plans. A sufficient reclamation bond must be posted with DEQ before implementing an operating permit modification.
Air Quality Permit (MAQP #1483)	Clean Air Act of Montana (75-2-102 *et seq*., MCA)	To control particulate emissions of more than 25 tons per year.
MPDES Permit	Montana Water Quality Act (75-5-201 *et seq*., MCA)	To establish effluent limits, treatment standards, and other requirements for point source discharges, which includes storm water discharges to state waters including ground water. Coordinate with USEPA.
401 Certification (33 USC § 1341)	CWA	To ensure that any activity that requires a federal license or permit (such as the Section 404 permit from the Corps) complies with Montana water quality standards.
Montana State Historic Preservation Office (SHPO)		
Cultural Resource Clearance (Section 106 Review) (16 USC § 470)	National Historic Preservation Act of 1966	To review and comment on federal compliance with the National Historic Preservation Act (NHPA).

1.4.1 Montana Department of Environmental Quality

1.4.1.1 Applicable Statutes and Regulations

The Montana legislature has enacted statutes and the Board of Environmental Review has adopted administrative rules defining the requirements for construction, operation, and reclamation of a coal surface mine; discharge of mining waters; discharge of air emissions; and storage of hazardous and solid wastes. DEQ is required to evaluate the AM5 amendment Application, as well as the associated applications, including the new MPDES permit, under the laws and regulations summarized below.

Montana Environmental Policy Act

MEPA requires a state agency to conduct an environmental review when making decisions or planning activities that may have a significant impact on the human environment. DEQ concluded in its May 24, 2017, completeness determination letter (**Appendix A**) that the decision to approve or deny Westmoreland Rosebud's Application would be a major state action that requires preparation of an EIS. MEPA (Title 75, chapter 1, parts 1 through 3, MCA) and its implementing administrative rules (ARM 17.4.601, *et seq*.), define the process to be followed when preparing an EIS.

Montana Strip and Underground Mine Reclamation Act

MSUMRA requires that Westmoreland Rosebud apply for and obtain a surface-mine operating permit before engaging in coal surface-mining operations in the Project area. If AM5 is approved, the Area B permit as amended would be subject to renewal at 5-year intervals by applying to DEQ at least 240 days (but not more than 300 days) before the renewal date (see ARM 17.24.416). To renew its permit, Westmoreland Rosebud would have to be in compliance with MSUMRA, environmental protection standards, and permit conditions. Some of the key requirements of MSUMRA are listed below. MSUMRA is discussed in detail in **Chapter 3** resource sections under the "Regulatory Framework" headings.

- The Application must contain a determination of the probable hydrologic consequences (PHC) of coal mining and reclamation operations, both on and off the mine site, with respect to the hydrologic regime and quantity and quality of water in surface water and ground water systems, so that cumulative impacts of all anticipated mining in the area on the hydrology of the area and particularly on water availability can be assessed (see 82-4-222, MCA).
- DEQ cannot approve the Application until it (1) prepares a cumulative hydrologic impacts assessment (CHIA) of the Proposed Action and all anticipated mining on surface and ground water systems in the cumulative impact area, and (2) determines, based on the information provided in the PHC and other relevant information compiled by the DEQ Coal Program, that the mining operations described in the Application are designed to prevent material damage to the hydrologic balance outside the Project permit area as required by 82-4-227(3), MCA.
    - Hydrologic balance is defined by MSUMRA in 82-4-203(24), MCA, as "the relationship between the quality and quantity of water inflow to, water outflow from, and water storage in a hydrologic unit, such as a drainage basin, aquifer, soil zone, lake, or reservoir, and encompasses the dynamic relationships among precipitation, runoff, evaporation, and changes in ground water and surface water storage."
    - Material damage is defined by MSUMRA in 82-4-203(31), MCA, as the "degradation or reduction by coal mining and reclamation operations of the quality or quantity of water outside of the permit area in a manner or to an extent that land uses or beneficial uses of water are adversely affected, water quality standards are violated, or water rights are

impacted. Violation of a water quality standard, whether or not an existing water use is affected, is material damage." DEQ makes its determination regarding material damage as part of its permitting decision; material damage is not assessed in this EIS, which has been prepared to comply with MEPA.

- The Application must contain information on how the applicant would restore or avoid disturbance to wetlands, riparian vegetation along rivers and streams and bordering ponds and lakes, and other habitats of unusually high value for fish and wildlife, and, where practicable, enhance such habitats upon reclamation of the disturbed surface area under ARM 17.24.751(2)(f).
- Reclamation and revegetation of land affected by mining must be done as rapidly, completely, and effectively as the most advanced technology would allow (see 82-4-231, MCA). Mining operations are required to have a detailed reclamation plan that must contain a description of the reclamation operations proposed, including the following information: (1) a description of postmining land uses; (2) a detailed timetable for reclamation; (3) a detailed estimate of reclamation costs (for the performance bond); (4) a backfilling and grading plan; (5) a description of postmining drainage basin reclamation that ensures protection of the hydrologic balance, achievement of postmining land-use performance standards, and prevention of material damage to the hydrologic balance in adjacent areas; (6) drainage channel designs appropriate for preventing material damage to the hydrologic balance in adjacent areas and for meeting performance standards; (7) plans for removal, storage, and redistribution of soil, overburden, spoil, and other material; (8) a revegetation plan (type, acreage, schedule, seed mixtures, revegetation methods, equipment, and success criteria); and (9) a list of reclamation of facilities and sites (see ARM 17.24.313).

State-Federal Cooperative Agreement

The state-federal Cooperative Agreement (Agreement) between DEQ and OSMRE is codified in 30 Code of Federal Regulations (CFR) 926.30 and applies to federal coal leases. Under the Agreement, DEQ reviews an operator's application to ensure that it complies with the permitting requirements and that the coal-mining operation would meet the performance standards of the approved Montana program. For the proposed Project, Westmoreland Rosebud is not seeking to mine any federal coal leases that have not been previously approved under the Area B federal mining plan (OSMRE 2016). Additional information on this agreement and its applicability to the Rosebud Mine can be found in the Area F EIS (OSMRE and DEQ 2018).

State and Federal Water Quality Statutes

The Montana Water Quality Act, 75-5-101 *et seq*., MCA and ARM 17.30.101 *et seq*. regulate discharges of pollutants into state surface waters through a MPDES permit application process and the adoption of water quality standards. Water quality standards, including the Montana nondegradation policy, specify the changes in surface water or ground water quality that are allowed from a wastewater discharge. A MPDES permit may also include limits for discharges of storm water and would require development of a storm water pollution prevention plan.

The Clean Water Act (CWA), 33 USC Section 1251, *et seq*., requires applicants for federal permits or licenses for activities that may result in a discharge to waters of the U.S. to obtain certification from the State under Section 401 of the CWA that the discharge would comply with state water quality standards. Section 404 permits, issued by the U.S. Army Corps of Engineers, require 401 certification. DEQ provides Section 401 certification pursuant to state regulations.

State and Federal Air Quality Statutes

Air quality is regulated under federal and state requirements. Under the federal Clean Air Act (CAA), the U.S. Environmental Protection Agency (USEPA) sets national standards for air quality and air pollutant concentrations. Under the CAA, states develop and implement procedures including monitoring, permitting, control measures, and enforcement to achieve and maintain these USEPA-designated standards. USEPA has primary and secondary National Ambient Air Quality Standards (NAAQS) for seven criteria pollutants: carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, fine particulate matter, and sulfur dioxide.

Under the Clean Air Act of Montana, DEQ has established Montana Ambient Air Quality Standards (MAAQS). USEPA approved the state's air quality program and has given DEQ authority to regulate air quality in Montana. DEQ requires a permit for the construction, installation, and operation of equipment or facilities that may cause or contribute to air pollution. Production from the Rosebud Mine is limited by conditions of Westmoreland Rosebud's existing DEQ-issued air quality permits (see **Section 2.2.3.1, Air Quality Permits)**. Expansion of an existing mine, in this case, the Rosebud Mine, that could result in changes in air quality, such as the addition of the Project area, must be approved by DEQ's Air Quality Bureau under ARM 17.8.748. Westmoreland Rosebud must demonstrate compliance with all applicable aspects of DEQ's Air Quality Operating Permit Program. This includes review of compliance with established emission limitations, review of compliance with ambient standards through modeling analyses, and establishment of control measures to meet best available control technology (BACT) requirements.

1.4.1.2 DEQ Decisions

Montana Strip and Underground Mine Reclamation Act

Amendment Application Review Process

Western Energy (now Westmoreland Rosebud) submitted an amendment Application to DEQ for its fifth major amendment to the Area B permit (C1984003B) on February 17, 2017 (see **Appendix A**). Westmoreland Rosebud's Application has since been revised to address deficiency comments provided by DEQ. Please see **Appendix A** for a list of reviews and revisions completed to date. DEQ is required to publish this Final EIS at least 15 days prior to the issuance of written findings granting or denying Westmoreland Rosebud's Application for an amendment to its permit. Westmoreland Rosebud must address all Application acceptability deficiencies identified by DEQ in order for DEQ to issue written findings approving Westmoreland Rosebud's permit amendment Application. A failure by Westmoreland to adequately address the Application acceptability deficiencies would result in DEQ's selection of the No Action Alternative. Within 45 days from the date that DEQ determines that the Application is acceptable (a future, yet-to-be-determined date) and 15 days after the Final EIS is published, DEQ shall prepare and issue a ROD and Written Findings, approving or denying the Application in whole or in part, per 82-4-231(8)(f), MCA, and ARM 17.24.405, and documenting DEQ's determination.

Conditions for Issuing a Permit

Because DEQ determined that an EIS was needed before making a permit decision, DEQ must complete and publish the Final EIS at least 15 days before issuing its written findings granting or denying the Application under 82-4-231(8)(c), MCA. Before approval, Westmoreland Rosebud must affirmatively demonstrate to DEQ that it will comply with the applicable laws and rules and that postmining reclamation will be carried out in accordance with the requirements of MSUMRA. Westmoreland

Rosebud must also submit a performance bond to DEQ under 82-4-223, MCA and ARM 17.24.405(7)(b) (see **Section 1.6, Financial Assurance**).

Conditions for Denial

DEQ may not approve an Application to modify a permit for an existing surface mine if there is an inadequate reclamation plan; inadequate protection of water resources outside the permit area; unacceptable impacts on exceptional topographic features, cultural resources, or scientific characteristics; a proposed location on a significant alluvial valley floor; unacceptable impacts on critical biological productivity or ecological fragility; or the threat of a public hazard or designation of the land as unsuitable for mining (82-4-227 and 82-4-228, MCA; ARM 17.24.1131–1148). DEQ may not issue a permit in the event that information contained in OSMRE's Applicant Violator System identifies unabated or uncorrected violations of the Surface Mining Control and Reclamation Act (SMCRA) or other environmental laws by affiliates or control entities of Westmoreland Rosebud (82-4-227, MCA; ARM 17.24.1265). If DEQ denies the permit, Westmoreland Rosebud can modify and resubmit its Application to address issues or concerns identified by DEQ during the permit review process.

Montana Water Quality Act

As part of its compliance with Montana water quality regulations and standards, Westmoreland Rosebud currently holds two MPDES permits: MT-0023965 for the Rosebud Mine (including Area B) and MT-0031828 for Area F (see **Permitted Discharges: Rosebud Mine** in **Section 3.1.4.1, Related Past and Present Actions**). To comply with Montana water quality regulations and standards, Westmoreland Rosebud must either modify its existing permit or apply for a new MPDES permit for new Project area discharge. Existing discharges for Area B (as currently permitted) would continue in accordance with existing MPDES Permit MT-0023965. Western Energy (predecessor to Westmoreland Rosebud) submitted the new MPDES Application to DEQ for new Project area discharge on May 3, 2018. DEQ subsequently reviewed the Application and found it to be deficient. Westmoreland Rosebud revised its Application, and DEQ is currently reviewing the revision and preparing the draft permit (MT-0032042).

Clean Air Act of Montana

Westmoreland Rosebud has an existing air quality permit, MAQP #1483-08, that covers Area B. If the Proposed Action is implemented, Westmoreland Rosebud proposes to mine an annual average of 5.1 million tons from the Project area; maximum production would be 6.5 million tons (see **Chapter 2, Table 9**). Westmoreland Rosebud has demonstrated to DEQ that the proposed Project would comply with this existing permit.

1.4.2 Other State and Federal Agencies

1.4.2.1 Montana Sage Grouse Habitat Conservation Program and the Montana Sage Grouse Oversight Team

The Montana Sage Grouse Habitat Conservation Program (Sage Grouse Program) was established in 2015 from collaborative work of the Montana Sage Grouse Habitat Conservation Advisory Council and other diverse stakeholders. The Sage Grouse Program was created to implement Executive Orders 12-2015 and 21-2015 across state government, by federal land management agencies, and private entities wishing to develop projects in key greater sage-grouse habitats. The Montana Sage Grouse Oversight Team (MSGOT) provides guidance to the Sage Grouse Program and makes decisions regarding implementation of the Executive Orders.

The AM5 Project area includes greater sage-grouse general habitat areas; no connectivity areas are present in the proposed Project area. Executive Order 12-2015 provides guidance that MSUMRA is the mechanism by which the Montana Sage Grouse Conservation Strategy should be applied to coal mining operations. Through the EIS and permitting process, DEQ is required to consider alternatives and impacts on greater sage-grouse, among other resources. Stipulations and thresholds outlined in Executive Order 12-2015 are still applicable, but should be considered through DEQ's EIS and permitting process under MSUMRA.

Executive Order 12-2015 states that all new land uses or activities subject to State agency review, approval, or authorization shall follow the sequencing approach of avoid, minimize, reclaim, and compensate, as appropriate (page 4, Section G, 13). That section further states that "mitigation shall be required even if the adverse impacts to greater sage-grouse are indirect or temporary" and describes a variety of mitigation tools with which to meet that requirement. Section N, 15 (page 8) clarifies that these requirements also apply to new activities associated with existing land uses in place prior to the effective date of the Executive Order, as is the case for the proposed AM5 Project. As noted, mitigation for sensitive species such as greater sage-grouse is also required by MSUMRA.

Westmoreland Rosebud consulted with the Sage Grouse Program to develop a mitigation plan (**Appendix C**) to address the areas of concern outlined above. The mitigation plan describes actions outlined in the Proposed Action. Westmoreland Rosebud included actions to avoid, minimize, and reclaim impacts on greater sage-grouse. MSGOT approved the mitigation plan at its December 18, 2018 meeting. More detail on the compensatory mitigation is provided in **Section 2.4.9.3, Greater Sage-Grouse Compensatory Mitigation**.

1.5 PUBLIC OUTREACH

1.5.1 Scoping

Scoping provides an opportunity for public and agency involvement during the early planning stages of the analysis. The intent of the scoping process is to gather comments, concerns, and ideas from those who have an interest in or who may be affected by the Proposed Action. Several methods were used to inform the public and solicit comments. These methods included a press release, legal notice, distribution of a scoping newsletter, and a public open house. A detailed account of the scoping processes can be found in the Public Scoping Report (ERO Resources Corporation [ERO] 2018). The report is available on DEQ's website: http://deq.mt.gov/Public/eis. A summary of public scoping activities is provided below.

1.5.1.1 Scoping Notice

On March 30, 2018, DEQ sent a news release announcing the scoping period and public open house to 14 media outlets, some of which are included in **Table 2**, and the Montana Governor's Office via email.

Table 2. Media Recipients of DEQ's Press Release.

Associated Press	*Montana Living*
Billings Gazette	Montana Public Radio
Bozeman Daily Chronicle	Newslinks
Independent Press	*Ravalli Republic*
KXLH-Helena	

Legal notices were published in the Forsyth *Independent Press* and the *Billings Gazette* announcing the scoping period and public open house. Legal notices were published in the *Billings Gazette* on March 31 and April 7, 2018, and in the Forsyth *Independent Press* on April 5 and April 12, 2018.

DEQ sent a newsletter announcing the scoping period and open house. The newsletter was sent to a mailing list consisting of the following:

- Elected officials and local governments
- State and federal agencies
- Adjacent and nearby landowners
- Individuals who had expressed previous interest in the Rosebud Mine

The newsletter was distributed to about 600 people via U.S. mail on March 30, 2018. It briefly described the proposed expansion of the Rosebud Mine, identified the Project location and description, provided the environmental review timeline, provided information for the public open house planned for April 11, 2018, and provided information on how to submit comments on the proposed Project. On April 9, 2018, a postcard was sent to the mailing list notifying recipients of a correction to the public comment deadline, which was stated in the newsletter as April 27, 2018. The postcard provided the corrected public comment deadline of April 30, 2018.

In addition, a tribal scoping letter was distributed to 17 tribal representatives via U.S. mail on April 20, 2018. Similar to the newsletter, the letter invited the recipients to comment on the proposed Project and included a brief description of the expansion including the location and anticipated environmental review timeline.

1.5.1.2 Open House

DEQ held a scoping open house and meeting at the Colstrip City Hall on Wednesday, April 11, 2018, from 4:00 to 7:00 pm. Thirty-seven people attended the event.

Twice during the open house, DEQ's MEPA coordinator gave a brief introduction of DEQ resource specialists in attendance and the EIS/permitting processes, followed by a brief description of the proposed Project. Members of the public were allowed five minutes each to provide public oral testimony. Nine attendees provided public oral testimony. Resource-specific exhibits were on display around the room during the open house, and attendees were invited to visit each exhibit, gather information, write comments, and ask questions of resource specialists. The resource specialists included staff from DEQ and ERO, the third-party consultant assisting DEQ with preparation of the EIS.

1.5.2 Scoping Issue Identification

During scoping, the public identified a number of potential issues or concerns. Some of these related to existing laws and regulations, such as the MEPA process and financial assurance (bond amounts and Western Energy's (now Westmoreland Rosebud's) ability to pay for mine reclamation). Commenters also raised concerns over the potential adverse impacts of the Project on environmental resources including air quality, water quantity and quality, and vegetation. A complete set of scoping comments can be found in the Public Scoping Report (ERO 2018). All comments received have been considered in the preparation of this document. The section below describes those scoping issues that the EIS interdisciplinary team identified as key issues considered during alternatives development.

1.5.2.1 Key Issues Identified during Public Scoping for Detailed Analysis

The following statements summarize the key issues of concern identified during scoping and used to guide the EIS interdisciplinary team's alternatives development. The issue statements below are intended to capture the essence of public and agency concerns. Detailed resource impacts analyses are provided in **Chapter 3** (direct, secondary, and cumulative impacts).

Issue 1: Impacts on air quality

The public expressed concern that surface coal-mining activities in the Project area would affect air quality.

Issue 2: Impacts on surface water quality and quantity

The Project area has two drainages, Lee Coulee and Richard Coulee, which are divided by a tall ridge. Lee Coulee and Richard Coulee flow into Rosebud Creek, a tributary of the Yellowstone River. Commenters expressed concern about water quality and quantity impacts on these surface waters.

Issue 3: Impacts on ground water quality and quantity

The public expressed concern that surface coal-mining activities in the Project area would affect ground water quality and quantity since mining would remove the Rosebud Coal aquifer from beneath most of the Project area and replace it with spoil (overburden removed during mining).

Issue 4: Impacts on wetlands

Small non-jurisdictional wetlands associated with drainages, springs, seeps, depressions, and impoundments are present within the Project area. DEQ and its consultants identified construction and operation of the Project as having the potential to directly or indirectly affect wetlands within and surrounding the Project area, including altering their function and values.

Issue 5: Impacts on vegetation and reclamation success

Comments received during public scoping indicated that reclamation of the Project area, including restoration of native vegetation and potential for noxious weeds, is of concern to the public. Public comments discussed a need to evaluate and disclose the potential for successful reclamation and revegetation within the Project area in the EIS.

Issue 6: Impacts on socioeconomic conditions

Comments received during public scoping indicated that the socioeconomic health of Colstrip and the surrounding region is of concern to the public. Public comments discussed a need to evaluate and disclose the impacts the Project would have on the region's socioeconomic condition.

1.5.2.2 Scoping Issues Eliminated from Detailed Analysis

Below are issues brought forward by the public during scoping that were eliminated from detailed analysis. These issues were not analyzed because they are covered by existing laws and regulations or are not applicable to the proposed Project. For a list of resources not studied in detail, please see **Section 3.19, Resources Considered but Not Studied in Detail**.

Bonding and Financial Assurance

Comments were received during public scoping requesting that the agencies thoroughly evaluate and disclose Western Energy's (now Westmoreland Rosebud's) ability to pay for mine reclamation.

Before issuance of the operating permit amendment (assuming the Proposed Action is selected), Westmoreland Rosebud would be required to submit a performance bond payable to DEQ as financial

assurance (82-4-223, MCA). A complete description of DEQ's bonding procedure, including bond release by reclamation phase, is provided in ARM 17.24.1101, *et seq*., and a discussion of financial assurance is included in **Section 1.6, Financial Assurance**. Because financial assurance is covered by existing statutory and administrative rule provisions enforced by the state, this issue, except as discussed in **Section 1.6**, was eliminated from detailed analysis.

Impacts of the Project and Power Plants on Climate Change and Environment

Indirect (secondary) and cumulative impacts of the power plants on climate change were also mentioned in public comments.

Pursuant to 75-1-201(2)(a), MCA, an environmental review may not include a review of actual or potential impacts beyond Montana's borders. Additionally, it may not include actual or potential impacts that are regional, national, or global in nature. Because climate change impacts extend beyond Montana's borders and are global in nature, climate change analysis has been excluded from this analysis.

Direct impacts of coal mining on climate change and indirect impacts of combusting coal in Colstrip Units 3 and 4 and in the Rosebud Power Plant were analyzed in in the Area F EIS (OSMRE and DEQ 2018). The Area F EIS was a joint environmental review by DEQ and a federal agency, and direct impacts of coal mining on climate change and indirect impacts of combusting coal in Colstrip Units 3 and 4 were included to satisfy federal requirements. For the proposed Project, unlike the Area F project, there is no required federal approval or need for National Environmental Policy Act (NEPA) compliance.

Demand for Coal and Alternative Energy Markets

Declining demand for coal and increased interest in and demand for alternative forms of energy generation were also discussed in public comments. Commenters requested that DEQ analyze both demand for coal and possible alternatives to coal.

The action before DEQ is to review and to make a decision on Westmoreland Rosebud's Application to modify its surface-mine operating permit under MSUMRA, 82-4-221 *et seq*., MCA (see **Section 1.4.1, Montana Department of Environmental Quality**). 75-1-220(1), MCA defines "alternatives analysis" to mean "an evaluation of different parameters, mitigation measures, or control measures that would accomplish the same objectives as those included in the proposed action by the applicant. For a project that is not a state-sponsored project, it does not include an alternative facility or an alternative to the proposed project itself." An alternative considering the demand for coal and alternative forms of energy generation is an alternative to the proposed project, which involves expansion of the Westmoreland Rosebud's coal mining operation into a new area. Thus, consideration of the demand for coal and alternative sources of energy generation are not properly included under the definition of "alternatives analysis" set forth in 75-1-220(1), MCA.

Analysis of the Colstrip and/or Rosebud Power Plants as Connected Actions

Public scoping comments indicated the need for DEQ to analyze the Colstrip and/or Rosebud Power Plants as connected actions and to thoroughly evaluate and disclose the direct impacts of the Colstrip Power Plant and/or the Rosebud Power Plant.

Unlike NEPA, MEPA does not require agencies to evaluate connected actions. See the Area F EIS (OSMRE and DEQ 2018) for a discussion of connected actions in the context of NEPA. For that project, OSMRE evaluated the proposed Area F and the Colstrip Power Plant (which would also apply to the Rosebud Power Plant) as potentially connected actions and concluded they were independent actions.

1.6 FINANCIAL ASSURANCE

Before receiving a permit for Project operations (if an action alternative is selected), Westmoreland Rosebud must tender a performance bond payable to DEQ as financial assurance (30 CFR 926.30, Article IX). Bonding requirements and procedures are governed by 82-4-233, MCA and ARM 17.24.1101 through 1122; these requirements are summarized in the sections below. These bonding requirements apply to all permit areas of the Rosebud Mine, including the Area B permit and proposed Project (AM5). See **Table 6** in **Chapter 2** for the amount of bond held by DEQ for each existing permit area of the Rosebud Mine.

1.6.1 Bond Amount

In determining the amount of the bond under 82-4-223(2), MCA, DEQ is required to take into consideration the character and nature of overburden, the future suitable use of the land involved, and the cost of backfilling, grading, highwall reduction, subsidence stabilization, water control, topsoiling, and reclamation to be required. The bond may not be less than the total estimated cost to the State of completing the work described in the reclamation plan. The direct and indirect estimated reclamation costs are based on industry standards. The bond amount includes the estimated cost for DEQ to contract, manage, and direct construction at the site during reclamation. In addition, the bond amount covers other contingencies and inflation (see ARM 17.24.1102).

1.6.2 Timing of Bond Calculation

The performance bond is calculated in accordance with ARM 17.24.1102. A performance bond cost estimate for the Proposed Action is provided in Westmoreland Rosebud's Application, Exhibit G. If the Application is approved, DEQ would make a performance bond calculation before issuing a ROD (Written Findings) and the permit (see **Section 1.4.1.2, DEQ Decisions**). The performance bond would be in the form of a surety bond or a collateral bond (ARM 17.24.1105).

1.6.3 Bond Review

Pursuant to ARM 17.24.1104, DEQ would be required to conduct a review of the bond amount whenever the operating permit is reviewed. The amount of the performance bond must be increased, as required by DEQ, as the acreage in the permit area increases, as methods of mining operation change, as standards of reclamation change, or when the cost of future reclamation, restoration, or abatement work increases. DEQ is required to notify the permittee of any proposed bond increase and provide the permittee an opportunity for an informal conference on the proposal. DEQ reviews each outstanding performance bond at the time that permit reviews are conducted under ARM 17.24.414 through 17.24.416 and reevaluates those performance bonds in accordance with the standards set forth in ARM 17.24.1102.

1.6.4 Bond Release

DEQ is primarily responsible for approval and release of the performance bond. The criteria and schedule for bond release are outlined in MSUMRA's implementing rules (see ARM 17.24.1116). Specifically, "the department may not release any portion of the performance bond until it finds that the permittee has met the requirements of the applicable reclamation phase as defined in this rule. The department may release portions of the performance bond applicable to a permit following completion of reclamation phases on the entire permit area or on incremental areas within the permit area" (ARM 17.24.1116(1)). Bond release is completed by reclamation phase. The four phases of reclamation that correspond to bond release, collectively known as the "bond liability period," are described in the following sections.

1.6.4.1 Phase I

Phase I reclamation consists of the completion of backfilling, grading, and drainage control as outlined in the approved reclamation plan and the plugging of all drill holes that are not approved to be retained as monitoring wells as defined in ARM 17.24.1116(6)(a).

1.6.4.2 Phase II

Phase II reclamation consists of surface stabilization to prevent accelerated erosion as defined in ARM 17.24.1116(6)(b). First, the soil replacement and the tillage of soil must be completed in accordance with the approved reclamation plan. At least two growing seasons (spring and summer for 2 consecutive years) must elapse after seeding or planting of the affected area. The established vegetation must be consistent with the species composition, cover, production, density, diversity, and effectiveness required by the revegetation criteria. Soil must be protected from accelerated erosion, and noxious weeds must be under control. Finally, for prime farmlands, production must be returned to the appropriate level.

1.6.4.3 Phase III

Phase III reclamation consists primarily of monitoring actions to ensure that postmining land uses have been achieved as defined in ARM 17.24.1116(6)(c). The established landscape must be stable and consistent with the approved postmining land use. The area of reclamation cannot be contributing suspended solids to streamflow or runoff outside the permit area in excess of the requirements of ARM 17.24.633 or the permit. If an impoundment is to remain in place, DEQ must be satisfied that the sound future management plan for that impoundment has been satisfactorily implemented. Finally, the area of reclamation may also meet the special conditions provided in 82-4-235(4)(a), MCA.

1.6.4.4 Phase IV

Phase IV reclamation is the last stage of reclamation. To be deemed complete, the following steps must be achieved in accordance with ARM 17.24.1116(6)(d):

(1) Reclamation phases I–III must be complete for all disturbed lands within the designated drainage basin;

(2) Fish and wildlife habitats and related environmental values must be restored, reclaimed, or protected in accordance with MSUMRA, its implementing rules, and the approved permit;

(3) Disturbance to the hydrologic balance must be minimized and offsite material damage prevented in accordance with MSUMRA, its implementing rules, and the approved permit;

(4) Water supplies adversely affected by mining and reclamation operations must be replaced and must function in accordance with MSUMRA, its implementing rules, and the approved permit;

(5) The essential hydrologic functions and agricultural productivity on alluvial valley floors must be reestablished;

(6) Any alternative land-use plan approved pursuant to ARM 17.24.821 and ARM 17.24.823 must be successfully implemented; and

(7) All other reclamation requirements of MSUMRA, its implementing rules, and the approved permit must be met.

CHAPTER 2. DESCRIPTION OF ALTERNATIVES

2.1 INTRODUCTION

This chapter provides background information on Westmoreland Rosebud Mining, LLC's (Westmoreland Rosebud) existing operations at the Rosebud Mine and describes the alternatives considered for the Project by the Montana Department of Environmental Quality (DEQ). This chapter also describes alternatives that were not carried forward for detailed analysis.

2.1.1 Alternatives Analyzed

Alternatives were considered based on requirements for alternatives in the Montana Environmental Policy Act (MEPA) and its implementing rules. MEPA does not specify the number of alternatives that need to be considered in the Environmental Impact Statement (EIS); however, any alternative proposed must be reasonable, in that the alternative must be achievable under current technology and the alternative must be economically feasible as determined solely by the economic viability for similar projects having similar conditions and physical locations and determined without regard to the economic strength of the specific project sponsor (75-1-201(1)(b)(iv)(C), Montana Code Annotated [MCA]). In addition, MEPA requires a meaningful analysis of a No Action Alternative in an EIS.

Under MEPA, "alternative" means an alternative approach or course of action that would appreciably accomplish the same objectives or results as the proposed action; design parameters, mitigation, or controls other than those incorporated into a proposed action by an applicant or by an agency before preparation of the EIS; or no action or denial (Administrative Rules of Montana [ARM] 17.4.603(2)). In accordance with ARM 17.4.603(2)(b), DEQ is "required to consider only alternatives that are realistic, technologically available, and that represent a course of action that bears a logical relationship to the proposal being evaluated."

DEQ considered one alternative to the Proposed Action for detailed analysis: Alternative 1 – No Action. Alternatives not carried forward for detailed analysis are discussed at the end of this chapter in **Section 2.5, Alternatives Not Carried Forward for Detailed Analysis**.

2.2 ROSEBUD MINE – DESCRIPTION OF PAST AND EXISTING MINE OPERATIONS AND RECLAMATION

2.2.1 Past and Existing Production

The Montana Power Company began production at the Rosebud Mine in 1968 to serve the Colstrip Power Plant, which began commercial operations in the mid-1970s. Past MEPA documents for the Rosebud Mine can be obtained at DEQ's Centralized Service Division upon request.

In 2001, Westmoreland Coal Company purchased the Rosebud Mine; its subsidiary, Western Energy operated the mine. In 2019, Westmoreland Coal Company sold the Rosebud Mine to its creditors as part of bankruptcy proceedings. The mine is now operated by Westmoreland Rosebud Mining, LLC, a subsidiary of Westmoreland Mining LLC. The Rosebud Mine operates 24 hours per day, 7 days per week and as of 2020 employs an average of 341 employees (see **Section 3.12, Socioeconomics**).

Between 1975 and 2018, approximately 478.8 million tons of coal were recovered from Rosebud Mine Permit Areas A, B, C, D, and E (see **Table 3**). Over the last 10 years, the Rosebud Mine produced between 8 and 13 million tons of low-sulfur (0.64 percent) subbituminous coal and 300,000 tons of high-sulfur "waste coal" (Western Energy 2018). Average annual production from the mine over that 10-year period was 9.9 million tons. In 2018 and 2019, production was lower than the 10-year average, with 8.1 million tons (Westmoreland Rosebud 2020) and 8.45 tons (Peterson 2020a) of coal recovered from the Rosebud Mine, respectively (see **Table 4**). Mine production is expected to be lower in the future due to the retirement of Colstrip Units 1 and 2. In years 2020 through 2029, mine production is expected to drop to approximately 6 million tons annually (Peterson 2020b).

All coal currently produced by the mine is consumed locally at the Colstrip Power Plant and the Rosebud Power Plant. Low-sulfur coal goes to the Colstrip Power Plant via conveyors, and high-sulfur coal is trucked to the Rosebud Power Plant. In the past (as recently as 2010), coal was also shipped by rail from the mine. A railroad spur in Area D was used to ship 5,000 to 10,000 tons per year to small customers using a few coal cars at a time. In Area A, a rail loop was used to load large trains with about 2 million tons per year for shipment to larger customers (Mahrt 2017). Westmoreland Rosebud no longer ships coal from the Rosebud Mine by train.

Table 3. Total Coal Produced by Rosebud Mine Permit Areas A, B, C, D, and E between 1975 and 2018.

Permit Area	Permit Number	Coal Sold (Tons)
A	C1986003A	68,999,657
B	C1984003B	77,820,420
C	C1985003C	215,759,451
D	C1986003D	82,894,405
E	C1981003E	33,339,045
Total		**478,812,978**

Note: Table includes permit areas only and does not include coal mined prior to MSUMRA (i.e., Pit 6).
Source: Westmoreland Rosebud 2020.

Table 4. Coal Produced by the Rosebud Mine in 2019 (January 1–December 31).

Permit Area	Permit Number	Coal Produced (Tons)
A	C1986003A	1,659,422
B	C1984003B	636,112
C	C1985003C	6,160,946
D	C1986003D	0
E	C1981003E	0
F	C2011003F	0
Total		**8,456,480**

Source: Peterson 2020a.

2.2.2 Existing Operating Permits, Disturbance, and Reclamation

The Rosebud Mine includes 30,951 permitted and bonded acres, of which 19,042 acres have been disturbed as of 2019 according to DEQ Coal Section data. See **Table 5** for a summary of permitted and disturbed acres.

Currently, four active mine areas at the Rosebud Mine operate under permits issued by DEQ[1]: Area A (4,303 acres, permit C1986003A); Area B (6,045 acres, permit C1984003B); Area C (9,382 acres, permit C1985003C); and Area F (6,746 acres, permit C2011003F) (**Chapter 1, Figure 2**). These active permit areas have been mined since 1976 (Areas A and B) and 1983 (Area C). Pre-mining development in preparation for mining in Area F began in 2019, and coal recovery began in August 2020.

In 2011, Western Energy (predecessor to Westmoreland Rosebud) submitted an operating permit application for a new permit area, Area F (C2011003F). After preparing a Draft EIS and holding a public comment period, DEQ and its co-lead agency, the Office of Surface Mining, Reclamation, and Enforcement (OSMRE), issued the *Western Energy Area F Final Environmental Impact Statement* (Area F EIS; OSMRE and DEQ 2018) in December 2018. DEQ documented its decision to approve an operating permit for Area F in a Record of Decision (ROD) and Written Findings in April 2019. OSMRE issued a ROD and a federal mining plan decision document that recommended approval of a federal mining plan in June 2019. Area F, which has a DEQ operating permit, federal mining plan, and $13,750,000 bond, added 6,746 acres to the Rosebud Mine. Currently, both the DEQ and OSMRE decisions are being litigated. Westmoreland Rosebud is also seeking to make modifications to a federal coal lease (MTM 80697) that would impact 160 acres within permit Areas B and C. For further information on pending permit Applications, see **Section 3.1.4.2, Related Future Actions**.

Two mine areas are no longer actively mined: Area D (4,475 acres, permit C1986003D) is being reclaimed, and Area E (1,026 acres, former permit C1981003E) was released from DEQ jurisdiction in 2019. Mining occurred in Area D from 1986 to 2013 and in Area E from 1976 (or prior) to 1988. Reclamation has occurred concurrently with mine operations in all permit areas as required by the Montana Strip and Underground Mine Reclamation Act (MSUMRA). **Table 6** provides an overview of bond release by permit area.

2.2.2.1 Permit Area B

Permit Area B (C1984003B) has been mined since 1976. Four amendments have modified the permit area and operations. Over its operational life, Area B has included 6,231 permitted acres; the actual number of acres currently within the permit area is 6,045 acres because final bond release has been achieved on portions of the permit area (see **Table 6**).

For purposes of analysis, Area B mining and reclamation (see **Figure 3**) described in the EIS as "existing conditions" are based on conditions within the permit area as of Western Energy's 2019 Area B Annual Mining Report (Westmoreland Rosebud 2020) and DEQ Coal Section data. Westmoreland Rosebud will continue to actively mine and reclaim Area B according to the approved operating permit throughout the environmental review process for the proposed Project. Projected areas of disturbance (primarily mining) in 2019 are shown on **Figure 3**.

As of 2019, Area B is being actively mined in the southeastern portion (Sections 7-10 and Sections 17-18), southwestern portion (Sections 13-15), and eastern portions of the current Area B permit area (see **Figure 3**). In 2018, 674,842 tons of coal were mined from the permit area.

Reclamation is ongoing in mined-out portions of the Area B permit area (see **Figure 3**). As of 2019, Westmoreland Rosebud has achieved Phase I bond release on 1,137 acres, Phase II bond release on 756 acres, Phase III bond release on 218 acres, and Phase IV bond release on 186 acres (Westmoreland Rosebud 2020). Please see **Section 1.6.4, Bond Release** for a description of bond-release phases as they

[1]Acreage totals include minor revisions (incidental boundary changes) and final bond release in each permit area.

pertain to reclamation success. DEQ holds a $86,650,000 performance bond to ensure that reclamation of Area B, as currently permitted, is successfully completed.

2.2.2.2 General Mining Method

The general sequence of surface-mining operations and reclamation used by Westmoreland Rosebud is similar for all permit areas at the Rosebud Mine. Following is a description of this method, which would be the same method used for the proposed Project.

In advance of each mining pass, soil (topsoil, subsoil, and tree soil) is removed from the disturbance area and hauled to graded areas for immediate use in reclamation or stockpiled according to type for later use during reclamation. After soil is removed, the overburden is drilled, blasted, and removed, creating broken, sedimentary rock material known as “spoil.” Blasting is done in accordance with Westmoreland Rosebud’s approved blasting plan. A dragline is then used to strip the overburden from succeeding mine passes; as needed, other auxiliary equipment may be used in overburden removal. Spoil is side cast by the dragline into the mined-out pit created by the preceding pass, forming spoil ridges. Spoil from boxcuts may be stockpiled for later use during reclamation. All spoil is needed to construct Westmoreland Rosebud’s proposed postmine topography.

After the dragline exposes the coal seam in each pass, the coal is drilled and blasted. A loading shovel, front-end loader, or backhoe loads the coal into coal haulers. The coal is then transported on an established haul road to Area C or Area A for crushing. After being processed in the Area C crusher, crushed coal is sent to the Colstrip Power Plant via an existing 4.2-mile conveyor. If processed in the Area A crusher, which is adjacent to the Colstrip Power Plant, it is sent on an existing short conveyor. Coal with higher sulfur content and low calorific value (typically the first 1-foot layer encountered in the deposit) from both crusher sites is trucked to the Rosebud Power Plant. For this EIS, it is assumed that Project area coal would be used in the Rosebud Power Plant and Colstrip Units 3 and 4.

Westmoreland Rosebud uses direct haul (hauling soil directly from the stripping area to graded areas ready for soil replacement) whenever possible. The initial stages of reclamation (grading, application of soil, and seeding) begin within 2 years of coal removal from a mining pass and continue as subsequent mine passes are completed until final bond release.

Reclamation, as it relates to bond release, occurs in four phases (bond release is described above in **Section 1.6.4, Bond Release**). Phase I includes pit backfilling and grading to meet the postmine topography and drainage basin design. Phase II consists of surface stabilization to prevent accelerated erosion, soil application, revegetation, and sediment-control measures. Phase III ensures that the postmining land uses have been met and includes extensive monitoring of the reclaimed landscape, including monitoring of vegetation, soil, and surface water and ground water resources. Phase IV ensures the restoration of the hydrologic balance, among other final reclamation measures as described in ARM 17.24.1116(6)(d).

In addition to the reclamation of the landscape disturbed by mining, other disturbed areas (road systems, mine plant facilities, sediment-control structures, and temporary diversion structures) are reclaimed after their use is no longer needed.

2.2.2.3 Existing Support Facilities

The Rosebud Mine includes the following existing facilities (**Figure 2**) and equipment, which would continue to be used for the proposed Project:

- Four active permitted mine operations: Area A, Area B, and Area C, and Area F
- A primary coal-processing facility (crusher) in Area C and a second crusher in Area A
- Conveyor-belt systems from Areas A and C to the Colstrip Power Plant
- Maintenance and operations complexes
- Haul roads with scoria surface
- Scoria pits (mined for use on road surfaces)
- Mine offices
- A mine-entrance guard shack and vehicle-weighing scale
- Four electric-powered draglines for removal of overburden, coal excavation, backfilling, and grading
- Front-end loaders, excavators, dozers, motor graders, and a fleet of haul trucks for removal of overburden, coal excavation, coal transportation to the conveyor-belt system, soil salvage, and soil application
- A fleet of five covered trucks (owned by the Rosebud Power Plant) that haul crushed coal to the Rosebud Power Plant; three trucks operate daily, with each truck delivering 6.5 loads daily (19.5 total loads daily)
- Area D railroad spur (not used since 2010); when it operated, it was used to ship a few cars of coal at a time to small customers
- Area A railroad loop (not used since 2010); when it operated, it was capable of loading large trains

Table 5. Rosebud Mine Permitted and Disturbed Acreage as of 2019.

Permit Area	Permit Number	Year Mine Disturbance Began	Permitted Acreage[1]	Active Mining 2019 (acres)	Facilities (acres)[2]	Disturbance (acres)[3]
A	C1986003A	1976	4,303	846	497	3,186
B	C1984003B	1976	6,045	2,564	455	4,601
C	C1985003C	1983	9,382	1,867	780	7,005
D	C1986003D	1986	4,475	0	1	3,037
F	C2011003F	2019	6,746	0	0	0
Rosebud Mine Total			**30,951**	**5,277**	**1,733**	**17,829**

Source: Derived from Westmoreland Rosebud's 2019 Annual Mining Reports for reporting year January 1, 2019–December 31, 2019 (Westmoreland Rosebud 2020) and DEQ Coal Section data. Numbers have been rounded to the nearest whole number.

[1] Total acreage includes minor revisions (incidental boundary changes) and final bond release.

[2] Includes roads, mine offices, equipment storage areas, coal storage barns, dams and impoundments, conveyor routes or other routes, power lines, pipelines, etc.

[3] Includes all surface that has been disturbed (Disturbance = Facilities + Active Mining + Complete Backfill and Grading).

Table 6. Reclamation Bond Amount and Phased Bond Release by Area of the Rosebud Mine as of 2019.

Permit Area	Permit Number	Acres Released from Phase I[1]	% of Disturbance Area Released from Phase I	Acres Released from Phase II[1]	% of Disturbance Area Released from Phase II	Acres Released from Phase III[1]	% of Disturbance Area Released from Phase III	Acres Released from Phase IV[1]	% of Permit Area Released from Phase IV[2]	Bond Retained by DEQ
A	C1986003A	1,596	50	1,248	39	489	15	0	0	$32,750,000
B	C1984003B	1,137	25	756	16	218	5	186	4	$86,650,000
C	C1985003C	3,808	54	3,220	46	821	12	50	1	$41,250,000
D	C1986003D	2,852	94	2,223	73	473	16	27	1	$7,950,000
F	C2011003F	0	NA	0	NA	0	NA	0	NA	$13,750,000
Rosebud Mine Total		**9,393**	53	**7,447**	42	**2,001**	11	**263**	1	**$182,350,000**

Source: Derived from Western Energy's 2019 Annual Mining Reports for reporting year January 1, 2018–December 31, 2019 (Westmoreland Rosebud 2020) and DEQ Coal Section data.

Note: Acres have been rounded to the nearest whole number.

[1] Bond-release phases are tied to reclamation. Please see **Section 1.6.4, Bond Release** for a description of bond-release phases.

[2] Phase IV has been demonstrated as a percentage of the Life of Mine Permit Area as it includes both disturbed and undisturbed acres.

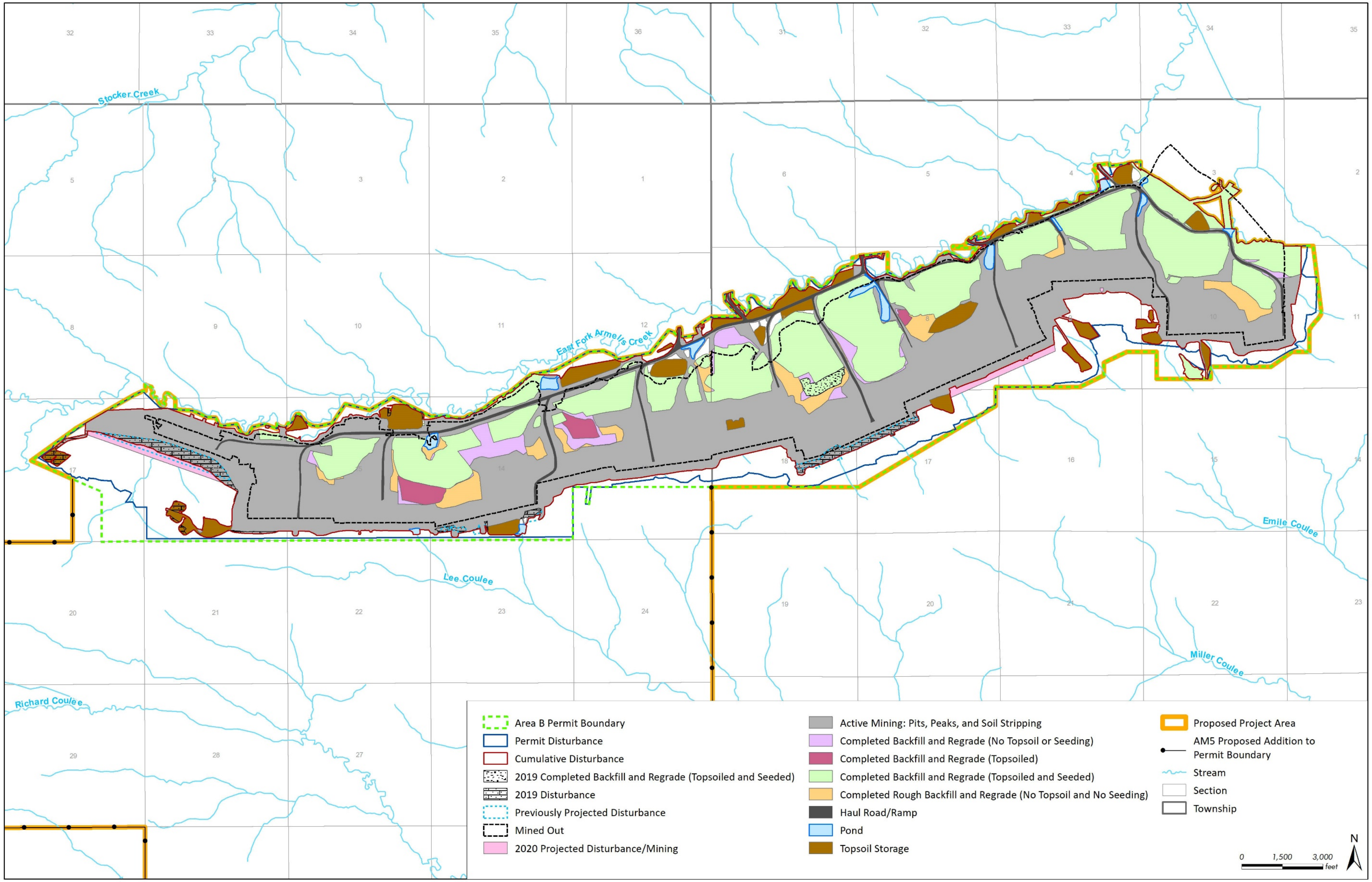

Figure 3. Existing Mining and Reclamation in Area B (as of 2019).

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2.2.3 Other Existing Permits

2.2.3.1 Air Quality Permits

The Rosebud Mine's five existing operating areas (A, B, C, D, and F) are currently covered by three Montana Air Quality Permits (MAQP):

- MAQP #1570-09, issued June 19, 2019. Area F was incorporated into MAQP #1570-07 with a final permit previously issued on May 30, 2019.
- MAQP #1483-09, issued June 19, 2019, for areas A, B, D, and former area E.
- MAQP #4436-01, issued July 6, 2019, for operating a portable crusher.

Production from the Rosebud Mine is limited by the conditions of these DEQ-issued air quality permits. MAQP #1483-09 limits annual coal production from Areas A, B, and D to 13 million tons per year. If the Proposed Action is implemented, Westmoreland Rosebud proposes to mine an annual average of 5.1 million tons from the Project area; maximum production would be 6.5 million tons (see **Table 9**). Coal production from Areas C and F is limited to 8 million tons per year per MAQP #1570-09 with an Area F–specific production cap of 4 million tons per year.

2.2.3.2 Discharge Permits

Westmoreland Rosebud has two Montana Pollutant Discharge Elimination System (MPDES) permits. MT-0023965 covers discharge of mine drainage and drainage from existing coal-preparation areas (including Area B), coal-storage areas, and reclamation areas. Following a decision by Judge Kathy Seeley of the First Judicial District Court, Lewis and Clark County, that invalidated a 2016 renewal of the permit (Cause No. CDV-2012-1075), the effective MPDES Permit MT-0023965 is the one issued by DEQ in 1999 and permits discharge into 151 outfalls. The receiving waters include East Fork Armells Creek, Stocker Creek, Lee Coulee, West Fork Armells Creek, Black Hank Creek, Donley Creek, Cow Creek, Spring Creek, and Pony Creek.

Westmoreland Rosebud's second MPDES permit, MT-0031828, covers discharge of mine drainage and drainage from new permit Area F into 55 discharge outfalls. The receiving waters for Area F discharge include Black Hank Creek, Donley Creek, Robbie Creek, McClure Creek, and Trail Creek.

2.2.4 Life of Operations

As discussed above, the Rosebud Mine has four other active mine areas. Area A is expected to be mined until 2022. Area B, as currently permitted, is expected to be mined until 2030. Area C is expected to be mined until 2022. Areas A, B (as currently permitted), and C are expected to account for 50 percent of the total output of the mine until 2019 and 40 percent of the total output until 2022 (the last year of active mining for Areas A and C) (Peterson 2016).

Area F was approved by DEQ and OSMRE in 2019 (see **Section 2.2.2, Existing Operating Permits, Disturbance, and Reclamation**). Coal removal from Area F began in August 2020; the first 7 years of mining in Area F will account for as much as 50 percent of the total output of the Rosebud Mine (Peterson 2016). After that, Area F will account for around 30 percent of the mine's total production. Westmoreland Rosebud is also seeking to make modifications to a federal coal lease (MTM 80697) that would impact 160 acres within Areas B and C at a future date. Without the addition of the Project, the operational life of the Rosebud Mine would be expected to end in 2038 (**Figure 4**).

The analyses in this EIS are based on the assumptions above regarding the operational life of the Rosebud Mine. Changes to production rates, additions of other mine permit areas, or changed market conditions may influence the operational life of the Rosebud Mine as a whole or of individual permit areas.

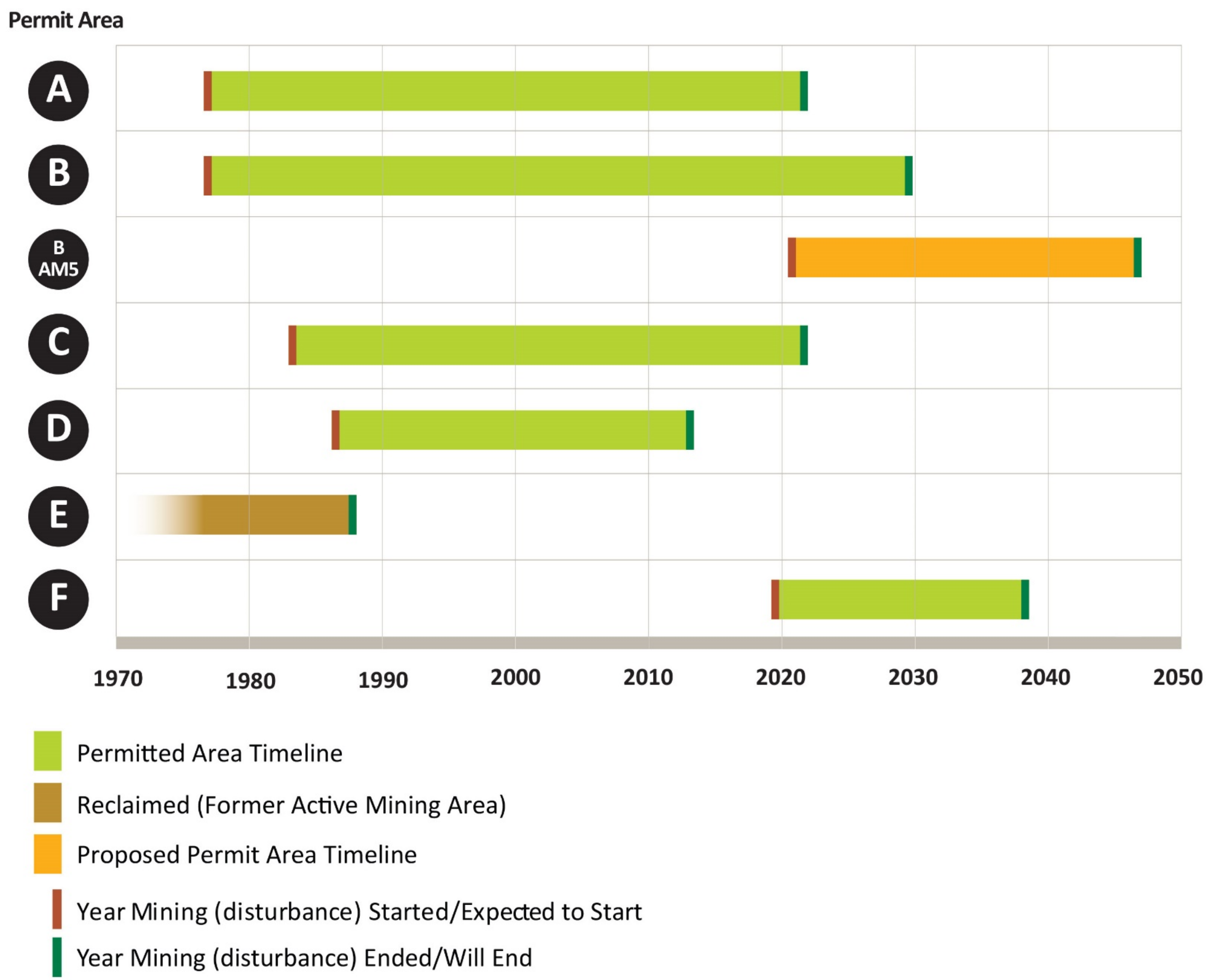

Figure 4. Operational Timeline for the Rosebud Mine.

2.3 ALTERNATIVE 1 – NO ACTION ALTERNATIVE

Under the No Action Alternative, Westmoreland Rosebud's proposed fifth amendment (AM5) to the Area B operating permit and the MPDES permit would not be approved by DEQ for one or more of the conditions outlined in **Section 1.4.1.2, DEQ Decisions, Conditions for Denial, Montana Strip and Underground Mine Reclamation Act, Conditions for Denial**. Westmoreland Rosebud would complete mining and reclamation in Area B according to its currently approved operating permit. Specifically, the following aspects, which would have been modified under the Proposed Action, would remain as currently permitted:

1) The size of the Area B permit area would not increase to 15,153 acres but would remain at 6,045 acres;

2) The size of the disturbance area would not increase to 11,201 acres but would remain at 5,655 acres;

3) The Area B operations plan would not be updated; and

4) The Area B reclamation plan would not be updated.

Under the No Action Alternative, mining in Area B would likely cease by 2030, and 104.3 million tons of coal would not be recovered from the Project area. Selection of the No Action Alternative would result in 5,547 acres of previously undisturbed ground remaining undisturbed. The environmental, social, and economic conditions described in **Chapter 3** would continue, unaffected by the construction and operation of the Project.

Selection of the No Action Alternative would not change the existing status of the other areas of the Rosebud Mine that are currently permitted (see **Section 2.2, Rosebud Mine – Description of Past and Existing Mine Operations and Reclamation** and **Table 6**). Nor would selection of this alternative change the status of the federal coal lease MTM 80697 (tracts in Areas B and C) modification application, which is currently being evaluated by the Bureau of Land Management.

2.4 ALTERNATIVE 2 – PROPOSED ACTION

Alternative 2 is the proposed Project (Proposed Action) as put forward by Westmoreland Rosebud in its Application to DEQ for AM5 to the existing Area B (C1984003B) operating permit. The Proposed Action, also referred to as AM5 or Alternative 2 in this EIS, would modify four primary aspects of the operating permit:

1) The size of the Area B permit area would increase to 15,153 acres (a 9,108-acre or 60 percent increase);

2) The size of the disturbance area would increase to 11,202 acres (a 5,547-acre or 50 percent increase);

3) The Area B operations plan would be updated to include additional mine passes, an extension of the Richard and Lee haul roads, construction of ramp roads, and an extension in operational life (mining until 2045 instead of 2030); and

4) The Area B reclamation plan would be updated to include reclamation of the additional disturbance area and an extended reclamation timeline (up to 15 additional years for initial stages of reclamation).

The description of the Proposed Action that is provided in the sections below is based on Westmoreland Rosebud's Application. Readers desiring greater detail can review the additional descriptions, maps, and drawings contained in the Application, which is available for digital download (see **Appendix A** for links).

For purposes of preparing this EIS, DEQ has assumed that Westmoreland Rosebud will address all of the Application deficiencies identified by DEQ. Once all of these deficiencies are addressed by Westmoreland Rosebud, DEQ will notify Westmoreland Rosebud that the Application is acceptable under MSUMRA. In order to ensure that the review timelines mandated in MSUMRA are met, the Proposed Action is presented as if the Application has already been determined by DEQ to be complete and acceptable under MSUMRA (for a description of the permit review process, see **Section 1.4.1.1, Applicable Statutes and Regulations**).

2.4.1 Operating Permit and Disturbance Acres

In the Proposed Action, 9,108 acres would be added to the Area B operating permit area, and 5,547 acres would be added to the permitted disturbance area (**Table 7)**. The additional acreage would be located adjacent to the southern boundary of the existing Area B permit area, primarily in the Lee Coulee and Richard Coulee drainages (**Figure 2** and **Figure 6**). Implementation of Alternative 2 could extend the operational life of Area B until 2045 based on Westmoreland Rosebud's estimated annual production (**Table 8**); as currently permitted, Area B is expected to be mined until 2030.

Table 7. Approximate Surface Disturbance.

Disturbance Area	Currently Approved Area B (acres)	Proposed Addition (acres)	New Area B Total, including AM5 (acres)
Mining area	4,227	3,170	7,397
Highwall reduction	960	279	1,239
Soil storage area	526	375	901
Scoria pits	0	80	80
Haul roads	232	225	457
Other disturbances[1]	129	1,006	1,135
Acreage with two or more types of disturbance	-422	414	-8
Total permitted disturbance area	***5,655***	***5,547***	***11,202***
Total operating permit area	***6,045***	***9,108***	***15,153***

[1]Other disturbances mostly include undisturbed ground near or adjacent to other disturbed areas including ponds, sediment traps, and ditching associated with surface-water sediment controls; ramps connecting haul roads to the mining area; and electrical substations.

Table is based on Table 303-1 from Westmoreland Rosebud's Application. Acreages are rounded to the nearest whole number in the text of this EIS.

If the Proposed Action is implemented, the Area B permit area would be 15,153 acres (Project area), and the permitted disturbance area would be 11,202 acres (see **Figure 6**). The proposed Project would disturb 5,711 acres within the 11,202-acre disturbance area (existing and proposed AM5 addition); Project disturbance would mostly be mining but would also include highwall reduction, soil storage, scoria pits, haul-road and ramp-road construction, and other miscellaneous disturbances (see **Table 7** for total surface disturbance and **Table 8** for approximate annual disturbances**)**. The surface of the Project area is owned

by private parties (92 percent) and the State of Montana (8 percent). The subsurface is owned by private parties, the State of Montana, and the federal government (see **Figure 69** and **Figure 70** in **Section 3.14, Land Use and Recreation**). Most coal to be mined as part of the proposed Project is within two private leases (G002 and Nance-Brown) with small portions of State of Montana coal to be mined (22 acres) as well as a third private lease (G001). As part of the proposed Project, Westmoreland Rosebud is seeking DEQ approval to mine 59 acres of a federal coal lease (MTM 80697), which is within the currently approved disturbance boundary and part of an approved federal mining plan (OSMRE 2016) but not currently approved for mining by DEQ.

Westmoreland Rosebud does not propose to construct any new facilities in the Project area, other than roads (e.g., haul road and ramp road extension and construction) to serve additional acreage to be added by AM5.

The primary pre-mine surface land use within the Project area is livestock grazing; others include pastureland, agricultural cropland, wildlife habitat, and industrial/commercial (i.e., scoria/gravel storage sites, ranch yards, and active mine lands). The southeastern part of the Project area includes 500 acres of the Big Sky Mine permit area (C1988004B), which was previously disturbed, mined, and reclaimed. A portion of this reclaimed area is within the proposed disturbance area. Approved postmining uses for the Big Sky Mine include livestock grazing and developed water resources. A significant portion of the Project area burned in a wildfire in 2012. For further details regarding pre-mine land uses and supporting vegetation, see **Section 3.14, Land Use and Recreation** and **Section 3.8, Vegetation.**

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Table 8. Estimated Annual Production in Area B (as Modified by AM5) by Year and Acres Disturbed.

Operation Year	Tons (x 10^6)	Cumulative Total	Acres Disturbed	
			Annual	Total
Before AM5	123.5	123.5	4,441.0	4,441.0
Year 1	4.6	128.1	132.0	4,573.0
Year 2	4.3	132.4	123.4	4,696.4
Year 3	5.4	137.8	955.0	5,651.4
Year 4	6.0	143.8	172.0	5,823.3
Year 5	5.7	149.5	163.4	5,986.7
Year 6	4.2	153.7	463.7	6,450.4
Year 7	2.2	156.0	64.3	6,514.7
Year 8	2.3	158.3	67.2	6,581.9
Year 9	4.7	163.0	134.4	6,716.3
Year 10	6.5	169.5	185.8	6,902.2
Year 11	6.1	175.5	516.4	7,418.5
Year 12	6.4	181.9	183.0	7,601.5
Year 13	6.2	188.1	177.2	7,778.7
Year 14	6.2	194.3	177.2	7,956.0
Year 15	6.2	200.5	177.2	8,133.2
Year 16	6.2	206.6	519.2	8,652.4
Year 17	6.2	212.8	177.2	8,829.7
Year 18	6.1	218.9	174.4	9,004.1
Year 19	6.1	225.0	574.4	9,578.4
Year 20	4.9	229.8	139.9	9,718.4
Year 21	4.9	234.7	139.9	9,858.3
Year 22	4.9	239.6	139.9	9,998.2
Year 23	4.9	244.5	139.9	10,138.1
Year 24	4.9	249.3	139.9	10,278.1
Year 25	4.9	254.2	139.9	10,418.0
Year 26	4.9	259.1	139.9	10,557.9
Year 27	4.9	264.0	139.9	10,697.9
Year 28	4.9	268.9	140.1	10,838.0
Year 29	1.8	270.7	51.7	10,889.7
Year 30 (begin closure)	0.0	270.7	155.9	11,045.6
Closure Year 2	0.0	270.7	155.9	11,201.5
Total	270.7	270.7	11,202	11,201.5

Table is based on Table 303-2 from Westmoreland Rosebud's Application.
Tonnage estimates provided in the table represent the most current information provided in Westmoreland Rosebud's Application and include the assumption that mining will continue as currently permitted in other permit areas of the Rosebud Mine.
Tons produced prior to AM5 include previously mined-out tonnages in the existing Area B permit area and the proposed AM5 Project area, including approximately 14 million tons of previously mined-out tonnages from Big Sky Mine (C1988004B).

2.4.2 Applications for Other Permits

2.4.2.1 MPDES Permit

Westmoreland Rosebud applied for a new MPDES permit (MT-0032042) for the Project area on May 3, 2018. As discussed above in **Section 1.4.1.2, DEQ Decisions, Montana Water Quality Act**, DEQ is currently preparing the draft permit.

2.4.3 Coal Recovery

Based on computer modeling, Westmoreland Rosebud estimates that if the proposed Project is implemented, an additional 104.3 million tons of recoverable coal reserves would be available for mining in the Project area, bringing the new total of mineable and marketable coal in Area B up to 147.2 million tons. Like the rest of the Rosebud Mine, two distinct coal seams, the Rosebud and McKay, lie under the Project area and are mineable using surface-mining techniques. The Rosebud Coal seam averages 22.6 feet thick with a maximum thickness of 26.0 feet. The McKay Coal seam, which is around 67 feet below the Rosebud Coal seam, averages 7.9 feet thick throughout the proposed Project area and is of poorer quality. Due to the depth and poor quality of the McKay coal seam, Westmoreland Rosebud proposes to mine only the Rosebud Coal seam, which is the highest coal seam in the Project area stratigraphic sequence.

Westmoreland Rosebud's objective is to recover as much of the Rosebud Coal deposit from the Project area as possible given operational constraints, such as the need to protect outcrops, coal quality, high-stripping ratios (areas where coal deposits are generally deep), equipment maneuverability, and safety considerations (**Figure 5**). Based on those considerations, Westmoreland Rosebud estimates 147.2 million tons would be available to mine in Area B if the Project is approved as proposed (see Table 322-2, Coal Volumes, in Westmoreland Rosebud's Application). For Area B, the average quality of mineable coal is defined by British thermal units (Btu) per pound (8,378) and percent sulfur (0.91 percent), moisture (25.44 percent), volatility (28.95 percent), fixed carbon (35.10 percent), and ash content (10.41 percent).

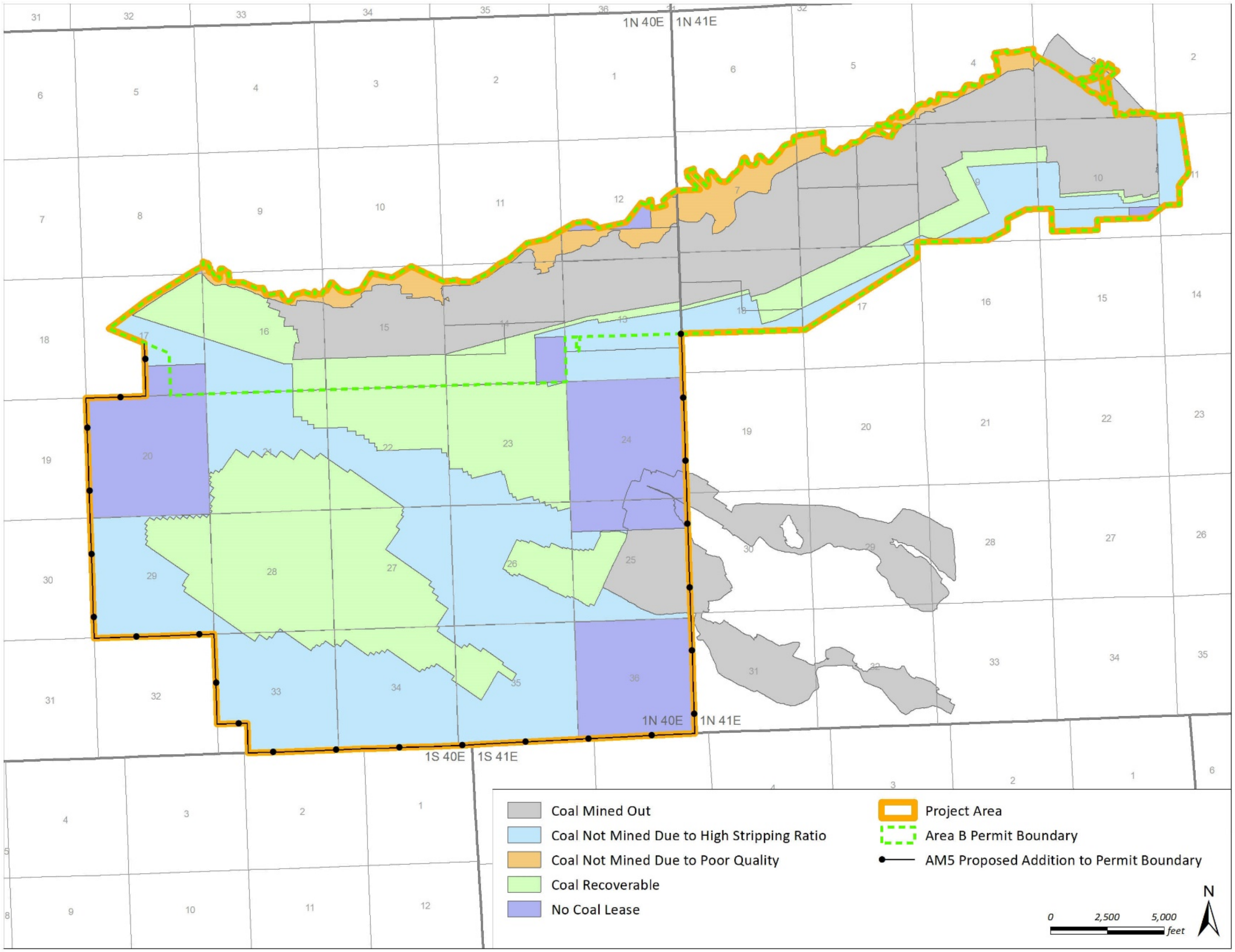

Figure 5. Coal Recovery in the Project Area.

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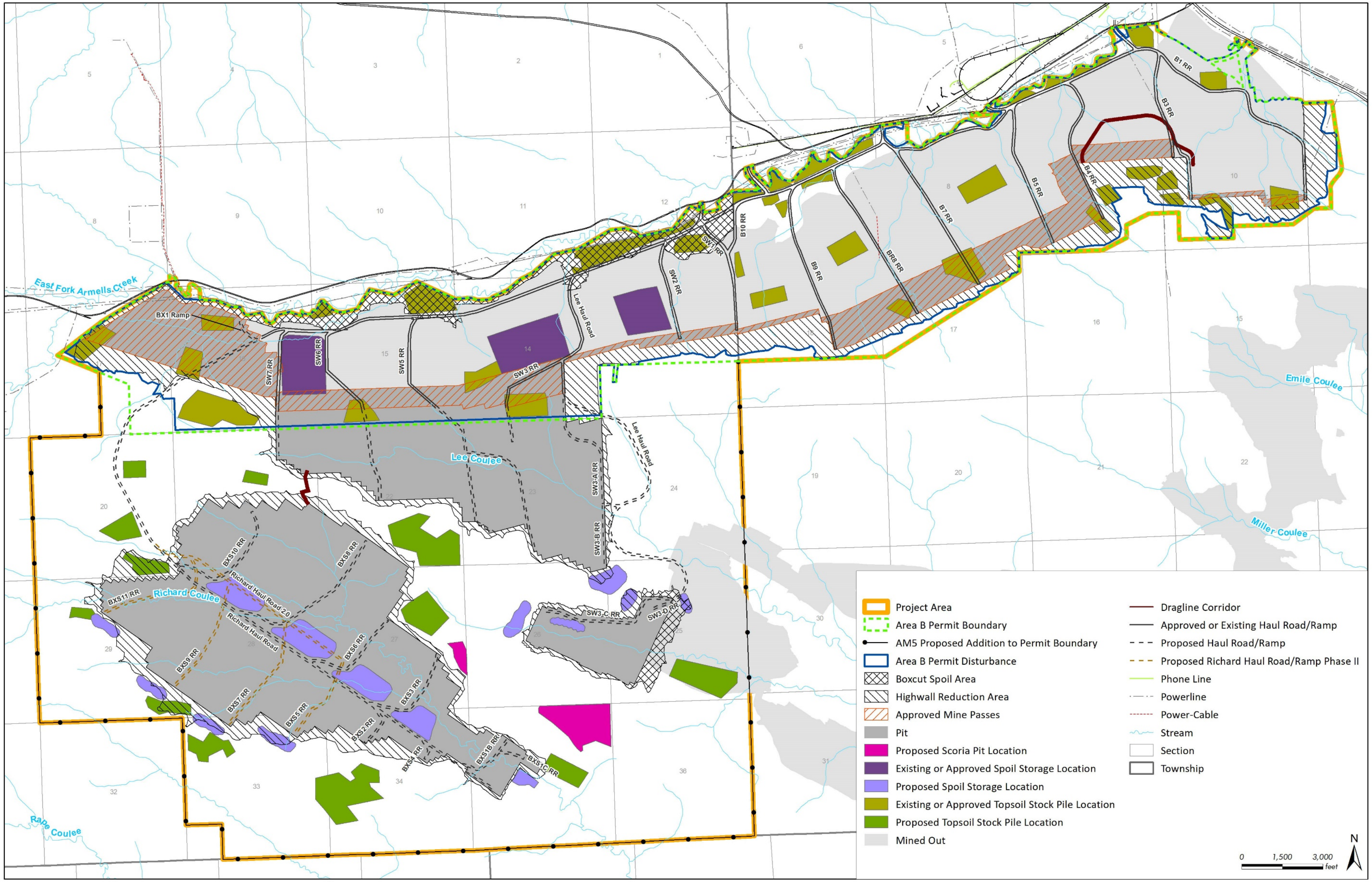

Figure 6. Proposed Project Area, Alternative 2.

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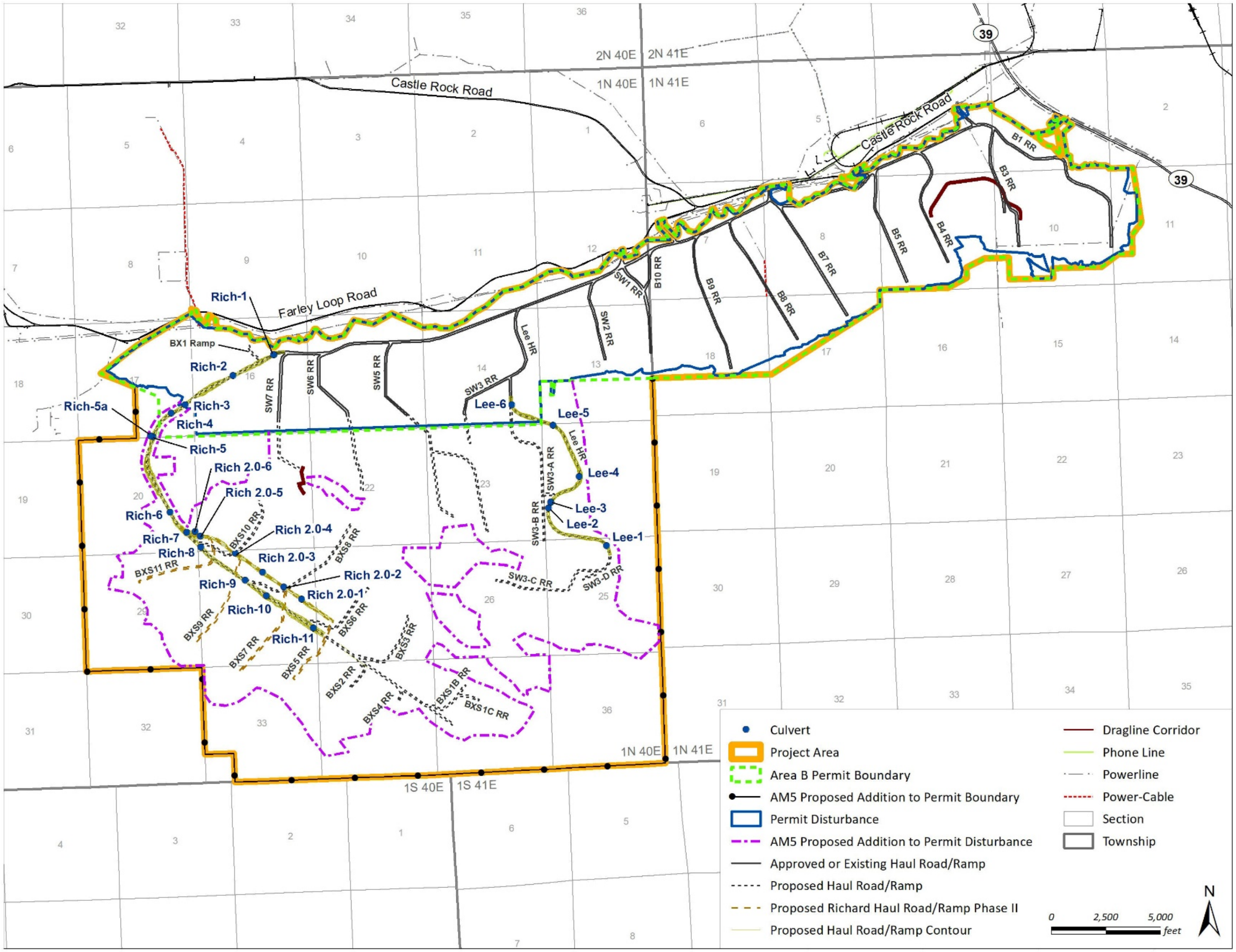

Figure 7. Proposed Ramp Road and Haul Road Construction in the Project Area.

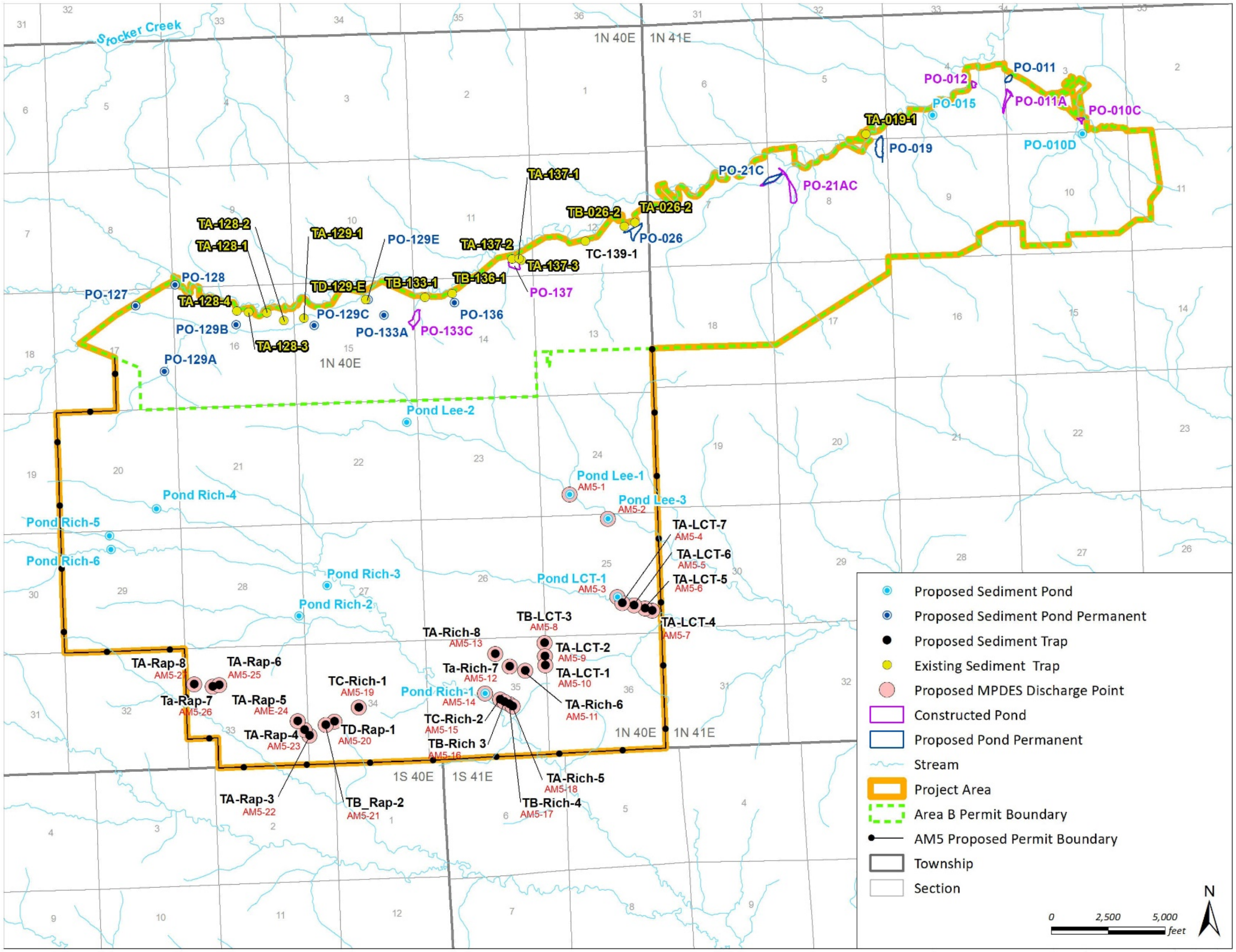

Figure 8. Proposed MPDES Permit MT-0032042 Outfalls and Sediment Ponds and Traps.

2.4.4 Operations Plan

If the Proposed Action is implemented, the Area B operations plan would be modified from the currently approved plan. Key changes include (1) extension in Area B operational life (mining until 2045 instead of 2030); (2) additional areas of mining within an enlarged disturbance area; (3) extension construction of the Richard haul road and Lee haul road to access new mining areas; (4) extension and modification of the configuration of Area B ramp roads to access new mining areas; and (5) changes to and additional soil stockpile and scoria pit locations. These key changes are described in the sections below. Features related to surface and ground water management (i.e., sediment ponds and traps) are proposed within the Project area; see **Figure 8** and discussion in **Section 2.4.6, Protection of the Hydrologic Balance**.

If the Proposed Action is implemented, mining operations in the Project area would continue to run 24 hours a day, 7 days a week, and the same surface-mining method currently used in Area B (described above in **Section 2.2.2.2, General Mining Method**) would continue to be employed throughout the Project area. Active mining in the Project area would continue through 2045, an additional 15 years of mining operations in Area B beyond what is currently permitted (2030), and would produce an additional 104.3 million tons of coal.

Westmoreland Rosebud would continue to use fugitive dust control measures in the Project area and other supporting permit areas consistent with MAQP #1483-08 throughout operations and reclamation. Blasting would continue to be completed according to Westmoreland Rosebud's approved blasting plan, which would be modified to include the entire Project area. Existing discharges for Area B (as currently permitted) would continue in accordance with existing MPDES Permit MT-0023965. New discharges from the Project area into 27 new outfalls would occur in accordance with Westmoreland Rosebud's new MPDES permit MT-0032042 (see **Figure 8** and discussion in **Section 3.5, Water Resources – Surface Water;** see also **Section 2.4.6, Protection of the Hydrologic Balance**).

2.4.4.1 Area of Mining Operations

In Alternative 2, the proposed Project includes adding passes within the currently approved Area B disturbance area (Sections 14-16) as well as passes to the south within the new proposed disturbance area of the AM5 expansion area (**Figure 6**). For Westmoreland Rosebud's detailed mine plan, including the anticipated annual mine sequencing proposed for the Project, please see Table 303-3 in Westmoreland Rosebud's Application (**Appendix A**).

2.4.4.2 Haul Roads

As currently approved in the Area B operating permit, Westmoreland Rosebud would continue advancing the Area B haul road from its current terminus in Section 16 westward into Section 17. Three ramp roads would then be constructed southward from the haul road to provide access to Sections 16 and 17, which are in the western portion of the current Area B permit area. Instead of advancing the Area B haul road as approved, Westmoreland Rosebud's Proposed Action includes construction of two haul roads: (1) an extension of the Area B haul road into the Project area, known as the "Richard haul road"; and (2) an extension of the Lee haul road in the Project area (Fossil Fork of Lee Coulee).

Richard Haul Road

After completion of mining in Section 16 (year 6), Westmoreland Rosebud would extend the existing Area B haul road southward from its current terminus in Section 16 through Sections 17 and 20 and advance it through Richard Coulee (Sections 23, 27, 28, 34, and 35) to facilitate mining in the proposed

Project area (**Figure 7**). The haul road extension would be known as the Richard haul road and would be advanced in two phases as mining progressed. A series of ramp roads would be constructed off of each phase of the Richard haul road to serve active mining areas (see **Section 2.4.4.3, Ramp Roads**).

Lee Haul Road

Around mine year 2, Westmoreland Rosebud would extend the existing Lee haul road from its current terminus in Section 14 southward through Sections 24 and 25 to facilitate mining in the Fossil Fork tributary of Lee Coulee (**Figure 7**). Two ramp roads would be constructed off the Lee haul road to serve active mining areas (see **Section 2.4.4.3, Ramp Roads**).

Haul Road Construction Westmoreland Rosebud proposes to use the same construction method that it currently uses in Area B and other active mining areas to construct the haul roads in the Project area. The haul roads would be constructed to facilitate two-way traffic, typically to a width of 80 feet, and surfaced with road material to provide for all-weather use, typically scoria (baked and fused rock resulting from in-place burning of coal deposits). As the haul roads advance in conjunction with mining, construction would be staged to provide a sound base, usually by watering and wheel-compacting the sub-base. The haul roads would generally be constructed with 0 to 3 percent grades but may need to be constructed with grades of up to 8 percent and a maximum pitch grade of 12 percent, if needed.

2.4.4.3 Ramp Roads

A series of ramp roads would be constructed in the Project area to connect the active mining and reclamation area pits to the Richard and Lee haul roads (**Figure 7**). These ramp roads would be constructed as mining progresses within the Project area.

The following existing ramp roads would be extended to facilitate mining in the proposed Project area, primarily in Lee Coulee (**Figure 7**).

- The SW3 and SW3-A ramp roads would be extended from Section 14, generally south through the Project area to the new mine passes in Section 14 and Section 23.
- The SW5 ramp road would be extended from the southern portion of Section 15 generally southeast through the Project area to Section 23.
- The SW6 ramp road would be extended from the southwestern portion of Section 15 generally southeast through the Project area to Section 22.
- The SW7 ramp road would be extended from the southeastern portion of Section 16 generally southeast through the Project area to the northeastern portion of Section 21.

In addition, the following new ramp roads would be constructed to facilitate mining in the proposed Project area, primarily in Richard Coulee (**Figure 7**).

- The SW3-B ramp road would be constructed from the Lee haul road in the southwestern portion of Section 24, through the southeastern portion of Section 14 to Section 26.
- The SWS3-D ramp road and the SWS3-C ramp road would be constructed in Sections 25 and 26 from the extended Lee haul road (for mining in the Fossil Fork tributary of Lee Coulee).
- Thirteen ramp roads would be constructed off of the Richard haul road to access mine cuts in Sections 21-22, 27-29, and 33-35.

Westmoreland Rosebud proposes to use the same ramp-road construction method for the proposed Project that it currently uses in Area B and other permit areas of the Rosebud Mine. Ramp roads would be maintained at 5 percent or steeper grades and surfaced with road material to provide for all-weather use. Spoil grading adjacent to ramp roads would allow for soiling and revegetation activities to proceed at the first appropriate period favorable for planting. Grading would not delay or prevent Westmoreland Rosebud from achieving the approved postmine topography.

2.4.4.4 Soil Stockpiles and Scoria Pits

If graded areas were not immediately available for redistribution, then topsoil, subsoil, and tree soil would be stockpiled in separate locations. Soil stockpiles would be placed on undisturbed, nonsalvaged areas or on graded spoil and located away from sensitive areas (e.g., wetlands and streams) in areas that would minimize impacts from wind, water erosion, and ongoing mine operations. Stockpiles would be identified with signs denoting the type of soil (i.e., topsoil, subsoil, or tree soil). Westmoreland Rosebud proposes numerous additional soil stockpile locations within the Project area (**Figure 6**). Inactive soil stockpiles would be seeded and maintained (including noxious weed control) according to current practices and Westmoreland Rosebud's Weed Control Plan.

Westmoreland Rosebud also proposes two new scoria pit locations, one in Sections 26 and 27 and one in Section 35.

2.4.4.5 Bottom Ash

Westmoreland Rosebud has been using bottom ash from the Colstrip Power Plant in some permit areas of the mine in the construction of parking facilities, as a sanding agent for ramp and haul roads during periods of poor road conditions due to weather, and as tank and culvert bedding. See **Section 3.16, Solid and Hazardous Waste**, for a description of current use of bottom ash at the Rosebud Mine.

As of July 2018, Westmoreland Rosebud no longer hauls bottom ash into Area B and does not propose to use any for the Proposed Action. As required by its Area B operating permit, Westmoreland Rosebud will continue to monitor bottom ash previously used in the Project area (**Section 3.16, Solid and Hazardous Waste**).

2.4.4.6 Buffer Zones

All mining activities, including highwall reduction and related reclamation, would cease at least 100 feet from a property line, permanent structure, unmineable or unreclaimable steep or precipitous terrain, or any area determined by DEQ to be of unique scenic, historical, cultural, or other value. If special values or problems are encountered, DEQ may modify buffer-zone requirements. The transition from undisturbed ground to the disturbed area would be blended to provide a smooth transition in topography.

2.4.5 Reclamation Plan

Westmoreland Rosebud proposes to reclaim all mining-related land disturbances to a use equal to or better than what existed before mining as provided for in 82-4-231 and 82-4-232, MCA. The general approach to reclamation would be the same as currently used in Area B and other permit areas of the Rosebud Mine (see **Section 2.2.2.2, General Mining Method**). Westmoreland Rosebud would use direct haul (hauling soil directly from the stripping area to graded areas ready for soil replacement) whenever possible. The initial stages of reclamation (grading, application of soil, and seeding) would begin within 2 years of mining and continue as subsequent mine passes are completed in the Project area until Phase IV

bond release (bond-release phases are discussed in **Section 1.6.4, Bond Release**). Westmoreland Rosebud's proposed postmine topography is shown on **Figure 9**. Under the Proposed Action, timing of initial stages of reclamation would be delayed by as much as 15 years for some existing areas of the Project area. The timing and sequence for completing the first stage of reclamation is shown on **Figure 10**, and Westmoreland Rosebud's proposed revegetation plan is shown on **Figure 11**.

Westmoreland Rosebud proposes postmine land uses similar to pre-mine land uses. The primary postmine land use would be grazing lands to be supported by appropriate vegetation (see **Figure 11**). Reclamation would also facilitate the following postmine land uses: pastureland, cropland, and wildlife habitat. For further details regarding postmine land uses and vegetation, see **Section 3.14, Land Use and Recreation** and **Section 3.8, Vegetation**. Westmoreland Rosebud's proposed revegetation plan, including proposed seed mixes, is presented in the Application (see **Appendix A**).

If the Proposed Action is implemented, the Project area reclamation plan would be modified from the currently approved plan. Key changes include (1) a longer reclamation period due to longer operational life, (2) a change in reclamation sequence, (3) additional areas of disturbance (primarily mining) to be reclaimed, (4) revised postmine topography, (5) reclamation of the Richard and Lee haul roads and new and longer ramp roads, and (6) delay in reclamation of mine support facilities due to extended mine life. These key changes are described below. Features related to surface and ground water management (i.e., sediment ponds and traps), including newly proposed ones within the Project area, would be reclaimed as described in approved reclamation plan. New hydrologic control features to be reclaimed are shown on **Figure 8**; see also **Section 2.4.6, Protection of the Hydrologic Balance**.

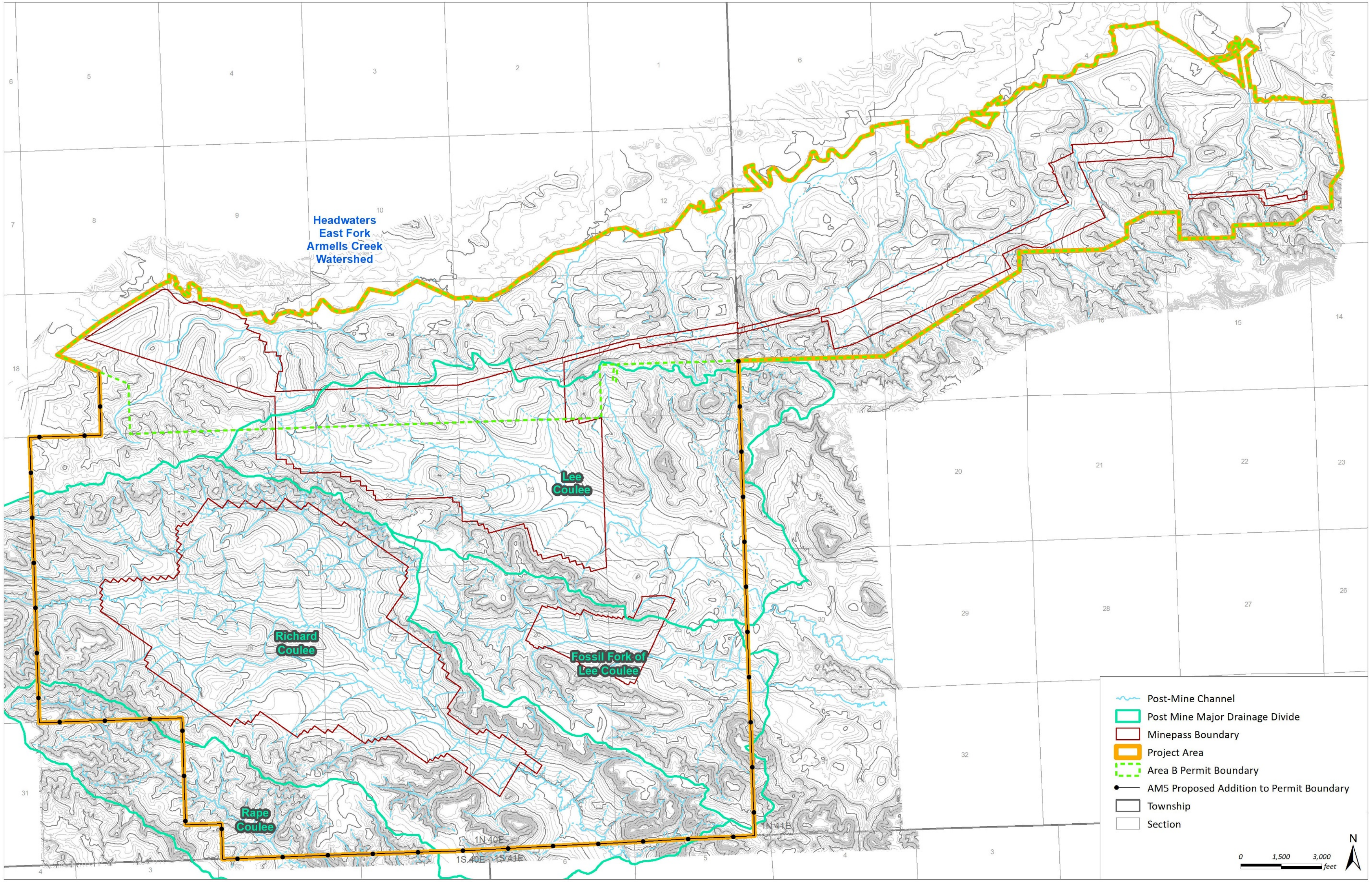

Figure 9. Proposed Postmine Topography.

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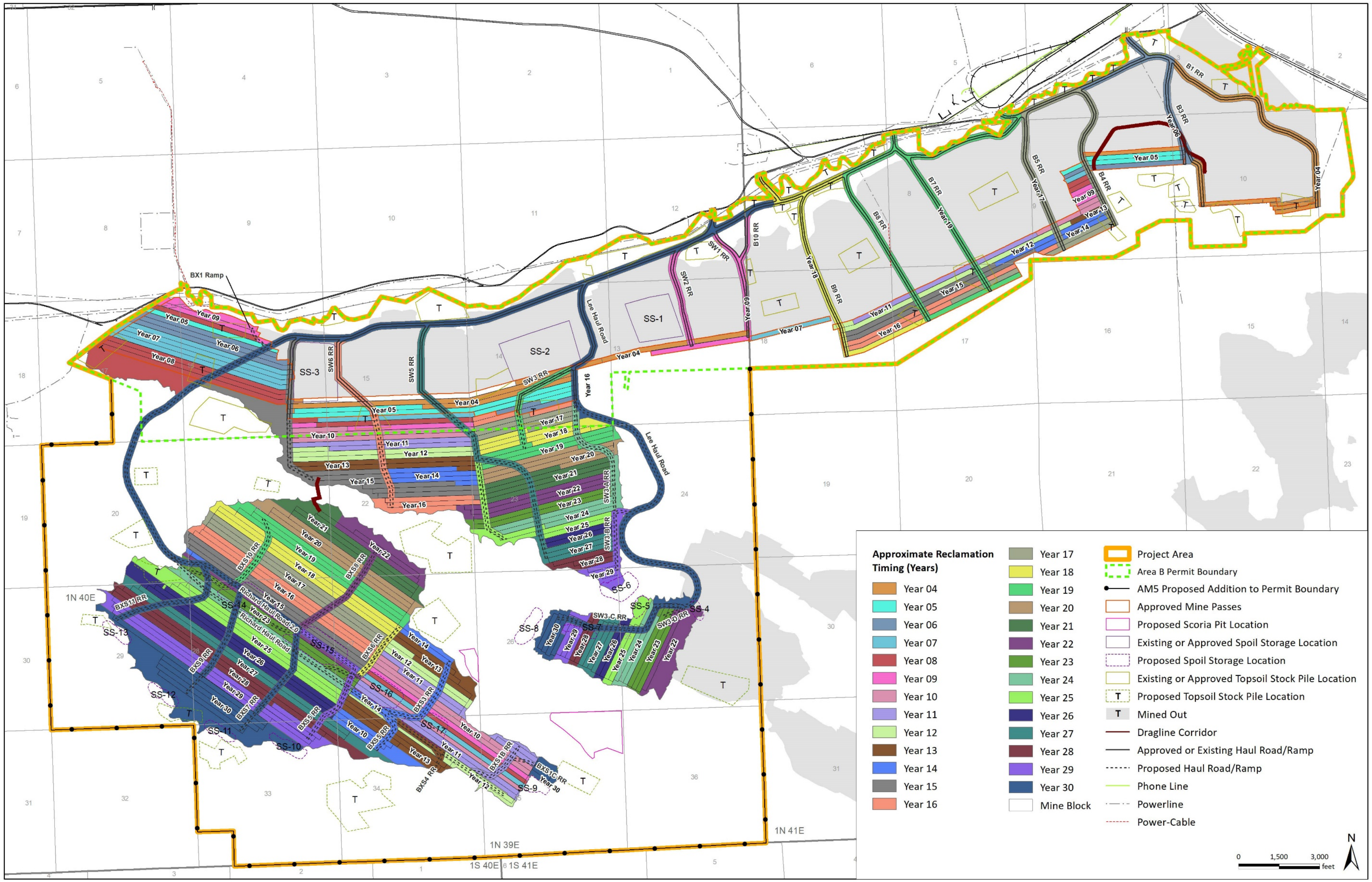

Figure 10. Proposed Project Area Reclamation Plan (Grading, Application of Soil, and Seeding).

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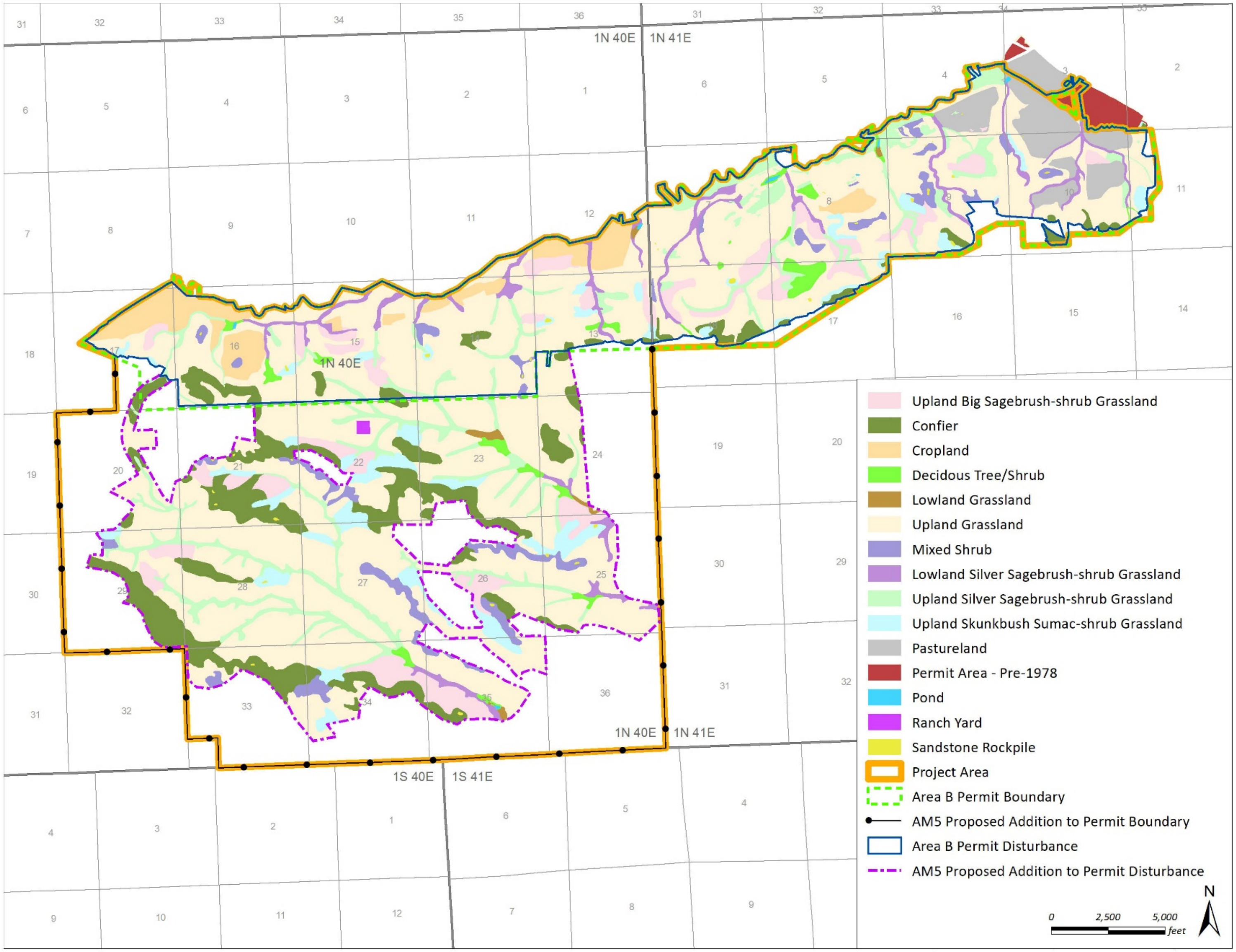

Figure 11. Proposed Revegetation Plan.

2.4.5.1 Reclamation Timing and Disturbance within the Proposed Project Area

Implementation of the Proposed Action would extend the geographical area and duration of reclamation activities in the Project area. As described above in **Section 2.4.4, Operations Plan**, implementation of the Proposed Action would enlarge the Area B disturbance area to 11,202 acres, necessitating reclamation of an additional 5,547 acres above what is currently permitted. The area of disturbance would extend further into in Lee Coulee and disturb one additional drainage, Richard Coulee, necessitating reclamation of both drainages and their associated subdrainages (see **Figure 9** and **Section 2.4.6, Protection of the Hydrologic Balance**). The Proposed Action would also disturb 500 acres previously mined (1989 to 2003) and subsequently reclaimed within the Big Sky Mine permit area (C1988004B).

If the Proposed Action is implemented, the timing of this reclamation would occur over a longer period as well. As currently permitted, mining operations are scheduled to end in Area B by 2030 with initial stages of reclamation (grading, application of soil, and seeding) completed on the last mine passes by 2032. If the Proposed Action is implemented, mining operations would extend until 2045, and the initial stages of reclamation would not occur until 2047.

2.4.5.2 Reclamation of the Haul Roads and Ramp Roads

Implementation of the Proposed Action would delay the expected reclamation date of existing ramp roads and the existing Area B haul road. It also would increase the length and number of ramp roads to be reclaimed, including the Richard and Lee haul roads (see list of road changes above in **Section 2.4.4.2, Haul Road**, and **Section 2.4.4.3, Ramp Roads**).

Westmoreland Rosebud would complete reclamation of ramp roads as currently permitted in the eastern portion of the Project area; these roads provide access to the southeastern portion of the current Area B permit area and reclaimed portions of the mine. Reclamation of ramp roads proving access to the southern and western portions of the current Area B permit area would be delayed until completion of proposed mining in those areas (see **Figure 10**). These ramp roads include SW-3, SW3-A, SW3-B, SW-5, SW-6, and SW-7.

Reclamation of the existing Area B haul road in the western portion of the current Area B permit area would be delayed until completion of proposed mining in the Project area. Similarly, the proposed haul road extensions (Richard and Lee haul roads) in the Project area would be left in place until completion of mining; these haul roads would be reclaimed in the final year of reclamation (see **Figure 10**).

2.4.5.3 Reclamation of Mine Support Facilities

Implementation of the Proposed Action would extend the operational life of Area B. The Proposed Action would also extend the operational life of existing Rosebud Mine support facilities (**Section 2.2.2.3, Existing Support Facilities**) in permit Area A and permit Area C (**Figure 2**). Based on current life-of-mine projections (**Section 2.2.4, Life of Operations**), implementation of the Proposed Action would extend the operational life of the Rosebud Mine from 2038 until 2045. Reclamation of these support facilities in Areas A, B, and C would occur at least 7 years later than currently permitted.

2.4.6 Protection of the Hydrologic Balance

Westmoreland Rosebud's plan for protection of the hydrologic balance is presented in Appendix J in Westmoreland Rosebud's Application (see **Appendix A**). Proposed Action disturbance would primarily occur in the Lee Coulee and Richard Coulee drainages but would also include portions of the East Fork Armells Creek and Rape Coulee drainages; Lee Coulee, Richard Coulee, and Rape Coulee are in the Rosebud Creek watershed, and both Rosebud Creek and Armells Creek are in the Yellowstone River watershed. Westmoreland Rosebud's proposed protection measures include ground water management, surface water management, operation of sediment-control measures (sediment ponds, diversions, ditches and culverts, and pit dewatering), pond maintenance and inspection, reclamation sediment-control measures, and protection of existing water rights. Proposed hydrologic control measures are shown on **Figure 8** (based on Exhibit D in Westmoreland Rosebud's Application).

2.4.6.1 Ground Water Management

As is current practice in Area B, Westmoreland Rosebud would continue to manage ground water inflow to active pits in the following ways: inflow would be pumped (1) directly into water wagons and used for haul-road dust suppression, (2) into adjacent sediment ponds, or (3) into an inactive pit that is separated from the active pit by a cross-pit ramp. Pit inflow contained in sediment ponds would be either used for haul-road dust suppression or allowed to seep and evaporate. During periods of relatively high sustained pit inflows, water transferred to sediment ponds (and not required for dust-suppression purposes) would be discharged to receiving drainages in compliance with the terms of Westmoreland Rosebud's MPDES permits; outfall locations are shown on **Figure 8**.

To restore the approximate recharge capacity of the mine area, Westmoreland Rosebud proposes reclamation of disturbed lands in accordance with the proposed reclamation plan (see **Section 2.4.5, Reclamation Plan** and **Figure 10**). Spoil would be replaced in the excavations as soon as possible, graded to the approved approximate postmine topography, and covered with soil. To ensure that there is not a low-permeability barrier at the soil-spoil interface (i.e., to aid ground water movement), graded spoil would be scarified before placement of soil. To minimize impacts on bedrock ground water, disturbance to the primary recharge areas consisting of clinker would be minimized by (1) relocating soil stockpiles from known scoria zones and (2) special placement of dragline spoil inward instead of outward during the boxcut in scoria zones.

2.4.6.2 Surface Water Management and Sediment-Control Measures

Upgradient flows (streamflow coming from outside the permit boundary into the Project area) would be captured in upstream ponds or traps, or in the pit. The primary means of restoring pre-mining runoff volumes in the Project area would be reclamation of disturbed lands in accordance with Westmoreland Rosebud's reclamation plan. Pre-mining channel morphology and gradients have been documented by surveyed longitudinal and cross-sectional channel and would be used to reclaim channels to their approximate pre-mining conditions. Pre-mine topography in the Project area is shown on **Figure 13** in **Section 3.2, Topography**, and described in **Section 3.2.2, Affected Environment.**

Westmoreland Rosebud does not anticipate the need for water treatment other than sediment-control measures and continued use of best technology currently available at the mine site. Sediment impoundments (ponds and standard traps), alternate sediment-control measures, and perimeter ditches would be constructed before any disturbance or in conjunction with soil stripping and road construction to control, treat, or contain runoff from the roadway construction and soil-stripping operations. Sedimentation ponds and standard traps in the remaining subdrainages would be constructed as required.

Proposed hydrologic control measures are shown on **Figure 8** (based on Exhibit D in Westmoreland Rosebud's Application).

2.4.6.3 Protection of Existing Water Rights

Existing surface and ground water rights are listed in **Appendix B**. Surface water rights are primarily used for stock watering, although there is an irrigation use near the confluence of Richard Coulee with Rosebud Creek, and ground water rights are used for domestic and stock water. Westmoreland Rosebud would have to "replace the water supply of any owner of interest in real property who obtains all or part of his supply of water for domestic, agricultural, industrial, or other legitimate use from surface or underground source if such supply has been affected by contamination, diminution, or interruption" caused by Project area mining operations (ARM 17.24.648). Reliable replacement water is available from the sub-McKay and in overburden and coal water-bearing units in some locations. See **Section 3.7, Water Resources – Water Rights**.

2.4.7 Contingencies of Cessation of Operations

Westmoreland Rosebud proposes to address temporary cessation of operations procedures if and when surface-mining operations temporarily cease. Upon permanent cessation of operations in the Project area (other than planned closure per the operations plan), Westmoreland Rosebud would close or grade and otherwise permanently reclaim all affected areas in accordance with ARM 17.24.522 and the permit approved by DEQ. All surface openings, equipment, structures, and other facilities not required for monitoring would be removed and the affected land reclaimed. Equipment needed for reclamation would not be removed from the mine until reclamation is complete. Some of the reclamation equipment may be periodically used in other mine areas at the Rosebud Mine or may be removed temporarily from the site for short-term activities such as community service, firefighting, use at the power plants, and maintenance. Notification of these activities, which require removal of equipment, would occur only if the ability to complete backfilling and grading within the time frames required by regulation would be impacted.

2.4.8 Monitoring

In Alternative 2, Westmoreland Rosebud would monitor resources in the Project area to ensure that any Project impacts are consistent with those considered in DEQ's permitting decision, including those disclosed in this EIS. Westmoreland Rosebud's monitoring program includes the following (**Table 9**): soil and spoil sampling and analysis per DEQ's Soil and Spoil Guidelines; revegetation monitoring during the bond liability period; boron in bottom ash, which has been used in the past in Area B on roads and as culvert bedding (see **Section 2.4.4.5, Bottom Ash**); surface and ground water monitoring; alluvial valley floor (AVF) monitoring; wildlife surveys; and aquatic macroinvertebrate surveys. Results of Westmoreland Rosebud's monitoring programs would be reported at least annually to DEQ. Westmoreland Rosebud's monitoring plans are adaptive and are routinely reviewed and modified in consultation with DEQ to optimize monitoring of potentially impacted resources.

As approved by the Air Resources Management Bureau, ambient air monitoring is no longer required. Air quality mitigation measures would be as described in Westmoreland Rosebud's Fugitive Dust Control Plan (applicable to the entire mine) and as required by MAQP #1483-08.

Wetland mitigation monitoring is described in **Section 2.4.9.5, Wetland Mitigation Plan, Mitigation Site Monitoring**.

Table 9. Overview of Parameters to Be Monitored and Monitoring Plans.

Monitoring Type	Description	Relevant Plan
Soil and spoil monitoring	Systematic sampling and analysis of graded spoil and soil would be conducted per DEQ's Soil and Spoil Guidelines.	
Revegetation monitoring	A three-phase revegetation monitoring plan would be implemented during the bond liability period.	Reclamation Plan
Stream monitoring	Surface water monitoring would be undertaken in drainages, including drainages that contain wetlands. At all surface water monitoring sites, flow, field parameter data, and water level readings would be collected monthly. At the flumes, water levels and flow would be monitored continuously using pressure transducers. Water quality samples would be taken on a quarterly, event-based basis. Sediment samples would be collected monthly and after major precipitation and snowmelt events.	Monitoring and Quality Assurance Plan
Pond monitoring	Water level measurements at ponds would be collected monthly throughout the year, and field parameters would be collected monthly. Water quality samples would be collected semiannually.	Monitoring and Quality Assurance Plan
Spring monitoring	Springs, including those that feed wetlands, would be monitored. Spring flow data and field parameter data would be collected monthly. Water quality samples would be collected semiannually. The frequency of spring sampling would be increased to quarterly once mining commences in the drainage in which the spring is located.	Monitoring and Quality Assurance Plan
Ground water monitoring	Ground water monitoring wells are located throughout the Project area, including upgradient and downgradient of the proposed disturbance area. Water level measurement frequency in wells is based on the observed variability in water levels and potential for impact and would be collected quarterly or semiannually in most wells. Water quality samples would be collected semiannually, annually, or every third year, dependent on observed trends in water quality and potential for impacts.	Monitoring and Quality Assurance Plan
MPDES Outfall monitoring	Monitoring is required under MT-0023965 and would be required under the new MPDES permit for the Project area.	Monitoring and Quality Assurance Plan
Climate monitoring	Precipitation data would be collected from 10 on-site rain loggers. Snow depth would be measured using snow boards at nine locations throughout the Rosebud Mine.	Monitoring and Quality Assurance Plan
Protection of AVF Monitoring	Additional alluvial groundwater monitoring locations near the confluence of Richard Coulee and Rosebud Creek to verify, during and after mining, that the likely AVF on Rosebud Creek would not be impacted by mining.	Required by DEQ's 6th Round Deficiency Letter
Wildlife surveys	Annual wildlife monitoring for the Rosebud Mine, including the Project area, would be undertaken for big game, upland game birds, raptors, and songbirds. In accordance with ARM 17.24.312(1)(d)(i), Westmoreland Rosebud would monitor threatened or endangered species listed under the Endangered Species Act of 1973, as amended, should these species be documented in the permit area.	Wildlife Monitoring Plan
Aquatic macroinvertebrate surveys	Aquatic macroinvertebrate surveys were completed during the permit renewal cycle for Area B in East Fork Armells Creek. Surveys followed the DEQ 2012 protocol, *Sample Collection, Sorting, Taxonomic Identification, and Analysis of Benthic Macroinvertebrate Communities Standard Operating Procedure*.	New plan to be developed, if required

2.4.8.1 Soil and Spoil Monitoring

This plan includes the systematic sampling and analysis of graded spoil and soil. The purpose of soil sampling would be to evaluate soil redistribution depth. Sampling intensity to typify soil redistribution depth would be one sample per 5 acres soiled, or a minimum of two samples per designated reclamation field.

In consultation with DEQ, if it is determined that soil chemistry analysis is necessary, representative samples of each redistributed soil lift would be collected. At a minimum, the following parameters would be analyzed for each soil chemistry sample, per DEQ's Soil and Spoil Guidelines (updated August 1998):

- pH
- saturation percentage
- EC
- SAR
- Texture

The sampling intensity would be one sample per 1,000 feet on a square-grid basis. The square grid for spoil sampling is taken from the Limbaugh coordinate grid system that overlays all mine maps. Spoil samples would be submitted to an accredited soil lab to be tested for the parameters listed above.

The upper 4 feet of graded spoil would be sampled prior to topsoil/subsoil redistribution. Additional sites would be sampled adjacent to sample sites that exhibit suspect material to gage the size of the potential problem. Sampling intensity of the additional sites and those sites that exhibit an abundance of coal (i.e., "coaly spoil") would be determined by consultation with DEQ. Sampling procedures and intensity of potential sodic spoil would be determined by consultation with DEQ. All graded spoil analysis results would be submitted to DEQ.

2.4.8.2 Revegetation Monitoring

Westmoreland Rosebud's revegetation monitoring is described in its Reclamation Plan (summarized in see **Section 2.4.5, Reclamation Plan** and **Figure 10**), and described in full in the Application (**Appendix A**); the proposed revegetation plan is shown on **Figure 11.** Westmoreland Rosebud would use a three-phase monitoring plan for revegetated areas during the bond liability period (see **Section 1.6.4, Figure 12**). Westmoreland Rosebud's complete water monitoring program, including monitoring locations for the entire Rosebud Mine, is described in detail in the Monitoring and Quality Assurance Plan (MQAP) (Application Appendix P). Monitoring and reporting of ground and surface water would be done in compliance with ARM 17.24.314, ARM 17.24.633, ARM 17.24.645, and ARM 17.24.646. Surface and ground water monitoring would be performed until final phase (Phase IV) bond release (**Section 1.6.4, Bond Release**).

2.4.8.3 Surface and Ground Water Monitoring

The surface and ground water monitoring plan for the Rosebud Mine including the proposed Project, (the MQAP), is presented in Appendix P of the Application. Westmoreland Rosebud monitors a number of surface water (streams, ponds, springs, and MPDES Outfalls) and ground water sites throughout the Rosebud Mine, including the Project area. The MQAP integrates all planning, data collection, and reporting activities and specifies how quality assurance (QA) and quality control (QC) measures are applied to ensure that the results obtained meet statutory requirements. Monitoring data collected under

the MQAP would be incorporated into the Annual Hydrology Report (AHR) for the entire Rosebud Mine, which would be submitted to DEQ no later than December 31 and June 30 of each year. The AHR summarizes data collected in each permit area of the Rosebud Mine.

Monitoring includes collection of climate data; ground water levels and ground water quality; stream, spring, and pond water quality and quantity; and MPDES discharge flow and quality (Application Appendix P). The monitoring schedule and requirements, except those required by the MPDES permit, would be reviewed and updated annually, or as needed in consultation with DEQ. The MQAP does not provide requirements for the collection and analysis of MPDES-mandated water quality and quantity data. Those project-specific requirements would be listed in the MPDES permit.

The data collected under the MQAP would be used to inform decision-making regarding the following:

- comparison of monitoring results to applicable water quality standards and analysis of long- and short-term flow, water level or water depth, and water quality changes or trends; and
- evaluation of the impacts on the hydrologic balance occurring on or off the Project area as a result of mining or reclamation activity in the Project area.

Monitored sites in and immediately adjacent to the Project area and/or within the surface water analysis area are shown on **Figure 12**. Westmoreland Rosebud's complete water monitoring program, including monitoring locations for the entire Rosebud Mine, is described in detail in the MQAP (Application Appendix P). Monitoring and reporting of ground and surface water would be done in compliance with ARM 17.24.314, ARM 17.24.633, ARM 17.24.645, and ARM 17.24.646. Surface and ground water monitoring would be performed until final phase (Phase IV) bond release (**Section 1.6.4, Bond Release**).

2.4.8.4 Protection of AVF Monitoring

DEQ's sixth round deficiency letter (**Appendix A**) required Westmoreland Rosebud to install additional alluvial groundwater monitoring locations near the confluence of Richard Coulee and Rosebud Creek. The purpose of these monitoring locations is to verify, pre-mining and postmining, that the likely AVF on Rosebud Creek would not be impacted by mining. DEQ required one year of monitoring data to be collected from these wells prior to a permit decision to ensure that baseline data were available for comparison to operational and post-operational data.

2.4.8.5 Wildlife Surveys

Westmoreland Rosebud conducts annual wildlife monitoring throughout the Rosebud Mine permit areas, including the Project area, according to its Fish and Wildlife Plan (see Application Appendix N-1 Fish and Wildlife Plan) and would continue to do so during operations and reclamation (see **Section 3.10, Fish and Wildlife Resources**). Species monitored include big game, upland game birds, raptors, and songbirds, including MNHP SOCs, and ESA-listed threatened or endangered species documented in the permit area (see **Table 2-3 in Application Appendix N-1 Fish and Wildlife Plan**). The annual wildlife monitoring report would cover the period from December 1 through November 30 of the following year. The annual report would be submitted to DEQ by March 1 of the year following completion of the annual data collection.

The wildlife survey area includes the entire Project area and a surrounding 1-mile perimeter. Survey forms would be developed by Westmoreland Rosebud and approved by DEQ prior to the respective surveys. All pertinent information and data would be recorded on the forms.

All surveys would be conducted by a professional wildlife biologist. This person would have a sound understanding of the wildlife species inhabiting the area and would be able to properly observe and identify the various wildlife species—particularly songbirds.

2.4.8.6 Aquatic Macroinvertebrate Surveys

Aquatic macroinvertebrate surveys were completed in 2015 and 2016 (ERM 2016a, 2016b) in East Fork Armells Creek adjacent to Areas A, B, and C of the Rosebud Mine (see **Section 3.10.2.6, Aquatic Species**). Surveys followed the DEQ 2012 protocol, *Sample Collection, Sorting, Taxonomic Identification, and Analysis of Benthic Macroinvertebrate Communities Standard Operating Procedure*. A Hilsenhoff Biotic Index (HBI) community indicator was calculated for each site following Montana-specific tolerance values for identified taxa. The HBI represents the relative sensitivity of the sample to nutrient perturbation. Westmoreland Rosebud would develop an aquatic macroinvertebrate survey plan for DEQ approval, if required (see Application Appendix N-1 Fish and Wildlife Plan).

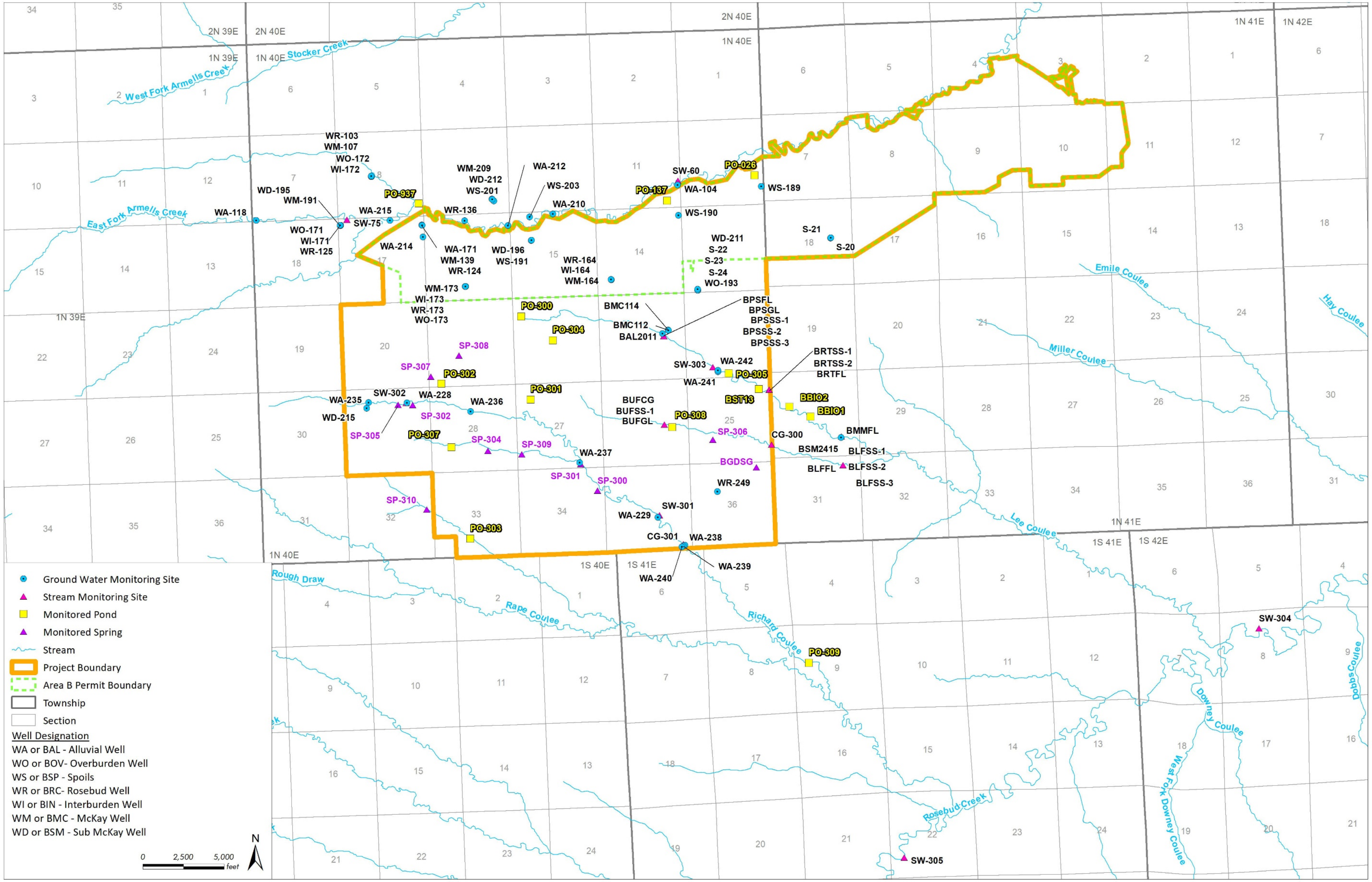

Figure 12. Surface and Ground Water Monitoring Locations.

Note: Figure does not include monitoring location described in **Section 2.4.8.4, Protection of AVF Monitoring**.

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2.4.9 Mitigations

2.4.9.1 Air Quality

Mitigations are described in Westmoreland Rosebud's Fugitive Dust Control Plan (applicable to the entire mine) and as required by the MAQP #1483-08. The Fugitive Dust Control Plan may need to be updated to address the addition of the Project area.

2.4.9.2 Cultural Resources

Adverse impacts on the potential historic properties would be resolved through a mitigation plan, to be developed by Westmoreland Rosebud, submitted to DEQ, and approved by DEQ in coordination with the SHPO prior to disturbance. In addition, if any cultural resources are inadvertently unearthed or otherwise encountered during mining activities, work would cease in the area of the discovery until the resources can be identified and appropriate resource protection measures can be implemented.

2.4.9.3 Greater Sage-Grouse Compensatory Mitigation

Westmoreland Rosebud consulted with the Montana Sage Grouse Habitat Conservation Program (Sage Grouse Program) to develop a mitigation plan (**Appendix C**) to address the areas of concern in the Project area. The mitigation plan includes actions to avoid, minimize, and reclaim impacts on greater sage-grouse. The Montana Sage Grouse Oversight Team (MSGOT) approved the mitigation plan at its December 18, 2018 meeting.

Westmoreland Rosebud is obligated to provide compensation for unavoidable adverse residual impacts on greater sage-grouse or their habitat; the proposed Project's impacts are described in **Section 3.10, Fish and Wildlife Resources**. The Sage Grouse Program helped calculate this obligation for the proposed Project. After working with the Sage Grouse Program to fully consider all options for meeting the Project's debit obligations, Westmoreland Rosebud opted to make a contribution in the full amount of $36,522.91 to the Stewardship Fund. The contribution must be deposited after all permits are issued, but prior to commencing construction.

2.4.9.4 Fish and Wildlife Enhancement Measures

Westmoreland Rosebud proposes the following measures to protect and enhance fish and wildlife habitat (see Application Appendix N-1 for more detail; **Appendix A**):

1. Avoiding, to the extent practicable, existing wildlife habitats of unusually high value (including wetlands);

2. Minimizing impacts on wildlife from mine operations;

3. Reclaiming wildlife habitat and replacing habitats of unusually high value at a ratio of 1:1 or greater;

4. Implementing a wildlife conservation plan to address threatened and endangered species and Montana Species of Concern (SOC); and

5. Monitoring wildlife use of the reclaimed area and surrounding habitat to ensure that reclamation provides effective habitat.

2.4.9.5 Wetland Mitigation Plan

All Project area wetlands have been determined by the U.S. Army Corps of Engineers (Corps) to be isolated and therefore not jurisdictional waters of the U.S. under the authority of Section 404 of the Clean Water Act (Corps 2017). Twenty wetlands within the Project area, and five potential wetland restoration sites, were assessed and ranked according to the Montana Department of Transportation Montana Wetland Assessment Method (MWAM; Berglund and McEldowney 2008). The objective of the field program was to assess wetland functions and values for developing a wetland mitigation program for the Project area (ERM 2018). Westmoreland Rosebud has proposed a wetland mitigation plan for nonjurisdictional wetlands that would be impacted by mining operations in the Project area (Application Appendix N-1; see **Section 3.9, Wetlands**).

Operations Plan Mitigation and Avoidance Measures

Westmoreland Rosebud's proposed operations plan includes measures to avoid or lessen potential wetland impacts (see Application Appendix N-1):

1. Sediment-control structures would be used to capture runoff water and for sediment control (**Figure 8**). These structures could be used to create wetlands (temporary and permanent) after their use as sediment-control structures.

2. Pits and pond locations would be strategically placed at the edge of disturbances to intercept and contain surface runoff from leaving the permit boundary (**Figure 8**). The placement of these ponds would allow runoff water to slowly infiltrate and possibly recharge some of the wetland areas.

3. Haul roads would be developed with a 120-foot width, designed to minimize wetland and spring crossings (**Figure 7**). Ditches along the haul roads would direct runoff to either sedimentation ponds or sediment traps (**Figure 8**). In areas where haul roads cross ephemeral drainages, sediment traps would be provided to collect runoff from the road embankment.

4. All discharges to public waters would comply with Westmoreland Rosebud's MPDES permits (**Figure 8**) to assure protection of water quality in receiving waters.

5. A Spill Prevention and Countermeasures Control plan would be modified to incorporate the Project area and would include measures to prevent and control spills that may occur due to mining activities.

6. Westmoreland Rosebud's proposed operations plan includes measures related to proper disposal of debris, acid, and acid-forming, toxic, and toxic-forming materials; compliance with the requirements of applicable air and water quality laws; and prevention and control of noxious weeds.

7. Westmoreland Rosebud would conduct concurrent reclamation.

The reclamation plan (see **Section 2.4.5, Reclamation Plan** and **Figure 10**) would avoid and lessen potential wetland impacts through the following measures (see Application Appendix N-1):

1. Reclamation of mined lands would approximate pre-mining conditions, particularly along the principal stream courses, and minimize the disturbance to scoria zones, to mitigate the impacts of mining on recharge capacity (**Figure 9**).

2. DEQ's vegetation guidelines would be followed for postmining reclamation, including promoting a diversity of native species to enhance nutrition, cover, and structural values.

Mitigations for the Loss of Wetland Function and Values

To mitigate for the loss of wetland function and values associated with impacts on Project area wetlands, Westmoreland Rosebud would implement mitigation before ground disturbance as described in the Application Appendix N-1. Mitigation options for the Project could include the following options and would be determined in consultation with DEQ:

1. *Creation through reclamation* – During mining and reclamation, Westmoreland Rosebud would look for opportunistic hydrologic features and conditions that would facilitate wetland creation, including but not limited to constructing permanent ponds, small depressions, and wildlife enhancement features. This effort could include developing additional wetlands in reclaimed areas of early mined stages of the Project area, before impacting wetlands in later stages of Project operations.

2. *Enhancement of wetland habitat* – During mining and reclamation, Westmoreland Rosebud would actively pursue enhancement of wetlands proposed to be minimally impacted by proposed mining activities.

3. *State initiative support* – Westmoreland Rosebud would seek opportunities to contribute to Montana's statewide wetland strategy of wetland and riparian area conservation and restoration.

4. *Restoration* – Westmoreland Rosebud could restore other wetlands within the same watershed. Westmoreland Rosebud has identified several potential wetland mitigation sites that could be enhanced or expanded in the Rosebud and Armells Creek drainages, including Wetlands G019, G500 (in areas that would be impacted), 32A, 049, and 27A. See the discussion in **Section 3.9, Wetlands**, specifically **Section 3.9.3.2, Direct Impacts**. **Table 10** outlines the current conditions of the wetlands and Westmoreland Rosebud's proposed mitigations.

Table 10. Potential Wetland Mitigation Sites.

Wetland[1]	Existing Condition and Proposed Mitigations	Existing Functional Category
G019	Wetland is shallow, open water with a silty bottom and restricted areas of emergent vegetation along the edges. The surrounding upland consists only of grasses; no vegetative structural diversity. Wetland may potentially be impacted by mining-related changes to surface and ground water flows, but could be enlarged and connected to enhance structural diversity.	III
G500	Drainage wetland and watercourse that follows a flowing stream (Richard Coulee); it is fed by upstream springs, seeps, and tributaries. It is structurally diverse, with sections of narrow streambed and sections of broader wetland areas. Wetland would be partially disturbed by mining, but could be enlarged and connected to enhance structural diversity.	III
32A	Wetland area sits within a reclaimed site and is not largely vegetated. Habitat enhancement in and around the wetland would increase the functions and values of this wetland.	IV
049	Wetland lacks vegetation and is heavily used as a livestock watering source; dams have been placed to pond water in this area. Livestock exclusion measures and habitat enhancement could be implemented to increase the functions and values of this wetland.	IV
27A	Wetland lacks vegetation and is heavily used as a livestock watering source; dams have been placed to pond water in this area. Livestock exclusion measures and habitat enhancement could be implemented to increase the functions and values of this wetland.	IV

Source: Application Appendix N-1, Section 4.4.

Mitigation Site Monitoring

Westmoreland Rosebud would monitor all wetland mitigation sites for establishment of invasive species, survival rates of planted vegetation, and efficacy of livestock exclusion measures. If needed, Westmoreland Rosebud would implement corrective actions. Functional values would be assessed annually. Success criteria would be defined in the Reclamation Plan (ARM 17.24.313). Once wetland mitigation sites are established, mitigation sites would be incorporated into wetland and wildlife monitoring plans (see **Section 2.4.8, Monitoring**).

2.5 ALTERNATIVES NOT CARRIED FORWARD FOR DETAILED ANALYSIS

DEQ's alternatives development process was designed to identify a reasonable range of alternatives for detailed analysis in the EIS. DEQ developed alternatives in accordance with its authorities (described in **Section 1.4, Agency Authority and Actions**). Alternatives or alternative components were suggested by the public in scoping comments or by specialists based on professional experience. Those considered during the development process but not carried forward for detailed analysis are discussed in the following sections.

As discussed in **Section 2.1.1, Alternatives Analyzed**, 75-1-220(1), MCA defines "alternatives analysis" to mean an evaluation of different parameters, mitigation measures, or control measures that would accomplish the same objectives as those included in the Proposed Action by the applicant. For a project that is not a state-sponsored project, it does not include an alternative facility or an alternative to the proposed Project itself. ARM 17.4.603(2) defines "alternative" as an alternative approach or course of

action that would appreciably accomplish the same objectives or results as the proposed action; design parameters, mitigation, or controls other than those incorporated into a proposed action by an applicant or by an agency before preparation of the EIS; or no action or denial under ARM 17.4.603(2).

To be considered further, an alternative must meet all the following criteria to determine which alternatives to consider (based on ARM 1417.4.603(2) and 75-1-220(1) and 75-1-201(1)(b)(4)(C), MCA):

- The alternative must appreciably accomplish the same objectives or results as the proposed action;
- Meets the purpose and need as stated in Section **1.3, Purpose and Need** ;
- Represents a course of action that bears a logical relationship to the proposal being evaluated;
- Is technically feasible (achievable by using current technology); and
- Is economically feasible (based on similar projects having similar conditions and physical locations, regardless of the economic strength of the specific project sponsor).

2.5.1 Sequencing the Order of Mining by Permit Area or within the Project Area

DEQ considered an alternative that would sequence mining of the Rosebud Mine by permit area (i.e., mine Area F first or mine sequentially to the south). This alternative was not carried forward for detailed analysis because the entire Rosebud Mine is not part of the Proposed Action. Sequencing mining in the Project area only would present operational limits, such as blending of coal for customers (Colstrip and Rosebud Power Plants), and could lead to increased cumulative impacts.

In addition, DEQ considered an alternative that would alter the mining sequence within the proposed Project area. This alternative was not carried forward for detailed analysis because the course of action must appreciably accomplish the same objectives or results as the Proposed Action. Westmoreland Rosebud must maintain the ability to blend coal to meet the specific coal quality required for their customers' needs. Westmoreland Rosebud has evaluated the coal quality and determined that the proposed sequencing would best meet their needs. Altering the sequencing would not produce the same results as the Proposed Action.

2.5.2 Maintain Wet Reaches of Drainages

To mitigate impacts on surface water and wetlands, DEQ considered an alternative that would have maintained the wet reaches of Project area drainages, including the downgradient portion of Lee Coulee. This alternative was not carried forward because downgradient reaches are inside the permit boundary and if impacts occurred on this portion of the drainage, the impacts would not be considered "material damage" under ARM 17.24.301(69).

2.5.3 Restrict Mining to Lee Coulee, Not Richard or Rape Coulee

To mitigate sediment and water quality impacts, DEQ considered an alternative that would have restricted new mining to Lee Coulee only. Disturbance (primarily mining) would have been prohibited in Richard Coulee and Rape Coulee. This alternative was rejected because it did not "appreciably accomplish the same objectives or results as the proposed action," under ARM 17.4.603(2). For a project that is not a state-sponsored project, an alternatives analysis under MEPA does not include an alternative facility or an alternative to the proposed project itself (75-1-220(1), MCA).

2.5.4 Alternative Land Uses

Comments were submitted during the public scoping period asking DEQ to consider other commercial and industrial uses for the Project area, such as a future energy facility, instead of surface mining in the Project area. Comments also were submitted asking DEQ to consider alternatives to continued coal energy (solar, wind, etc.) generation at the Colstrip Power Plant, which is not part of the Project. Neither concept was carried forward as an alternative for detailed analysis because it would be inconsistent with the Project's stated purpose. As described in **Section 1.3, Purpose and Need** , the Project is predicated on DEQ review of an Application to modify an operating permit for an existing surface mine, Area B of the Rosebud Mine. In addition, requiring the land to be used for a different purpose would infringe on private property rights. This alternative also was rejected because it did not "appreciably accomplish the same objectives or results as the proposed action," under ARM 17.4.603(2). For a project that is not a state-sponsored project, an alternatives analysis under MEPA does not include an alternative facility or an alternative to the proposed project itself (75-1-220(1), MCA).

2.6 PREFERRED ALTERNATIVE

DEQ is required to identify in a draft EIS the agency's preferred alternative, if any, and its reasons for the preference. DEQ has not identified a preferred alternative as of the issuance of this Draft EIS.

CHAPTER 3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 INTRODUCTION

This chapter describes the condition of the affected environment (including its human elements), the resource-specific analysis areas for direct and secondary impacts, the regulatory framework (federal, state, and local laws and regulations) applicable to each resource, and the environmental impacts (direct, secondary, and cumulative) that may result from selection and implementation of the Proposed Action and alternatives described in **Chapter 2**. The Montana Environmental Policy Act (MEPA), which is described in **Chapter 1**, requires state agencies to examine and disclose to the public the potential impacts on the human environment of proposed projects or activities that require state approval.

This chapter provides the scientific and analytic basis for the comparison of the Proposed Action and alternatives as presented in **Chapter 2** of this Environmental Impact Statement (EIS). Resources analyzed are listed in **Section 3.1.2, Resources Analyzed and Chapter Organization**, and were identified during public and agency scoping. The geographic context for the resource-specific discussions is introduced in **Section 3.1.3, General Setting of the Affected Environment**. Environmental baseline information summarized in this chapter was obtained from the review of published sources, review of unpublished data, communication with government agencies, and review of field studies of the area.

Impacts were analyzed by considering the impacts of an action (direct, secondary, and cumulative) on each of the 17 resources. The Montana Department of Environmental Quality (DEQ) based these impact analyses and conclusions on the review of existing literature and studies, information provided by resource specialists and other agencies, professional judgment, agency staff insights, and public input; resource-specific analysis methodologies are provided in the introductions to each resource section. An overview of impacts on each resource by alternative is presented in **Section 2.6, Preferred Alternative**.

In order to use the most appropriate boundaries for each resource, the analysis areas varied by resource. Resource-specific analyses used the following analysis areas: (1) the 15,153-acre Project area, (2) the 5,711-acre area of new Project-related disturbance (within the proposed 11,202-acre disturbance area), or (3) another resource-specific boundary.

In this EIS, an environmental impact is any change from the present condition of any resource or issue that may result as a consequence of implementation of the No Action Alternative (Alternative 1) or the Proposed Action (Alternative 2). Definitions used to describe impacts are listed below.

3.1.1 Definitions Used for Impacts Analyses

The following terms were used in this EIS to describe the nature of impacts associated with each alternative. These definitions were formulated through the review of existing laws (such as MEPA), policies, and guidelines, and with assistance from resource specialists.

Direct, Secondary, and Cumulative Impacts: As defined by MEPA, impacts can be direct, secondary, or cumulative.

- Direct impacts are caused by an action and occur at the same time and place as the action.

- Secondary impacts are defined in Administrative Rules of Montana (ARM) 17.4.603(18) as "a further impact to the human environment that may be stimulated or induced by or otherwise result from a direct impact of the action."
- Cumulative impacts are defined in ARM 17.4.603(7) as the "collective impacts on the human environment of the proposed action when considered in conjunction with other past and present actions related to the proposed action by location or generic type. Related future actions must also be considered when these actions are under concurrent consideration by any state agency through pre-impact statement studies, separate impact statement evaluation, or permit processing procedures."

Duration: For this EIS, impact duration is described as short-term or long-term; generally, these are defined as follows (exceptions occur for Cultural and Historic Resources, and Geology and Geochemistry):

- Short-term impact – a change that within a short period would no longer be detectable as the resource is returned to its pre-mine condition, appearance, or use. In this EIS a "short period" is defined as the length of the Area B proposed fifth amendment (AM5) bond liability period (see **Chapter 1** for a description of the bond liability period).
- Long-term impact – a change in a resource or its condition that does not immediately return the resource to pre-mine condition, appearance, or productivity; long-term impacts would apply to changes in condition that continue beyond the bond liability period but would be expected to eventually return to pre-mine condition, or would meet Montana Strip and Underground Mine Reclamation Act (MSUMRA) requirements.

Type: Impacts can be beneficial or adverse and residual. Beneficial impacts are those that create a positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition. Adverse impacts are those that move the resource away from a desired condition or detract from its appearance or condition. Residual impacts are those that are not eliminated by mitigation, as defined in ARM 17.4.603(16).

3.1.2 Resources Analyzed and Chapter Organization

Based on internal agency scoping and comments received during public scoping, the 17 resources listed in **Table 11** were identified for detailed assessment in this EIS. Direct, secondary, and cumulative impacts on these resources are disclosed in this chapter. Following DEQ's alluvial valley floor (AVF) determination (DEQ 2019), AVFs were dismissed from further analysis. Key language from DEQ's AVF determination and reasons the resource was dismissed from further analysis in this EIS are identified in **Section 3.19, Resources Considered but Not Studied in Detail**.

Table 11. Resources Analyzed.

Resource	Chapter and Section		
	Introduction (*Regulatory Framework and Analysis Area and Methods*)	Affected Environment	Environmental Consequences (*Direct, Secondary, and Cumulative*)
Topography	3.2.1	3.2.2	3.3.2
Air Quality	3.3.1	3.3.2	3.3.3
Geology and Geochemistry	3.4.1	3.4.2	3.4.3
Water Resources – Surface Water	3.5.1	3.5.2	3.5.3
Water Resources – Ground Water	3.6.1	3.6.2	3.6.3
Water Resources – Water Rights	3.7.1	3.7.2	3.7.3
Vegetation	3.8.1	3.8.2	3.8.3
Wetlands	3.9.1	3.9.2	3.9.3
Fish and Wildlife Resources	3.10.1	3.10.2	3.10.3
Cultural and Historic Resources	3.11.1	3.11.2	3.11.3
Socioeconomics	3.12.1	3.12.2	3.12.3
Visual Resources	3.13.1	3.13.2	3.13.3
Land Use and Recreation	3.14.1	3.14.2	3.14.3
Transportation	3.15.1	3.15.2	3.15.3
Solid and Hazardous Waste	3.16.1	3.16.2	3.16.3
Noise	3.17.1	3.17.2	3.17.3
Soil	3.18.1	3.18.2	3.18.3

3.1.3 General Setting of the Affected Environment

The 15,153-acre Project area analyzed in this EIS is the proposed Area B permit area as modified by AM5 (**Figure 6**). The proposed Project area is located adjacent to the southern boundary of Area B about 5 miles southwest of Colstrip in Township 1 North, Ranges 40 and 41 East (**Figure 2**). The Northern Cheyenne Indian Reservation is 8 miles south of the Project area in Big Horn and Rosebud Counties. The northeast corner of the Crow Reservation is about 11 miles southwest of the Project area in Big Horn County.

Situated in the northern Powder River Basin, the Project area is generally east and north of the Little Wolf Mountains. The region has a semiarid climate and flat to rolling topography of shale and sandstone punctuated by occasional buttes. The Project area has two drainages, Lee Coulee and Richard Coulee, which are divided by a tall ridge. Lee Coulee, Richard Coulee, and their tributaries flow into Rosebud Creek, a tributary of the Yellowstone River. Elevation of the Project area ranges from about 3,200 to 3,800 feet above sea level.

The Project area is in the Northwest Great Plains Ecoregion, which encompasses the Missouri Plateau section of the Great Plains. Precipitation is variable, ranging from 5 to nearly 24 inches per year (over the past 40 years); mean annual precipitation ranges from about 10 to 14 inches. The wettest months are May and June, and the driest are November through February. Large precipitation events of 1 to 3 inches in a day occur fairly frequently, and monthly precipitation totals of 4 to 10 inches have been recorded in April through September. Average annual snowfall is about 35 inches, and the snowiest month is January, averaging 6.9 inches. December, February, and March are nearly as snowy, averaging about 6 inches of snow. The average length of growing season is about 125 days.

The majority of the northern section and eastern section of the Project area (within the existing Area B permit area) has been mined or disturbed by Rosebud Mine activities or Big Sky Mine activities,

respectively. The southern portion of the Project area, where the AM5 expansion is proposed, has also been affected by human disturbance, primarily from livestock grazing, agriculture, and roads. The Project area consists primarily of native grasslands (41 percent), conifer/sumac woodlands (28 percent), sagebrush (10 percent), and revegetated areas (15 percent).

3.1.4 Actions Considered in Cumulative Impacts Analyses

MEPA requires an analysis of cumulative impacts, which are defined as “the collective impacts on the human environment of the Proposed Action when considered in conjunction with other past and present actions related to the Proposed Action by location or generic type. Related future actions must also be considered when these actions are under concurrent consideration by any state agency through preimpact statement studies, separate impact statement evaluation, or permit-processing procedures” as set forth in the Administrative Rules of Montana (ARM) 17.4.603(7).

The sections below identify past, present, and related future actions. Actions considered in these analyses were identified by DEQ and its consulting team as well as from public scoping comments. Past and present actions, which are described in Section **3.1.4.1, Related Past and Present Actions**, are accounted for as part of the existing, or “baseline,” environmental conditions. MEPA is forward-looking, with analyses focused on the potential impacts of the Proposed Action that DEQ is considering.

The type and timing of impact for the Proposed Action are key to the cumulative impacts analyses. To be considered for cumulative impacts, other actions must affect the environment in a similar manner and at a similar time as the Proposed Action and alternatives. For these analyses, the time period includes active mining in the Project area through completion of reclamation (final bond release). Types of actions include but are not limited to these general categories: agriculture, coal combustion, mining, municipal and industrial water use, rail transport and development, and wildland fire.

Past, present, and related future actions under concurrent consideration that are in the vicinity of the Project area are shown on **Figure 2**.

3.1.4.1 Related Past and Present Actions

The following is a summary of past and present actions with the potential to contribute to cumulative impacts. The list of actions below does not cover all actions used in air quality modeling, which looked at a much larger geographic area than other resources; please see **Section 3.3.3.3, Cumulative Impacts (Air Quality)**. A discussion of past and present actions is included in the cumulative impacts analysis for each resource.

Agriculture

The Project area and surrounding areas have been used for agricultural (mostly grazing) purposes for decades and continue to be used in this manner. Agriculture has historically had and continues to have a substantial impact on land and water use in the drainages surrounding the Project area. Continuous strips of irrigated farmland border drainages in Rosebud County, with extensive dryland areas between the drainages used primarily for grazing. The source of water for irrigation is predominantly surface water. According to U.S. Department of Agriculture (USDA) 2017 statistics, the largest portion of irrigated farmland is used for hay production, with barley and sugar beets as additional crops (USDA 2017). Irrigated acreage accounts for about 1 percent of the land in the analysis area watersheds.

Airport

Rosebud County owns and operates a small public airfield located between Areas B and C of the Rosebud Mine (about 3 miles southwest of Colstrip). The airfield, which is identified as M46 by the Federal Aviation Administration, has operated since 1990 and has two runways open daily from sunrise to sunset. Twelve single-engine aircraft are based at the airfield. The airfield averages 28 flights per week (Airnav.com 2018).

Air Pollutant Sources and Emissions

There are a number of existing sources of air pollutants that affect air quality in the analysis area. In the immediate surroundings of the Project area, the primary sources of air pollution are the existing permit areas of the Rosebud Mine and the Colstrip and Rosebud Power Plants, while in the larger analysis area there are a number of other major regional point and area sources including other mines and electric generation facilities. The emissions from these sources are quantified and discussed in **Section 3.3, Air Quality**.

Power Plant Operations

Two coal-fired power plants operate in the Colstrip area (**Figure 2**). Both plants exclusively burn coal from the Rosebud Mine. The two plants and their operations are described below.

Colstrip Power Plant

The Colstrip Power Plant is located in the city of Colstrip and currently is operated by Talen Energy. Colstrip Units 1 and 2, which each had 307 megawatts (MW) of generating capacity; were constructed in 1972; began operating in 1975 and 1976, respectively; and were retired from use on January 5, 2020.

Colstrip Units 3 and 4, which each have about 740 MW of generating capacity, started operating in 1984 and 1986, respectively, and are currently generating power. Direct employment at Colstrip Units 3 and 4 is about 280 workers (see **Section 3.12, Socioeconomics**).The Colstrip Power Plant and the operations of its associated facilities (paste plant, ponds, etc.) are governed by a certificate issued by DEQ under the Major Facility Siting Act (MFSA), 75-20-101, Montana Code Annotated (MCA) *et seq*. (Certificate).

In 2018 and 2019, the Rosebud Mine delivered between 8.0 and 9.0 million tons of coal annually to the Colstrip Power Plant primarily by a covered conveyor system (**Figure 2**) and a small amount by truck. Over the last 10 years, the mine averaged 9.9 million tons annually. With the retirement of Colstrip Units 1 and 2 in 2019, annual production from the mine and deliveries to the Colstrip Power Plant is expected to decrease to around 6 million tons (Peterson 2020b); analyses in this EIS are based on recent rather than projected production rates. Colstrip Units 3 and 4 were originally limited to burning coal from Areas C, D, and E, but in 2015, DEQ approved an amendment to the Certificate also allowing the use of coal from other permit areas (DEQ 2015).

Rosebud Power Plant

The Rosebud Power Plant is a 24-MW coal-fired power plant located about 6 miles north of the city of Colstrip that has been operating since May of 1990. The Rosebud Power Plant was designed to burn low-Btu (British thermal unit) “waste coal” from the Rosebud Mine, which is coal not suitable for use at the Colstrip Power Plant due to the high sulfur content and low calorific value. This waste coal is typically found in the first 1-foot layer of the Rosebud Coal deposit. Coal from all of the active permit areas (A, B, and C) is currently used in the plant. The Rosebud Mine trucks 300,000 tons of coal annually to the

Rosebud Power Plant using a fleet of five covered haul trucks. Three of the five trucks operate daily, with each truck delivering an average of 6.5 loads, for an average total of 19.5 total loads daily.

Actions by Federal Land Management Agencies

U.S. Department of the Interior – Bureau of Land Management

Although there is no federal surface land in the immediate vicinity of the Project area, there is federal mineral ownership (estate) in and adjacent to the Project area. This federal mineral estate is administered by the Bureau of Land Management (BLM). The BLM's Miles City Field Office (MCFO) recently revised and combined the Big Dry (1996) and Powder River (1985) Resource Management Plans, as amended, into one document, the Miles City Field Office Approved Resource Management Plan (ARMP). The plan applies to BLM surface and federal mineral estates. The planning area includes all of Carter, Custer, Daniels, Dawson, Fallon, Garfield, McCone, Powder River, Prairie, Richland, Roosevelt, Rosebud, Sheridan, Treasure, and Wibaux Counties as well as portions of Big Horn and Valley Counties; northern Big Horn County is under the Billings Field Office Management Plan.

In the existing Area B permit area, Westmoreland Rosebud holds several leases permitting coal mining in the federal mineral estate, including the following: M35734, M35735, M54711, M54712, M73109, M80697, M82186, M88574, M88755, M88756, and M88758. Western Energy mined these federal coal leases in the past and Westmoreland Rosebud continues to mine them as permitted by their federal coal leases, federal mining plan, and state operating permit (see **Coal Mining** below).

BLM-authorized actions in the near vicinity of the Project area include rights-of-way for powerlines and pipelines, coal leases, mineral material sites, land withdrawals, and land sales and exchanges. Oil and gas leases were issued in the past, but currently none are authorized in the near vicinity of the Project area.

USDA Forest Service – Custer Gallatin National Forest

The Custer Gallatin National Forest is located in southeastern Montana. The closest ranger district, the Ashland District, is about 35 miles southeast of the Project area. Except for management activities such as controlled burns, past and present management activities on the Ashland District are not expected to influence or be influenced by the proposed Project.

Mining

Gravel Quarries

There are eight gravel quarries operating within 25 miles of the Project area. These quarries have operating permits through DEQ's Opencut Mining Program. Westmoreland Rosebud has five gravel quarry sites for mining scoria (used on road surfaces in the Rosebud Mine). These quarries are authorized under Westmoreland Rosebud's existing Rosebud Mine operating permits.

Coal Mining

Rosebud Mine

Westmoreland Rosebud's past and present operations at the Rosebud Mine are described in **Section 2.2, Rosebud Mine – Description of Past and Existing Mine Operations and Reclamation**. Also see **Figure 4** for an operational timeline.

Other Coal Mines in Southeastern Montana

The Big Sky Mine is an inactive surface coal mine (C1988004B) that was operated by Peabody Energy from 1984 to 2003 and is located just south of the existing Area B permit area. About 500 acres of the Big Sky Mine permit area is included in the southeastern part of the proposed Project area. The Big Sky Mine, including the portion within the proposed Project area, is fully graded and revegetated and is now in the 10-year period of responsibility pending evaluation by Peabody Energy and DEQ for Phase IV bond release (the actual period may be longer than 10 years). Approved postmining uses for the Big Sky Mine include livestock grazing and developed water.

Permitted Discharges: Rosebud Mine

MPDES permits held by Westmoreland Rosebud are described above in **Section 2.2.3.2, Discharge Permits**.

Municipal and Industrial Water Uses and Discharges

Rosebud Power Plant

Deep ground water wells provide water to the Rosebud Power Plant. Colstrip Energy Limited Partnership, owner of the Rosebud Power Plant, is permitted under MPDES permit MT-0031780 to discharge water from a storm-water control pond to an unnamed ephemeral tributary to East Fork Armells Creek. The discharge must meet effluent limitations and conditions. There have been no recent exceedances of discharge limits.

Colstrip Power Plant

Water piped from the Yellowstone River to Castle Rock Reservoir is the source of water to the Colstrip Power Plant, which operates as a zero-discharge facility. Process water is contained in ponds on the plant site.

Colstrip Water Treatment Plant

The Colstrip Water Treatment Plant provides potable water from Castle Rock Reservoir to the city of Colstrip. The water supply to Castle Rock Reservoir is piped from the Yellowstone River. Backwash from the potable water treatment plant is discharged back to the reservoir under MPDES permit MT-0030422. Municipal sewage flows via a collection system to the Colstrip Wastewater Treatment Plant, which operates at about 200,000 gallons per day, about one-third of stated capacity. The city of Colstrip is authorized to discharge from its sewage treatment plant to East Fork Armells Creek pursuant to MPDES discharge permit MT-0022373.

Irrigation – Golf Course

A nine-hole public golf course is located adjacent to East Fork Armells Creek about 1 mile downstream of Colstrip. Water used to maintain the greens infiltrates into the creek, likely causing undefined changes in water level and water quality. Irrigation water for the golf course comes from the municipal water supply, which is piped from the Yellowstone River.

Rail Transport

The Northern Pacific Railway established the city of Colstrip and its associated mine in the 1920s to provide fuel for the railway's steam-locomotive trains. BNSF Railway currently owns and operates a functioning rail spur that runs north-south from Nichols, Montana, to the Rosebud Mine. Westmoreland Rosebud has intermittently shipped coal via this line in the past (as recently as 2010) but does not have a current contract to ship coal via railway.

Wildland Fire and Prescribed Burns

Wildland fires have historically occurred in the vicinity of the Rosebud Mine. During the 2012 wildland fire season, the McClure Creek and Donley Creek fires burned 221 acres, impacting vegetation and wildlife on and around the southern boundary of Rosebud Mine Areas C and F. The 2012 Chalky Fire burned 131,000 acres south of Area B, including the majority of the AM5 area. Prescribed burns have also occurred from time to time on BLM or Forest Service lands in southeastern Montana.

3.1.4.2 Related Future Actions

Under ARM 17.4.603(7), related future actions must also be considered in a cumulative impacts analysis when those actions are under concurrent consideration by any state agency through preimpact statement studies, separate impact statement evaluation, or permit processing procedures. The following is a summary of future actions that were considered; it does not cover all actions used in air quality modeling, which looked at a much larger geographic area than other resources; please see **Section 3.3.3.3, Cumulative Impacts (Air Quality)**. A discussion of related future actions under concurrent consideration is included in the cumulative impacts analysis for each resource.

Agriculture

Agricultural operations are expected to continue as described above in **Section 3.1.4.1, Related Past and Present Actions, Agriculture**. No related future actions as defined under ARM 17.4.603(7) are known to currently be under consideration by a state agency.

Airport

The M46 airfield is expected to continue to operate as described above in **Section 3.1.4.1, Related Past and Present Actions, Airport**. No related future actions as defined under ARM 17.4.603(7) are known to currently be under consideration by a state agency.

Air Pollutant Sources and Emissions (Active Permits and Applications Only)

Emissions from sources quantified and discussed in **Section 3.3, Air Quality** are expected to continue as described with the following exception.

As described below in **Section 3.1.4.2, Related Future Actions, Mining and Mineral Development**, changes are expected to occur in the operations of the various coal mines in the vicinity of the Project area, leading to changes in emissions and emission sources. No other related future actions as defined under ARM 17.4.603(7) are known to currently be under consideration by a state agency.

Power Plant Operations

Colstrip Power Plant

Colstrip Units 3 and 4 continue to operate, burning coal from Areas A, B, C, and F and the Project area (if permitted). Areas A and C are expected to be mined until 2022, and Area F would be expected to be in production from 2020 through 2038. Area B, as currently permitted, is expected to operate through 2030; see the discussion below under **Section 3.1.4.2, Related Future Actions, Mining and Mineral Development**. Total mine production and delivery to the Colstrip Power Plant is estimated to be around 6 million tons annually for years 2020 through 2029 (Peterson 2020b). No related future actions as defined under ARM 17.4.603(7) are known to currently be under consideration by a state agency.

Rosebud Power Plant

The Rosebud Power Plant is expected to continue operations as described in **Section 3.1.4.1, Related Past and Present Actions, Rosebud Power Plant**, using waste coal from Areas C and B (as currently permitted) through 2022 and 2030, respectively. Waste coal from Area F may be used in the plant until 2038. No related future actions as defined under ARM 17.4.603(7) are known to currently be under consideration by a state agency.

Actions by Federal Land Management Agencies (Active Permits and Applications Only)

Management actions by federal resource agencies such as BLM and the Forest Service are expected to continue as described above in **Section 3.1.4.1, Related Past and Present Actions, Actions by Federal Land Management Agencies**. No related future actions as defined under ARM 17.4.603(7) are known to currently be under consideration by a state agency.

Mining and Mineral Development

Gravel Quarries

Gravel quarry operations are expected to continue in the future as described above in **Section 3.1.4.1, Related Past and Present Actions, Mining**. No related future actions as defined under ARM 17.4.603(7) are known to currently be under consideration by a state agency.

Lease by Modification to Federal Coal Lease MTM 80697

Westmoreland Rosebud has applied to BLM for a lease by modification (LBM) to federal coal lease MTM 80697. The pending LBM includes two tracts in existing permit areas of the Rosebud Mine and would affect 160 acres total. The Area B tract is about 60 acres, and the Area C tract is about 100 acres; both are within the currently approved disturbance boundary but are not currently approved for mining. BLM prepared a Draft Environmental Assessment (EA) for public comment in October 2018 (BLM 2018). If BLM approves the LBM, Westmoreland Rosebud may need to submit a major revision application to DEQ to cover the change to the permit area boundaries to include the modified federal lease areas. This revision may include private coal as well.

Coal Mining and Prospecting at Other Locations in the Region

Existing Coal Mines

The active coal mine closest to the Rosebud Mine, the Absaloka Mine, is expected to continue operating at current levels for the next few years, but would decrease as approved coal removal has been completed. The mine is located in Big Horn County about 8 miles southwest of the Project area.

Two coal mines (Spring Creek and East Decker Mines) currently operating in southeastern Montana are expected to expand their operations. As described above in **Section 3.1.4.1, Related Past and Present Actions, Mining**, both mines are more than 50 miles from the Project area and are not expected to influence or be influenced by the Proposed Action (see **Section 3.3, Air Quality** for discussions related to air quality). Proposed updates to these three mines can be found on DEQ's website: http://deq.mt.gov/Public/ea/coal.

Proposed Coal Mines

No new coal mines are proposed in the vicinity of the Project area. All pending applications are posted to DEQ's website: http://deq.mt.gov/Public/ea/coal.

Permitted Discharges

Permitted discharges for the Rosebud Mine are described above under **Section 2.2.3.2, Discharge Permits** and would continue as described in the future. Others, described above under **Section 3.1.4.1, Related Past and Present Actions, Municipal and Industrial Water Uses and Discharges**, also would continue as described. No related future actions as defined under ARM 17.4.603(7) are known to currently be under consideration by a state agency.

Wildland Fire and Prescribed Burns

Wildland fires and prescribed burns have historically occurred in the vicinity of the Rosebud Mine and are expected to continue to occur.

3.2 TOPOGRAPHY

3.2.1 Introduction

This section provides an overview of the topography within the analysis area and the governing regulatory authorities. The analysis area for topography is defined below in **Section 3.2.1.2, Analysis Area and Methods**.

This section also analyzes the environmental consequences, including the direct, secondary, and cumulative impacts, of the No Action Alternative (Alternative 1) and the Proposed Action (Alternative 2) with respect to topography in the analysis area.

3.2.1.1 Regulatory Framework

Federal Requirements

Because no federally regulated coal would be mined, no federal requirements are related to topography within or near the analysis area.

State Requirements

DEQ regulates permitting and operation of surface coal mines on federal lands within Montana under the authority of MSUMRA (82-4-221 *et seq.*, MCA) and its implementing rules (ARM 17.24.301-1309). ARM 17.24.313 outlines the requirements for postmine reclamation of topography, which must facilitate postmine land uses and hydrologic flow. The postmine topography that Westmoreland Rosebud proposes to meet at final bond release under Alternative 2 is described in **Section 2.4.4.5, Postmining Topography and Drainage Basin Design** and shown in **Figure 9** in **Chapter 2**. A discussion of the reclamation phases as they relate to bond release is provided in **Section 1.6**.

Local Requirements

There are no local requirements related to topography within or near the analysis area.

3.2.1.2 Analysis Area and Methods

Analysis Area

The analysis area for direct and secondary impacts on topography is the 15,153-acre Project area. Within the Project area is an 11,202-acre disturbance area where proposed Project activities would disturb 5,711 acres.

Analysis Methods

Impacts on topography were determined based on the information contained in Westmoreland Rosebud's Application. The Application provided details concerning reclamation activities and changes in topography related to proposed mining and reclamation.

3.2.2 Affected Environment

The analysis area is located in the Pine Breaks region of southeastern Montana on the gently dipping northwest flank of the Powder River Basin, which is part of the unglaciated Missouri Plateau, a division of the Northern Great Plains physiographic province. The topography of this region is characterized by open, high hills, with low to moderate relief. The analysis area topography is shown on **Figure 13**. The mined portions of the analysis area have large topographic changes over relatively short distances. The AM5 portion of the analysis area has not previously been mined and displays a gentle topographic decline to the southeast in the valley areas with steep bluffs overlooking the valleys. Prominent monoliths of eroded sandstone exist in some parts of the Project area. Differential erosion of softer, more erosive materials surrounding harder material such as sandstone and thermally metamorphosed stone (clinker) are responsible for much of the topographic relief in the area. The geomorphic processes have resulted in landforms consisting of recurrent patterns of sandstone- and clinker-dominated ridges, valley slopes, and narrow bands of alluvium with ephemeral and intermittent channels. Surface elevation topographic relief within the Project area ranges from 3,820 feet in the western portion of AM5 to 3,260 feet where Richard Coulee exits the analysis area.

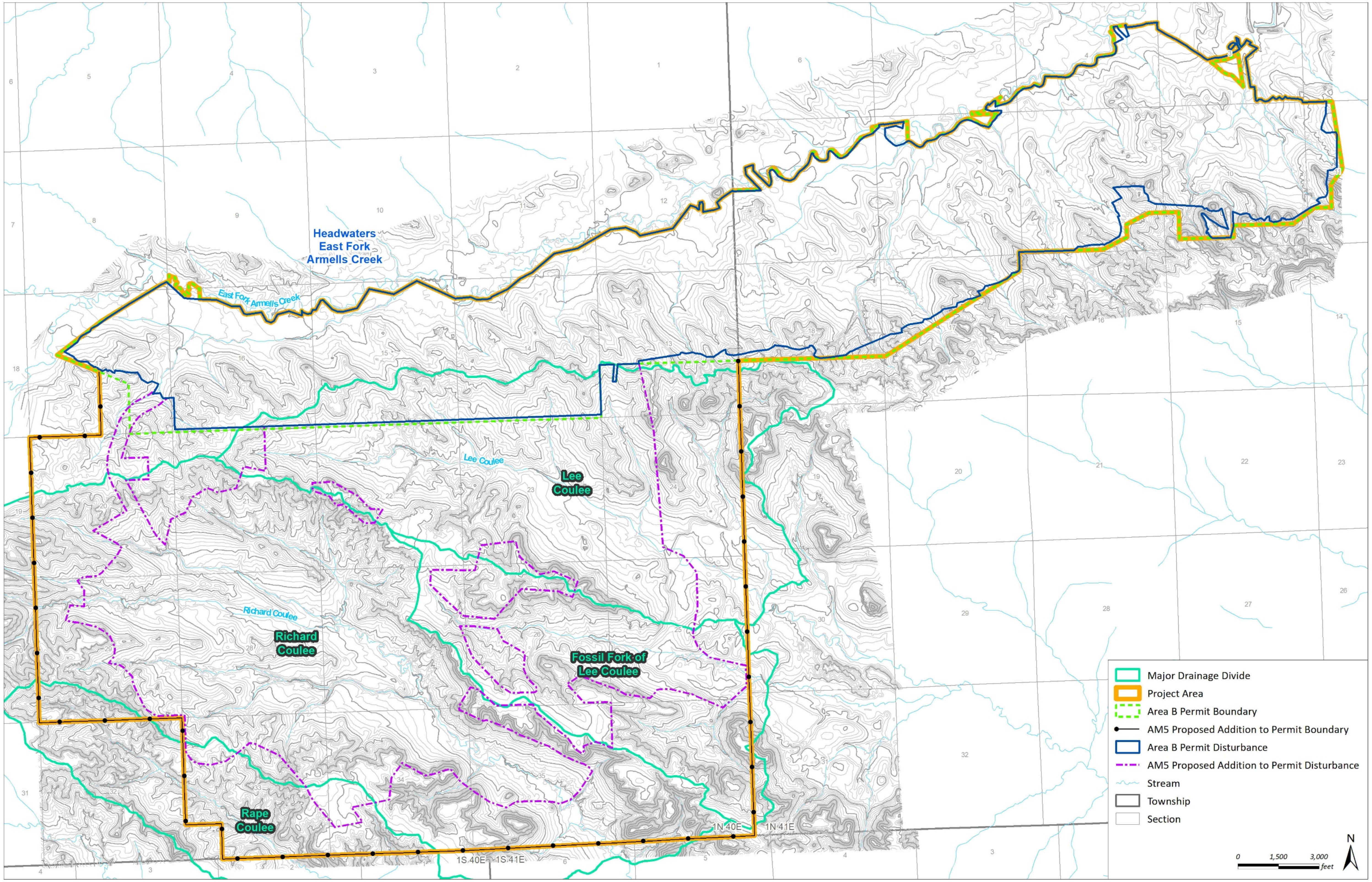

Figure 13. Analysis Area Topography.

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3.2.3 Environmental Consequences

3.2.3.1 Alternative 1 – No Action

Under the No Action Alternative, the AM5 amendment (proposed Project) would not be permitted. Westmoreland Rosebud would complete mining and reclamation in the Area B permit area according to its currently approved operating permit. Mining is permitted in Area B until 2030, and initial stages of reclamation would be completed within 2 years of the cessation of mining. There would be no Project impacts on the pre-mine topography of the analysis area described above in **Section 3.2.2, Affected Environment**, because none of the disturbances associated with development of the Project would occur.

The No Action Alternative would not change the status of the existing Area B permit area or other permit areas, including Area F, of the Rosebud Mine (**Section 2.2, Existing Operating Permits, Disturbance, and Reclamation**), nor would it affect the federal coal lease MTM 80697 (tracts in Areas B and C) modification application, which is currently being evaluated by the Bureau of Land Management (**Section 3.1.4.2, Related Future Actions**). Impacts on topography due to current and future mining and reclamation in the existing Area B permit area and other permit areas of the Rosebud Mine would continue.

3.2.3.2 Alternative 2 – Proposed Action

Direct Impacts

Under the Proposed Action, impacts on topography would occur on 5,711 acres in the analysis area due to disturbance from Project activities; 68 acres in this area have been disturbed previously. During operations, mining would lower the surface elevation, resulting in a steep topographic gradient toward the open pits. Areas of soil and overburden piles would result in an increase in surface elevation where these piles were stored. The impacts on topography during mining would be noticeable in the analysis area. During operations, Westmoreland Rosebud would provide DEQ with an updated topographic map of all existing areas being graded. The topographic map would show the amount of pit advance and the actual graded contours. This map would be included in Westmoreland Rosebud's Annual Report for the Project.

Due to the use of ramp roads and the Area B haul roads in the currently permitted portion of the analysis area to access the AM5 portions for mining, under the Proposed Action reclamation of these areas would be delayed 15 years.

In accordance with the reclamation plan, the postmine landscape of the analysis area would be reclaimed after mining operations to the approximate original contour to facilitate postmine land uses. The postmine topography that Westmoreland Rosebud proposes to meet at final bond release is shown in **Figure 9** in **Chapter 2**. During the final phases of spoil grading, surface drainages would be reconstructed to the approved approximate postmine topography. The postmine topography shows the general topography (ridges, drainages, slopes, etc.) that would serve as Westmoreland Rosebud's grading template for approximating the pre-mine topography. Cross sections would be used to evaluate the blending of undisturbed terrain and disturbed ground to provide a smooth and stable transition in the topography.

Drainage basin design would be based on pre-mine conditions. A pre- and postmine comparative analysis of geomorphic characteristics of the analysis area would be used to determine reclamation recontouring and drainage. Aerial and ground surveys also would be used to evaluate other drainage characteristics, such as channel profiles, drainage patterns, and separation of flow between adjacent drainages. The pre-

mine survey would also ensure that drainages and slope contours are designed and constructed consistent with the approved postmine topography.

During final grading, Westmoreland Rosebud may be able to incorporate additional drainage features to more closely approximate original contours and avoid geomorphic problems including long uniform slopes, inappropriate channel or slope profiles, and inadequate drainage density. Examples of some of the diversity features that Westmoreland Rosebud may be able to include during final grading include additional tributaries, over-steep slopes of various exposures in headwater locations, incised tributary or dry-wash areas, complex side slopes, and other smaller anomalies (i.e., hogbacks and knolls).

Secondary Impacts

The Proposed Action would mix geologically distinct layers into spoil consisting of fragments of sandstone, siltstone, mudstone, and claystone in the analysis area. The resulting fine-grained sediment generated due to the breakdown of these stones into fragments would result in a well-graded mixture of lithified and nonlithified material comprising the material used to backfill the analysis area. Differential erosion of the spoil would include the preferential erosion of the softer stone fragments and nonlithified sediment relative to the harder stone fragments. This would occur first within the created areas of drainage in the backfill and then extend out to the hillsides.

3.2.3.3 Cumulative Impacts

The analysis area for evaluation of cumulative impacts on topography includes all permit areas of the Rosebud Mine, including past and ongoing mining areas. Past and ongoing mining at the Rosebud Mine have resulted in short-term cumulative impacts during mining activities and long-term cumulative impacts on the overall topography due to the removal of geologic outcrops and differences between the pre-mine topography and the postmine topography. Mining in the Project area and future mining of other active permit areas at the Rosebud Mine would result in additional short-term cumulative topographic changes during active mining and long-term cumulative topographic changes after reclamation.

3.2.3.4 Unavoidable Adverse Impacts

Short-term unavoidable adverse impacts on topography would occur during mining as the topography is altered in an effort to mine the coal. After reclamation activities, no unavoidable adverse impacts would be anticipated for topography.

3.2.3.5 Irreversible and Irretrievable Impacts

Alteration of the previously undisturbed pre-mine topography to postmine approximate original contours would be an irreversible impact on analysis area topography.

3.3 AIR QUALITY

3.3.1 Introduction

Operations associated with coal mining, including drilling, blasting, hauling, collection, and transportation, can be sources of emissions and air pollution. This section describes the affected environment with respect to air quality, including the governing regulatory framework, historic and existing emissions, and current regional air quality.

This section also analyzes the environmental consequences including direct, secondary, and cumulative impacts of the No Action Alternative (Alternative 1) and the Proposed Action (Alternative 2) with respect to air quality.

3.3.1.1 Regulatory Framework

The air quality regulations pertaining to the Proposed Action are discussed separately for federal, state, and local requirements in this section. The analysis considers both the regulations governing ambient air quality and the source performance standards and emission limits that apply to the Rosebud Mine. Existing operations at the Rosebud Mine are covered by three Montana Air Quality Permits (MAQPs). AM5 involves permitted activities under MAQP #1483-09, which includes Areas A, B, and D. Area C is permitted under MAQP #1570, and MAQP #4436-01 permits the operation of a portable crusher. With the issuance of the final EIS and ROD for Area F, MAQP #1570-07 was issued to include Area F and, subsequently, the ownership transfer incremented the permit number to MAQP #1570-09. MAQP #1570-08 was issued prior to MAQP #1570-07 due to the delay associated with the Area F EIS. These permits and the Area F application for permit modification (Bison Engineering 2013) were used as the basis for the air quality regulations discussed in this section.

Federal Requirements

Ambient Air Quality Standards

The Clean Air Act (CAA) is a comprehensive federal law that authorizes USEPA to regulate air emissions from stationary and mobile sources and to protect and enhance the air resources of the US. The CAA requires that USEPA set and periodically review and revise National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and welfare. NAAQS exist for seven common air pollutants that are considered harmful (also known as “criteria” air pollutants [CAPs]): carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone (O_3), particulate matter with diameter 2.5 micrometers or less ($PM_{2.5}$), and particulate matter with diameter 10 micrometers or less (PM_{10}). The NAAQS include primary standards for the protection of public health including sensitive populations, such as children and the elderly, and secondary standards for the protection of public welfare, such as preventing decreased visibility and damage to vegetation. The NAAQS are provided in **Table 12**.

Air quality design values are calculated annually for each CAP using ambient monitoring data following the form of the respective NAAQS (provided in the “Form” column of **Table 12**). Design values describe the air quality of a given location relative to the NAAQS and are used to determine compliance and assess progress against the NAAQS. Design values are used by USEPA to designate areas as either attainment or nonattainment for each standard. Areas in which the air quality meets or is below the NAAQS are designated as “unclassifiable/attainment,” while areas that are determined to not meet the NAAQS are

designated as "nonattainment." If there is not enough available information for USEPA to determine the attainment status, the area will be designated as "unclassifiable."

Table 12. National Ambient Air Quality Standards.

Pollutant	Primary / Secondary	Averaging Time	Level	Form
Carbon monoxide (CO)	Primary	8 hours	9 ppm	Not to be exceeded more than once per year
		1 hour	35 ppm	
Lead (Pb)	Primary and secondary	Rolling 3-month average	0.15 μg/m^3	Not to be exceeded
Nitrogen dioxide (NO_2)	Primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Primary and secondary	1 year	0.053 ppm	Annual mean
Ozone (O_3)	Primary and secondary	8 hours	0.070 ppm	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particulate matter ≤ 2.5 μm diameter ($PM_{2.5}$)	Primary	1 year	12.0 μg/m^3	Annual mean, averaged over 3 years
	Secondary	1 year	15.0 μg/m^3	
	Primary and secondary	24 hours	35 μg/m^3	98th percentile, averaged over 3 years
Particulate matter ≤ 10 μm diameter (PM_{10})	Primary and secondary	24 hours	150 μg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur dioxide (SO_2)	Primary	1 hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	Secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

Source: USEPA 2016.
ppm = parts per million.
ppb = parts per billion.
μg/m^3 = micrograms per cubic meter.

Title V Operating Permits

The 1990 amendments to the CAA established the Title V permit program requiring that major stationary sources obtain an operating permit outlining all applicable emission limits, air pollution control requirements, monitoring requirements, and reporting requirements. A major source is defined as any stationary source that emits over 100 tons per year of any regulated air pollutant, 10 tons per year of a single hazardous air pollutant (HAP), or 25 tons per year of all HAPs combined. Some nonmajor sources are also required to obtain a Title V permit (e.g., solid waste incineration units), and lower major source thresholds apply in nonattainment areas. The Rosebud Mine is not designated as a major source under Title V as it is below the potential-to-emit (PTE) criteria for major sources excluding fugitive sources.

New Source Performance Standards

The New Source Performance Standards (NSPS) are established by Section 111 of the CAA (40 CFR 60) and authorize USEPA to develop technology-based performance standards (emission limits) for new or modified sources within defined source categories (USEPA 2013). The NSPS Standards of Performance for Coal Preparation Plants (Subpart Y) is applicable to the stationary coal processing equipment in Area

A and Area C of the Rosebud Mine. Subpart Y defines standards for thermal dryers, pneumatic coal cleaning equipment, coal processing and conveying equipment, coal storage systems, transfer and loading systems, and open storage piles. The expansion to the Project area would not add any new stationary sources subject to NSPS and instead would utilize the existing coal processing facilities in Area A and Area C.

New Source Review Permitting

The New Source Review (NSR) permitting program was established by the 1977 amendments to the CAA and requires a preconstruction permit defining emission limits and required operating procedures for any new or modified stationary source that would result in a significant net increase in emissions of regulated pollutants. There are three separate NSR permitting programs whose applicability depends on the source classification (major or minor) and the attainment status of the area in which the source is being constructed (attainment/unclassifiable or nonattainment). The Prevention of Significant Deterioration (PSD) program and the Nonattainment NSR program apply to new major sources and major modifications in attainment and nonattainment areas, respectively, while the Minor NSR program applies to new minor sources and minor modifications in both attainment and nonattainment areas.

The Rosebud Mine is an attainment area for all CAPs but is not subject to the PSD program as it is not a major source. Additionally, the expansion to the Project area would not result in any increase in emissions from stationary sources.

Hazardous Air Pollutants

Section 112 of the CAA requires USEPA to regulate HAPs, also known as air toxics, that are known or suspected to cause cancer or other serious health impacts (USEPA 2015). There are currently 187 pollutants regulated as HAPs. Emissions of HAPs from specific categories of stationary sources are regulated by the National Emission Standards for Hazardous Air Pollutants (NESHAP) (40 CFR 63). The Rosebud Mine is subject to the general provisions of NESHAP (Subpart A) and the standards for stationary reciprocating internal combustion engines (Subpart ZZZZ).

Visibility and Regional Haze

Visibility impairment, known has regional haze, occurs due to the scattering and absorption of light by fine particles and gases in the atmosphere and is the result of the emissions of numerous air pollution sources over large geographic regions. The Regional Haze Rule (RHR) was promulgated by USEPA in July 1999 to improve visibility and protect against future visibility degradation from manmade air pollution in 156 federal national parks and wilderness areas known as Mandatory Federal Class I areas (40 CFR 51.308). The RHR requires states to develop State Implementation Plans containing reasonable progress goals to improve visibility on the 20 percent most impaired days while ensuring that no degradation occurs on the 20 percent least impaired days. The primary goal of the RHR is to achieve natural visibility conditions (estimated visibility in the absence of manmade emissions) in all Class I areas by 2064.

State Requirements

USEPA has delegated authority to DEQ to administer and enforce the regulations set forth under the CAA; as a result, some of the regulations established by the CAA are directly referenced in the ARMs. For this reason, many of the applicable regulations have already been described under **Federal Requirements**. Individual states have the option to adopt more stringent air quality regulations such as ambient air quality standards. The Montana Ambient Air Quality Standards (MAAQS) include both

standards that are more stringent than the NAAQS in some instances and pollutants that are not included in the NAAQS (ARM 17.8.101-17.8.1713). The MAAQS are provided in **Table 13**, and the corresponding federal NAAQS are provided for comparison where applicable.

The AM5 Project would also be subject to DEQ air quality regulations ARM 17.8.304(2), 17.8.308(2), and 17.8.308(3) relating to fugitive particulate matter emissions. Pursuant to ARM 17-8-304(2), fugitive dust emissions would need to meet an operational visible opacity of standard or 20 percent or less averaged over 6 consecutive minutes. The same 20 percent (6-consecutive-minute) average would apply during the construction of the haul road (ARM 17.8.308(3)). Pursuant to ARM 17.8.308(2), the AM5 Project would also be required to take reasonable precautions to control emissions of airborne particulate matter from haul road operations. MSUMRA further requires that all surface areas associated with Westmoreland Rosebud's operations be stabilized and protected to effectively control air pollution (82-4-231(10)(m), MCA). Operators are required to employ fugitive dust control measures in accordance with 82-4-231(10)(m), MCA; the operator's air quality permit; and applicable federal and state air quality standards (ARM 17.24.761(1) and 17.24.311(1)). Monitoring to evaluate the effectiveness of the fugitive dust control practices must also be conducted (ARM 17.24.761(2)).

Local Requirements

There are no local regulations applicable to air quality.

3.3.1.2 Analysis Area and Methods

Analysis Area

The analysis area for air quality is selected as the area within 50 km of the Area B disturbance boundary as modified by AM5. This analysis area accounts for direct impacts due to mining within the Project area as well as secondary and cumulative impacts such as deposition and secondary formation of ozone and particulate matter in the atmosphere. The analysis area for air quality is shown on **Figure 14**.

Table 13. Montana Ambient Air Quality Standards.

Pollutant	Averaging Time	MAAQS (State)	NAAQS (Federal)	Form of MAAQS
Carbon monoxide (CO)	8 hours	9 ppm	9 ppm	Not to be exceeded more than once over any 12 consecutive months
	1 hour	23 ppm	35 ppm	
Lead (Pb)	Quarterly	1.5 μg/m^3	NA	Not to be exceeded
	Rolling 3-month average	0.15 μg/m^3	0.15 μg/m^3	
Nitrogen dioxide (NO_2)	1 hour	0.30 ppm (300 ppb)	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	1 year	0.05 ppm	0.053 ppm	Annual mean
Ozone (O_3)	1 hour	0.10 ppm	NA	Not to be exceeded more than once over any 12 consecutive months
	8 hours	0.070 ppm	0.070 ppm	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particulate matter ≤ 10 μm diameter (PM_{10})	24 hours	150 μg/m^3	150 μg/m^3	Not to be exceeded more than once per year on average over 3 years
	Annual	50 μg/m^3	NA	3-year average of annual mean not to exceed the standard
Particulate matter ≤ 2.5 μm diameter ($PM_{2.5}$)	24 hours	35 μg/m^3	35 μg/m^3	98th percentile of 24-hour concentrations
	Annual	12.0 μg/m^3	12.0 μg/m^3	3-year average of annual mean not to exceed the standard
Sulfur dioxide (SO_2)	1 hour	0.50 ppm (500 ppb)	75 ppb	Not to be exceeded more than 18 times in 12 consecutive months
	24 hours	0.10 ppm	NA	Not to be exceeded more than once over any 12 consecutive months
	Annual	0.02 ppm	NA	Average over any four consecutive quarters not to exceed the standard
Fluoride in forage	Monthly	50 μg/g	NA	Not to be exceeded
	Grazing season	35 μg/g	NA	
Hydrogen sulfide (H_2S)	1 hour	0.05 ppm	NA	Not to be exceeded more than once over any 12 consecutive months
Settleable PM	30 days	10 g/m^2	NA	Not to be exceeded
Visibility	Annual	3×10^{-5} m^{-1}	NA	Average over any four consecutive quarters not to exceed the standard

Source: DEQ 2017.
ppm = parts per million.
ppb = parts per billion.
μg/m^3 = micrograms per cubic meter.
μg/g = micrograms per gram.
g/m^2 = grams per square meter.
NA = not applicable.

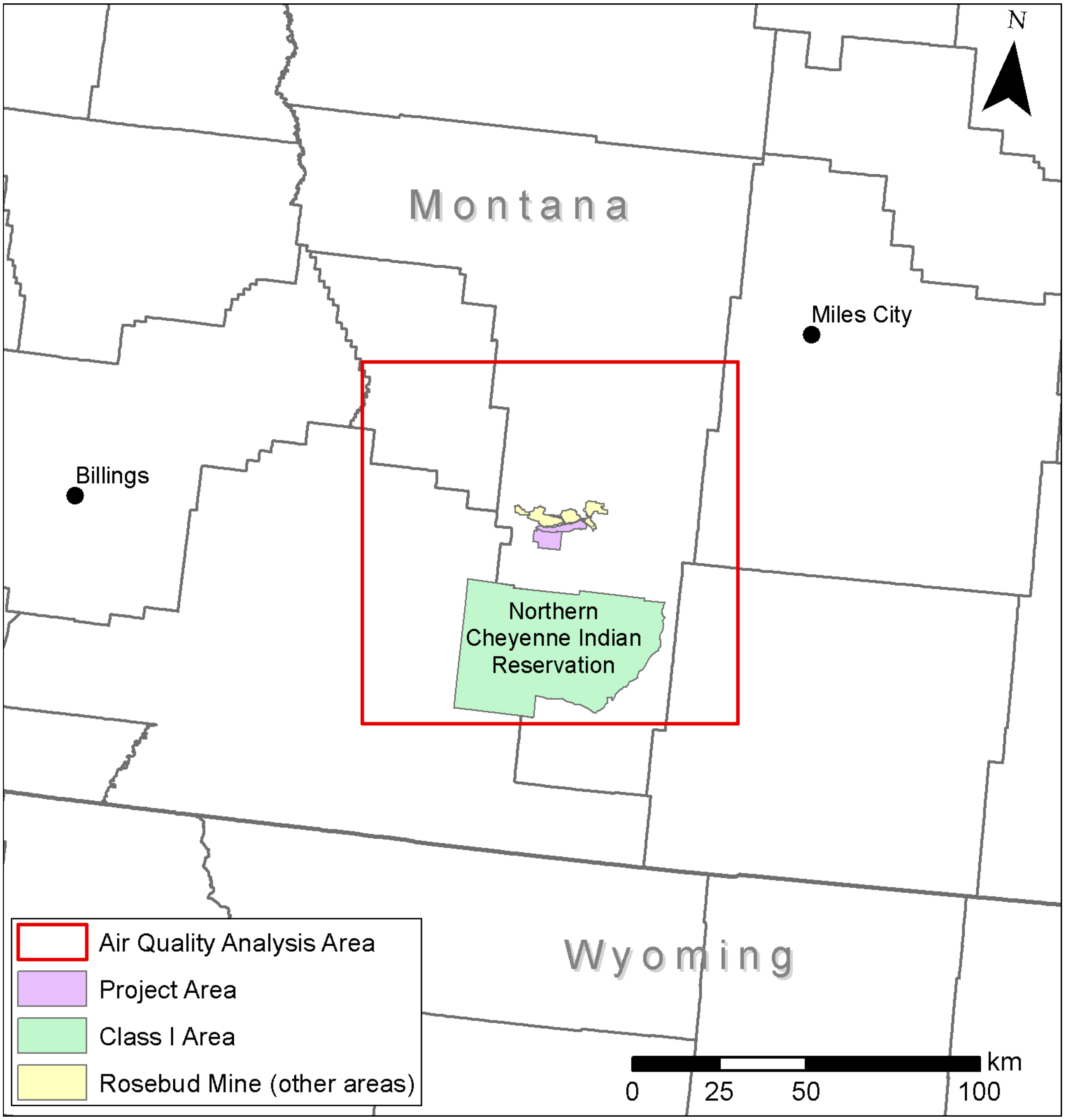


Figure 14. Analysis Area for Air Quality.

Analysis Methods

The existing air quality of the affected environment was used as a baseline and was characterized using air quality monitoring data at the mine and in the greater analysis area. Emissions from existing facilities at the Rosebud Mine and other regional air pollutant sources were also quantified. The environmental consequences and cumulative impacts of the Proposed Action on air quality and air quality related values were estimated for CAPs and HAPs (fugitive coal dust and diesel particulate matter) using air quality modeling analyses conducted for the Area F EIS (OSMRE and DEQ 2018).

The Area F EIS modeling used the Comprehensive Air Quality Model with Extensions (CAMx; www.camx.com), which is a publicly available, state-of-the-science photochemical air quality model with a wide range of uses including rulemaking by the USEPA (e.g., 2015 ozone NAAQS rulemaking and Cross-State Air Pollution Rule), modeling analysis under NEPA, state implementation plans, and air quality research by academia. The model is equipped with source attribution technologies that provide the ability to estimate air quality impacts for each source group and cumulative impacts simultaneously.

The modeling was conducted with CAMx version 6.2 using two rectangular gridded geographical domains at 1 kilometer (km) and 4 km horizontal resolutions. The finer-resolution grid (1 km) covered the Rosebud Mine and its vicinity; the coarser-resolution grid covered a much larger area spanning more than 300 km in all directions from the mine. The model configuration and inputs were the same as the photochemical grid-modeling study previously conducted for the Bureau of Land Management Montana/Dakotas (BLM-MT/DK) State Office, which included an extensive model performance evaluation (BLM 2016b). AM5 was treated as a reasonably foreseeable action and a separate source group in the modeling, and the model results from the air quality analysis area were extracted for this analysis. The forecasted coal production from the existing Area B permit area was treated separately from AM5 and was included in a larger “Other Regional Sources” group, which also included the other existing areas of the mine and other cumulative sources in the larger modeling domain. The Colstrip Power Plant and Rosebud Power Plant were not included in the Other Regional Sources group. Colstrip Units 3 and 4 and the Rosebud Power Plant were modeled as one source group. Colstrip Units 1 and 2 were modeled as a separate source group; it is noted, though, that these two units were retired in January 2020. Area F was also treated as a separate source group.

3.3.2 Characterization of Analysis Area Air Quality

3.3.2.1 Local and Regional Meteorological Patterns

The climate in southeastern Montana is classified as semiarid continental and is characterized by hot, moderately dry summers; cool, dry falls; cold, dry winters; and cool, moist springs. Winter cold spells are often interrupted by the periods of warmer weather. The average monthly temperatures in Colstrip range from a maximum of 88.1 degrees Fahrenheit (°F) in July to a minimum of 9.6 °F in January. The annual average precipitation at Colstrip is 15.09 inches, with the highest monthly average of 2.7 inches in June. Precipitation occurs predominately as snow between November and April; overall, about one-third of the precipitation occurs in the form of snow (Application Appendix C).

Prevailing regional wind patterns are presented on **Figure 15** as measured at Frank Wiley Field Airport in Miles City, Montana, from 2011 to 2015 (DEQ 2016). This station is the closest to the mine (80 km to the northeast) with a complete meteorological dataset, has similar terrain, and is influenced by similar eastern Montana weather patterns. The wind directions are primarily from the west-northwest and south-southeast.

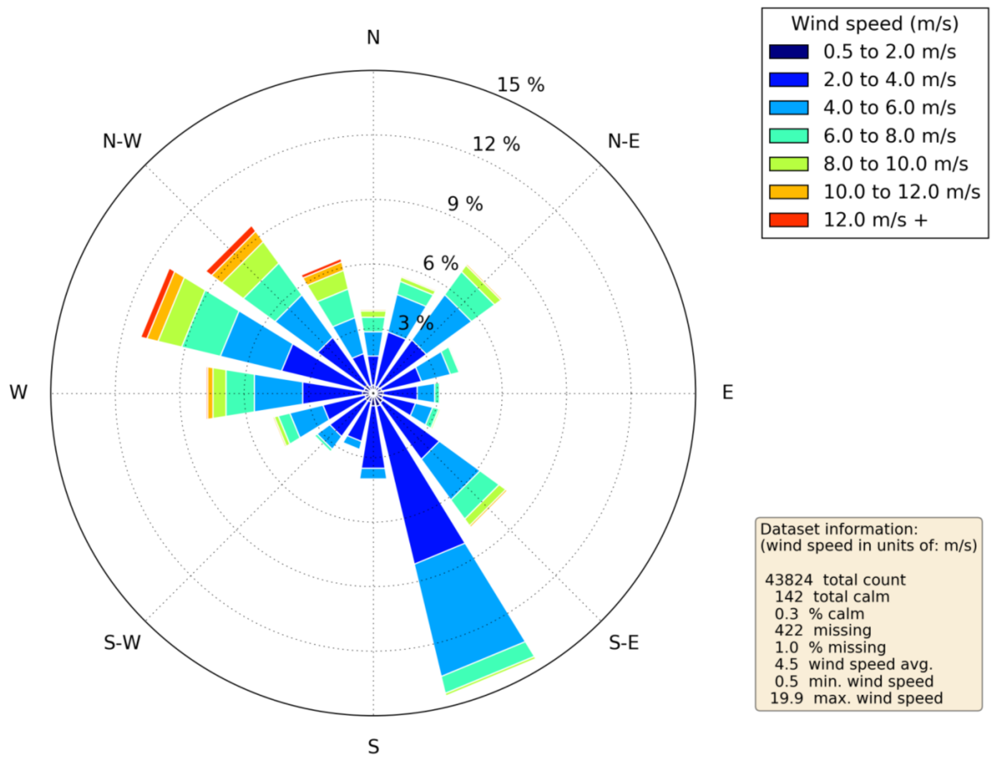


Figure 15. Wind Rose of Frank Wiley Field Airport in Miles City, Montana, for 2011–2015 (m/s = meters per second).

3.3.2.2 Air Quality Monitoring at Rosebud Mine

Western Energy (predecessor to Westmoreland Rosebud) operated seven PM_{10} ambient air quality monitoring sites throughout the Rosebud Mine from 1992 to 2000 until the mine was authorized by DEQ to terminate the network in 2001 after a review of the monitored concentrations (MAQP #1570-06). The highest monitored values from this monitoring period are presented in **Table 14**. The highest observed annual and 24-hour mean PM_{10} concentrations were 14 µg/m^3 and 80 µg/m^3, respectively, which were well below both the NAAQS and the MAAQS (**Table 14**).

Table 14. Air Quality Monitoring PM_{10} Values at the Rosebud Mine from 1992 to 2000.

Pollutant	Averaging Time	NAAQS/MAAQS		Monitored Values (1992–2000)	
		Primary Standard	Secondary Standard	1st High	2nd High
PM_{10}	24-hour	150 µg/m^3	150 µg/m^3	80 µg/m^3 (53% of standard)	78 µg/m^3 (52% of standard)
	annual	50 µg/m^3	—	14 µg/m^3 (28% of standard)	—[a]

Source: Monitoring data from Bison Engineering 2013.
[a] 2nd high not shown because the standard is based on the first high.
µg/m^3 = micrograms per cubic meter.

In 2012, Western Energy deployed two modern real-time Met One Beta Attenuation Monitors to measure PM_{10} at the eastern boundary of Area A and on the northern boundary of Area F (Bison Engineering 2013). The Area F monitor was converted to measure $PM_{2.5}$ in January 2014. The data collected from

these monitors from 2012 through 2016 are shown in **Table 15**, and monitored values are consistently below both the NAAQS and the MAAQS.

Table 15. Monitored PM Concentrations at the Rosebud Mine from 2012 to 2016.

Parameter	Units	Site	2012	2013	2014[1]	2015	2016	NAAQS
PM_{10} 2nd highest 24-hour average	μg/m³	Area A[2]	74	47	57	83	80	150
		Area F	62	28	—	—	—	
PM_{10} annual Average	μg/m³	Area A[2]	18	12	12	15	14	50
		Area F	12	9	—	—	—	
$PM_{2.5}$ 98th percentile 24-hour average	μg/m³	Area F	—	—	12	31	12	35
$PM_{2.5}$ annual average	μg/m³	Area F	—	—	5.1	5.6	3.7	12.0

Source: Monitoring data from Western Energy 2017.
[1] The PM_{10} Beta Attenuation Monitor in Area F was modified to measure $PM_{2.5}$ on January 15, 2014. Therefore, the Area F 2nd highest 24-hour average PM_{10} and annual average PM_{10} are not available for 2014.
[2] Area A PM_{10} data were not available for November and December 2016.
μg/m³ = micrograms per cubic meter.

3.3.2.3 Regional Air Pollutant Sources and Emissions

The major regional sources of air emissions (with greater than 100 tons per year of any CAP) in the analysis area for air quality are the existing areas (combined) of the Rosebud Mine, the Colstrip Power Plant, the Rosebud Power Plant, and the Absaloka Mine. The historical emissions from these facilities are provided and discussed in this section.

Existing Emissions from the Rosebud Mine

The existing Rosebud Mine includes Areas A, B, and D (MAQP #1483-09); Areas C and F (MAQP #1570-09); and a portable crusher used throughout the mine (MAQP #4436-01). Areas A, B, and C are still actively mined, and Area D is no longer actively mined and is being reclaimed. Area E has received full bond release and is no longer a Montana coal mine. Active mining began in Area F in August 2020. Mining and reclamation operations include a number of sources of CAP and HAP emissions. The majority of CAP emissions are from low-level, fugitive dust emission sources. Sources of fugitive dust include:

- Removal, handling, and storage of topsoil
- Drilling, blasting, removal, handling, and storage of overburden
- Drilling, blasting, removal, loading, dumping, crushing, and conveying of coal
- Vehicle traffic on haul and access roads
- Wind erosion of disturbed areas

Westmoreland Rosebud is required to develop and employ a Fugitive Dust Control Plan to minimize fugitive dust emissions from the mine. The control measures include but are not limited to the application of water and chemical dust suppressant on haul and access roads, use of a foam dust-suppression system in coal processing and conveying facilities, prompt revegetation of disturbed areas, and use of an enclosure when drilling coal and overburden before blasting. Other major emission sources at the mine include diesel exhaust emissions from mobile and stationary diesel engines and blasting emissions from the explosives used in coal and overburden blasting.

Annual emissions of CAPs and volatile organic compounds (VOCs) from the existing areas of the Rosebud Mine are shown as reported by DEQ for the period 2010 through 2015 in **Table 16**. VOCs are included as they contribute to the secondary formation of ozone and particulate matter.

Table 16. Historic Criteria Air Pollutant Emissions from the Rosebud Mine.

Year	PM_{10}	$PM_{2.5}$	NOx	SO_2	CO	VOC
	(tons/year)					
2010	1557.7	345.9	200.8	21.5	724.1	1.5
2011	1312.3	263.6	162.2	16.9	569.4	1.5
2012	1307.2	271.9	212.7	22.2	747.1	2.0
2013	1267.1	301.4	200.6	21.1	709.7	1.8
2014	1529.3	358.1	238.9	26.6	894.1	1.0
2015	1514.7	350.4	302.1	33.1	1111.7	1.7
2016	1449.6	331.5	293.4	31.8	1069.8	1.9
2017	1336.0	306.3	288.9	31.1	1047.5	2.0

Source: DEQ Annual Emission Inventory Reporting Records (2010–2017).

The existing areas of the Rosebud Mine are also a source of HAPs with the primary sources being fugitive coal dust sources and diesel engines. Coal dust contains a number of hazardous metals (e.g., antimony, arsenic, chromium, lead, mercury, and selenium), and emission of coal dust suspends these compounds in the air. Suspended fugitive coal dust can impact human health and ecosystems through inhalation or deposition to soil and waterbodies. The use of diesel engines throughout the mine results in the emission of toxic gases and particulates known as diesel particulate matter (DPM). DPM is not currently regulated by USEPA but is considered a carcinogen (USEPA 2002). The emission and resulting air concentrations and deposition of HAPs from existing areas of the mine and Project area are discussed further in **Section 3.3.3, Environmental Consequences**.

Existing Emissions from other Regional Sources in the Analysis Area

The Colstrip Power Plant, Rosebud Power Plant, and Absaloka Mine are the other major sources of air emissions within the analysis area. The Colstrip Power Plant is adjacent to the Rosebud Mine and receives coal directly from the existing areas of the mine via enclosed conveyors. The Rosebud Power Plant is located 6 miles north of the mine and burns waste coal that is transported from the mine via covered haul trucks. The Absaloka Mine is a coal surface mine located to the west-southwest of the Rosebud Mine. **Table 17** presents existing annual CAP emissions from these sources. Two of the four units at the Colstrip Power Plant (Units 1 and 2) were retired in January 2020, so the historic emissions shown for Colstrip represent an upper bound of actual Colstrip emissions.

Table 17. Historic Criteria Air Pollutant Emissions from Other Major Regional Sources.

Year	PM_{10}	$PM_{2.5}$	NOx	SO_2	CO	VOC
	(tons/year)					
Colstrip Power Plant[a]	491	1,570	12,394	8,490	2,123	297
Rosebud Power Plant[a]	9	5	569	798	3	4
Absaloka Mine[b]	458	60	109	21	410	1

[a] Source: DEQ Annual Emission Inventory Reporting Records (2017).
[b] Source: Emission inventory of the Bureau of Land Management Montana/Dakotas modeling study (BLM 2016a).

3.3.2.4 Regional Air Quality

Regional air quality is influenced by the emission, chemical reaction, and transport of air pollutants from both natural and manmade sources. Ambient air quality monitoring networks are deployed throughout the country by USEPA and other federal, state, and local agencies to monitor concentrations of CAPs and other indicators of air quality such as visibility and deposition. The existing air quality in the analysis area

was evaluated by acquiring and evaluating recent ambient monitoring data and analysis from a number of these networks including USEPA's Air Quality Service (AQS), Interagency Monitoring of Protected Visual Environments (IMPROVE) network, National Atmospheric Deposition Program (NADP), and Clean Air Status and Trends Network (CASTNET).

Criteria Air Pollutants

Data from ambient air quality monitors in the analysis area were acquired from USEPA's AQS database for 2011 to 2015 to assess regional air quality. In addition to monitored concentrations, USEPA provides annual reports of design values calculated using monitored site level concentrations. To assess regional air quality, design values were extracted for all AQS sites within the analysis area and compared to the NAAQS. The AQS monitoring sites that are within the analysis area and active between 2011 and 2015 are shown on **Figure 16**. Valid design values (those meeting USEPA completeness requirements) from these sites are shown in **Table 18**. There are no valid design values for PM_{10}, and there are no active AQS CO and Pb monitors in the analysis area. The reported design values for O_3, SO_2, NO_2, and $PM_{2.5}$ from the monitoring sites in analysis area are well below the NAAQS and MAAQS, and although there are no valid PM_{10} design values from AQS monitors in the analysis area, monitoring data from the mine show that PM_{10} concentrations are well below the standards (**Table 14** and **Table 15**). Therefore, the existing air quality in the region of the Proposed Action is generally clean with respect to the NAAQS.

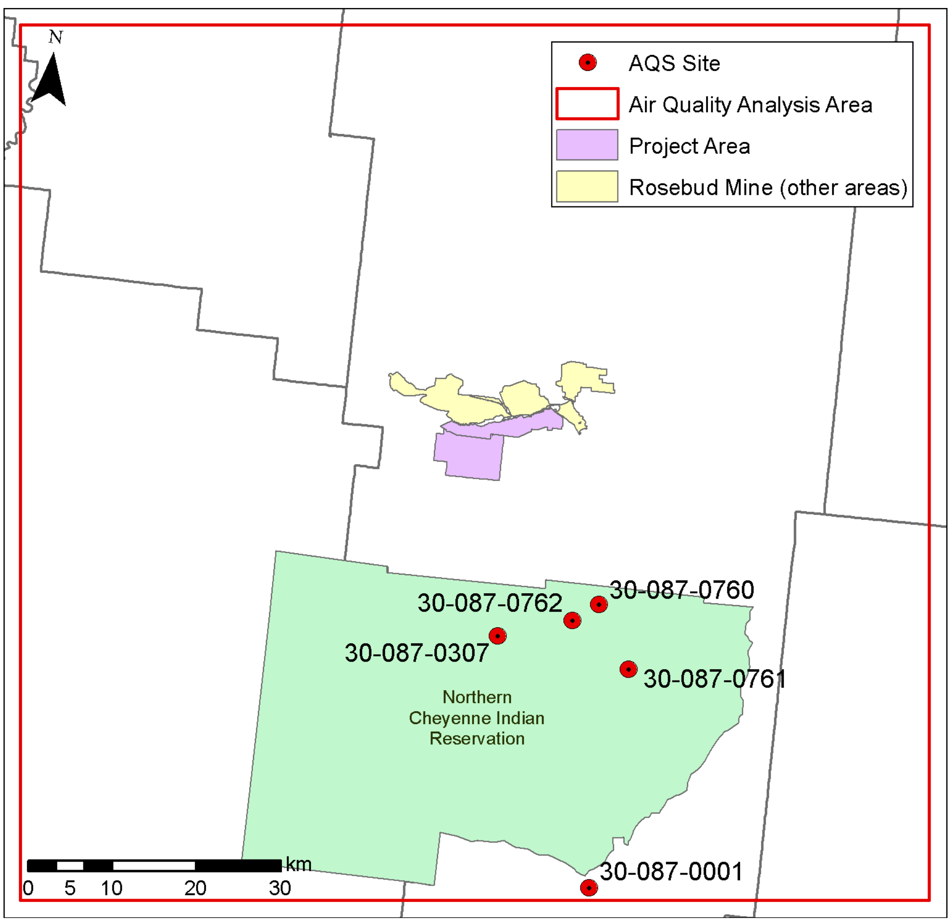


Figure 16. Criteria Air Pollutant Monitoring Sites in the Analysis Area.

Table 18. Historic Criteria Air Pollutant Design Values in the Analysis Area.

Pollutant and Metric	Units	AQS Site ID	2011	2012	2013	2014	2015	NAAQS Standard	Design Value Meets NAAQS
O_3, 4th highest daily maximum 8-hour concentration	ppm	30-087-0001	--	0.056	0.055	0.056	0.055	0.070	Yes
NO_2, 98th percentile 1-hour daily maximum	ppb	30-087-0001	--	--	--	7	--	100	Yes
		30-087-0761	--	--	46	--	--		Yes
		30-087-0762	--	--	--	--	--		Yes
NO_2, annual mean	ppb	30-087-0001	0	1	1	1	0	53	Yes
		30-087-0760	1	2	2	--	--		Yes
		30-087-0761	3	1	2	--	--		Yes
		30-087-0762	3	2	2	--	--		Yes
$PM_{2.5}$, 98th percentile of 24-hour concentration	μg/m³	30-087-0001	--	--	--	20	19	35	Yes
$PM_{2.5}$, annual mean	μg/m³	30-087-0001	--	--	--	5.8	5.4	12.0	Yes
SO_2, 1-hour daily maximum	ppb	30-087-0760	13	12	12	--	--	75	Yes
		30-087-0761	--	--	12	--	--		Yes
		30-087-0762	12	11	10	--	--		Yes

Source: https://www.epa.gov/air-trends/air-quality-design-values.
ppm = parts per million.
ppb = parts per billion.
μg/m³ = micrograms per cubic meter.
-- = design value is not valid (does not meet USEPA completeness requirements).

Attainment Status

The Project area is designated as attainment/unclassifiable for all NAAQS by USEPA. Within the analysis area for air quality, there is one nonattainment area located in Lame Deer, Montana, south of the Project area. This nonattainment area was designated as a "moderate" PM_{10} nonattainment area on November 15, 1990, and is a federal nonattainment area outside Montana jurisdiction.

Visibility and Regional Haze

The Northern Cheyenne IMPROVE site is present in the analysis area (collocated with the other monitors at AQS Site 30-087-0762 shown on **Figure 16**). However, this site does not provide information on a federally mandated Class I area as part of the Regional Haze Rule. Also, the state of Montana has no authority relative to the IMPROVE monitor or Regional Haze Rule at this site. Therefore, the visibility data provided below are only for information. The visibility trend at this site for 20 percent haziest and 20 percent clearest days is shown on **Figure 17** along with the natural conditions on these days. There is no apparent specific trend in visibility since monitoring began in 2003. The visibility on the haziest days peaked during 2012, but the haze index for all other years lies in the range of 3 to 12 deciviews (dv) over the natural conditions on the haziest days. The visibility on the clearest days is relatively constant among years and ranges between 1 and 3 dv over natural conditions.

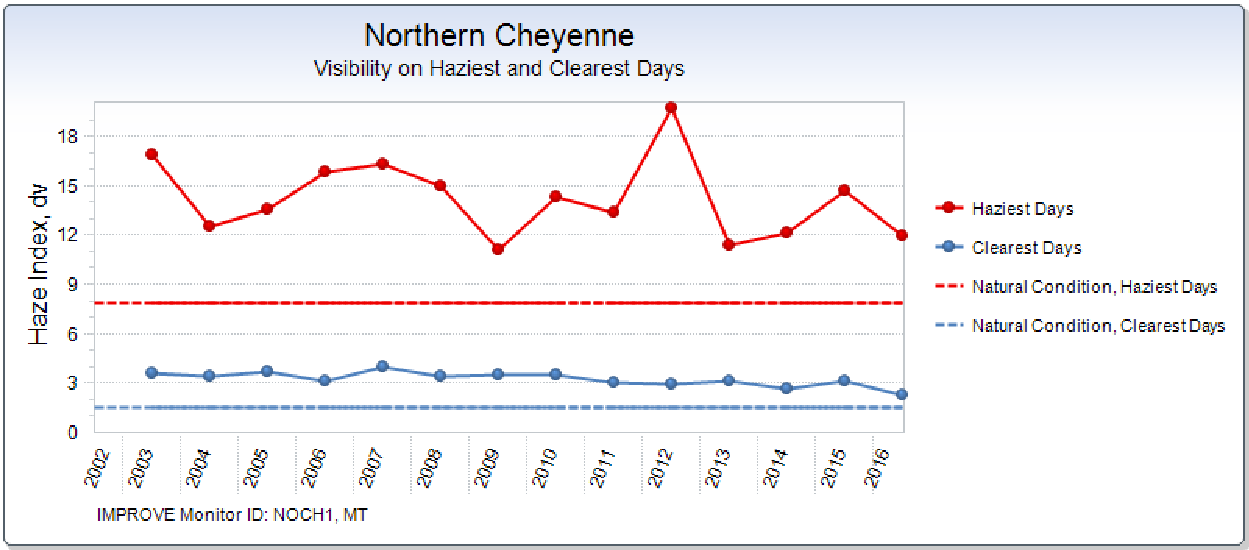


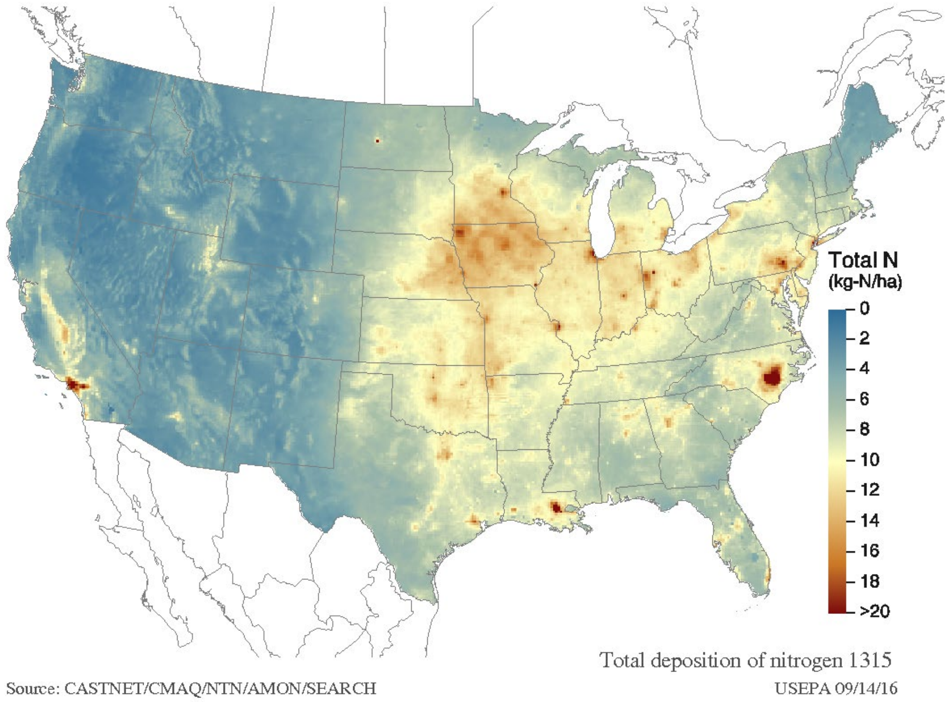
Figure 17. Visibility Extinction on Northern Cheyenne Indian Reservation.

Source: http://vista.cira.colostate.edu/Improve/.
dv = deciviews.

Atmospheric Deposition

Atmospheric deposition is an atmospheric removal process by which pollutants such as nitrogen and sulfur compounds are transferred from the gas phase to surfaces such as vegetation and waterbodies. Wet deposition occurs in the presence of precipitation, whereas dry deposition occurs without it. Both types of deposition can negatively affect ecosystems, and impacts often occur far downwind from pollution sources. Acid rain refers to the deposition of acidic particles and gases, such as sulfuric acid and nitric acid, formed from the atmospheric reaction such as NOx and SO_2 with atmospheric oxidants such as hydroperoxyl (HO_2) radicals. The deposition of these acidic particles and gases can damage ecosystems through acidification of sensitive soil and waterbodies.

Deposition is monitored across the U.S. by various networks. The NADP manages the National Trends Network (NTN), which has continuously monitored wet deposition since 1978 to quantify and understand trends in precipitation chemistry and acid rain. CASTNET was established in 1991 to measure ambient concentrations of sulfur, nitrogen, and ozone concentrations, which are used to determine long-term trends of acidic dry deposition. There are not any NTN or CASTNET sites within the analysis area for air quality, but the NADP Total Deposition Science Committee provides estimates of total sulfur and nitrogen deposition using a combination of monitoring data and model data (NADP 2016). Maps of the estimated mean total (wet and dry) nitrogen and sulfur deposition in 2015 are shown on **Figure 18**. Overall, total acid deposition in the analysis area is generally lower than the deposition in urban areas and the eastern U.S.



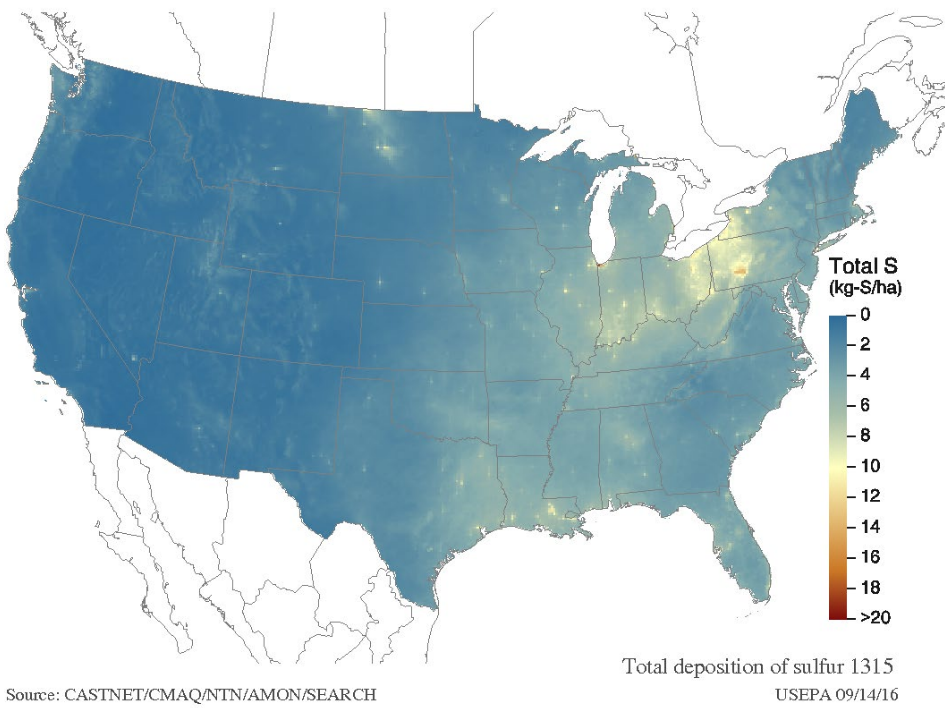


Figure 18. Total Mean Nitrogen and Sulfur Deposition (Wet + Dry) from 2013 to 2015.

3.3.3 Environmental Consequences

The direct, secondary, and cumulative impacts of the Proposed Action on air quality in the analysis area are discussed in this section. Direct impacts on air quality are changes in the ambient concentrations of CAPs and HAPs resulting from the emission of these pollutants from operations associated with the mining, processing, and handling of Project area coal and reclamation of disturbed areas. Secondary impacts on air quality are the result of the atmospheric reaction of direct air emissions downwind. Secondary impacts include the atmospheric formation of ozone from NOx and VOC emissions, secondary PM formation and deposition from NOx and SO_2 emissions, and impacts on visibility. Cumulative impacts are the collective impacts on air quality in the analysis area due to emissions from past, present, and future actions from both state and nonstate sources of air pollution.

3.3.3.1 Alternative 1 – No Action

Under the No Action Alternative, Westmoreland Rosebud's proposed fifth amendment (AM5) to the Area B operating permit and the air quality permit would not be approved by DEQ, and current Area B operations would proceed as currently permitted. Air emissions from the other existing areas of the mine and other regional sources in the analysis area would also continue (see **Section 3.3.2.3, Regional Air Pollutant Sources and Emissions**). As the No Action Alternative would not result in any change of emission sources or air quality impacts, the air quality conditions in the analysis area would remain as described in **Section 3.3.2, Characterization of Analysis Area Air Quality**.

3.3.3.2 Alternative 2 – Proposed Action

The Proposed Action would expand the Area B permit area by 9,108 acres and extend active mining until 2045. Direct and secondary air quality impacts would occur as a result of the emission of air pollutants from mining and reclamation operations. Fugitive dust generating activities such as topsoil and overburden removal and handling, coal removal and processing and transport, blasting of coal and overburden, travel on unpaved haul and access roads, and wind erosion of disturbed areas would be the primary source of PM emissions. Vehicle exhaust would also be a source of PM emissions as well as gaseous emissions of NOx, SO_2, CO, and VOC. Explosives use in coal and overburden blasting would result in gaseous emissions of NOx, SO_2, and CO.

Direct Impacts

Project Area Criteria Air Pollutant and Precursor Emissions

Emissions of CAPs and VOCs (which are precursors to secondary ozone and $PM_{2.5}$) were estimated using the PTE values provided in the emission inventory of MAQP #1483-09 (previously #1483-08). The PTE includes all emissions from Areas A, B, and D and is based on the permitted maximum annual coal production of 13 million tons per year from all areas. Of these areas, Areas A and B are still actively mined, while Area D is undergoing reclamation. Area E has received full bond release and is no longer a Montana coal mine. Note that all of the aforementioned areas, as well as Areas C and F, are discussed under **Section 3.3.3.3, Cumulative Impacts**. Direct emissions from sources associated with mining (overburden drilling, overburden blasting, overburden removal, haul roads, access roads, coal drilling, coal blasting, coal removal, coal dumping, coal crushing, conveyors, and vehicle exhaust) were estimated by apportioning the total PTE for all areas in MAQP #1483-09 (previously #1483-08) using the ratio of the maximum projected coal production from the Project area (estimated at 6,349,170 tons per year prior to the retirement of Colstrip Units 1 and 2) to the total maximum permitted coal production (13 million tons per year). Note that the maximum projected coal production from the Project area after the closure of Colstrip Units 1 and 2 is lower than that modeled and, therefore, the results presented below represent a

conservative overestimate of the impacts of emissions from the Proposed Action. Fugitive dust emissions from topsoil handling and wind erosion were apportioned using surface area because these emissions would occur in both the actively mined areas and the areas undergoing reclamation.

The PTE was quantified only for total PM emissions and the sum of gaseous emissions from vehicle exhaust and explosives. PM_{10} and $PM_{2.5}$ emissions were estimated from the total PM using the assumed ratios of PM_{10}/PM and $PM_{2.5}$/PM used in the air quality permit for Rosebud Mine Area C (MAQP# 1570-08) and the Area F permit modification application (Bison Engineering 2013). Gaseous emissions from vehicle exhaust and explosives were estimated from the total PTE using the ratio of the source-specific gaseous emissions to total gaseous emissions from the Area F permit modification application (Bison Engineering 2013). Estimated direct CAP emissions for the Project area are provided in **Table 19**.

Table 19. Estimated Project Area Criteria Air Pollutant Emissions.

Emission Source(s)	PM_{10}	$PM_{2.5}$	NOx	CO	SO_2	VOC
	(tons / year)					
Topsoil removal	35.45	3.55	----	----	----	----
Overburden drilling	0.45	0.04	----	----	----	----
Overburden blasting – cast blasting	0.53	0.03	----	----	----	----
Overburden removal	83.03	7.34	----	----	----	----
Haul roads – travel	23.46	2.33	----	----	----	----
Access roads – unpaved	24.24	2.42	----	----	----	----
Wind erosion	79.18	7.92	----	----	----	----
Coal drilling	0.20	0.02	----	----	----	----
Coal blasting	1.09	0.06	----	----	----	----
Coal removal	2.23	0.41	----	----	----	----
Coal dumping	1.42	0.22	----	----	----	----
Coal crushing	3.81	0.38	----	----	----	----
Conveyors	22.45	3.10	----	----	----	----
Vehicle exhaust	17.88	17.88	162.56	63.23	0.65	18.07
Explosives – overburden	----	----	17.97	106.34	7.48	----
Explosives – coal	----	----	36.80	217.74	15.32	----
Total	**295.44**	**45.70**	**217.34**	**387.30**	**23.44**	**18.07**

Project Area Hazardous Air Pollutant Emissions

Mining and associated operations in the Project area would result in the emission of HAPs. Coal contains a number of HAPs, and processes associated with the mining, processing, and transport of Project area coal would result in the emission and suspension of HAP-containing fugitive coal dust. Sources of fugitive coal dust in the Project area include coal drilling, coal blasting, coal removal, coal dumping, coal crushing, and coal conveyors. Project area emissions of HAPs in coal dust were estimated using PM_{10} emissions from fugitive coal dust sources (**Table 19**) and the average concentrations of trace metal HAPs in AM5 coal as measured by PPL Montana (2014). The concentrations of trace metal HAPs in Project area coal are provided in **Table 20** along with estimated annual emission rates. PPL Montana also measured trace metal HAP concentrations in a mixture of Area A and Area B coal, but the AM5 specific concentrations were used as they had a larger sample size and were more conservative for all measured HAPs except manganese, for which the AM5 average concentration was 98.4 percent of the average concentration of Areas A and B.

Table 20. Project Area Trace Metal HAP Emissions from Fugitive Coal Dust.

Metal HAP	Concentration in AM5 Coal[1] (ppm)	HAP Emissions (lbs/year)
Antimony	0.49	3.06E-02
Arsenic	1.71	1.07E-01
Beryllium	0.53	3.31E-02
Cadmium	0.06	3.74E-03
Chromium	4.07	2.54E-01
Copper	6.73	4.20E-01
Lead	3.99	2.49E-01
Manganese	79.35	4.95E+00
Mercury	0.07	4.37E-03
Nickel	2.72	1.70E-01
Selenium	0.68	4.24E-02

ppm = parts per million.
lbs/year = pound(s) per year.
[1] HAP concentration is the moisture-corrected average value from 67 samples of AM5 coal (PPL Montana 2014).

Diesel equipment used throughout the Project area would also be a source of HAPs. Diesel exhaust contains both gases and fine particles, and DPM is considered a carcinogenic air toxic (USEPA 2002). Potential Project area DPM emissions were estimated to be 17.88 tons per year, which is equivalent to the total $PM_{2.5}$ emissions from vehicle exhaust (**Table 20**).

Direct Impacts on Criteria Air Pollutants

Direct impacts on ambient concentrations of CAPs are discussed in this section with the exception of O_3 and Pb, which are discussed in the **Secondary Impacts** and **Direct Impacts on Hazardous Air Pollutants** sections, respectively. The analysis leverages modeling performed for the Area F EIS (OSMRE and DEQ 2018; see **Analysis Methods** in **Section 3.3.1.2, Analysis Area and Methods**). In the Area F EIS, emissions from the existing Area B permit area and the AM5 expansion area were modeled separately using area-specific coal production forecasts provided by Western Energy (Peterson 2017). Western Energy provided coal production forecasts through 2031, and the maximum annual projected coal production rates for each area were used in modeling. The modeled coal production rates for AM5 and the existing Area B permit area were 4,876,270 tons/year and 1,472,900 tons/year, respectively, which together is equivalent to the total maximum coal production projected for the Project area. Note that the production rates modeled are higher than actual projections of production rates following the retirement of Colstrip Units 1 and 2 and, therefore, as noted above, the results presented here represent a conservative overestimate of the impacts of emissions from the Proposed Action. In the Area F EIS modeling, AM5 was treated as a separate source group, while the existing Area B permit area was included in a larger cumulative source group ("Other Regional Sources," which also includes other existing areas of the mine and all other cumulative sources except the Colstrip Power Plant and Rosebud Power Plant). For this reason, modeled impacts from AM5 are available directly, while modeled impacts from emissions within the rest of the Area B permit area are discussed in the context of other regional sources and cumulative impacts. Moreover, the total direct impacts on air quality from the Project area are also estimated by scaling the modeled impacts from AM5 using the ratio of total coal production from the Project area to the modeled coal production from AM5 (6,349,170 tons per year / 4,876,270 tons per year = 1.3). As noted above, the coal production from AM5 would be likely lower and, therefore, the results presented below are a conservative overestimate of impacts.

Figure 19 through **Figure 23** present the spatial distribution of direct impacts on NO_2, SO_2, $PM_{2.5}$, and PM_{10} within the analysis area for air quality. Impacts were calculated and are shown in the form of the NAAQS and MAAQS. Results from both the fine (1 km resolution) and coarse (4 km resolution) modeling domains within the analysis area are shown. All references to maximum impacts refer to the 1-

km resolution modeling domain (and not the 4-km domain) because modeled impacts at the 1-km resolution are always greater than or equal to the maximum impact in the 4-km resolution domain. The coarse domain is provided to show the spatial extent of the impacts.

The maximum impacts due to emissions from AM5 on the eighth highest 1-hour daily maximum and annual average ambient NO_2 concentrations are 29.7 ppb and 1.4 ppb, respectively, and occur within the Project area (**Figure 19**). Impacts are smaller outside the Project area and drop further with increasing distance from the mine. The maximum spatial impacts for the eighth highest 1-hour daily maximum and annual average concentrations from the Other Regional Sources source group that includes the coal production in the existing Area B permit area are 34.6 ppb and 2.3 ppb, respectively, and both occur within Area C of the Rosebud Mine (see **Section 3.3.3.3, Cumulative Impacts**). The direct impacts from Area B comprise only a small fraction of the impacts from Other Regional Sources as this source group also includes the other existing areas of the mine and other major regional sources. The total maximum direct impacts from emissions from the Project area are also estimated by scaling the modeled AM5 impacts using the ratio of the total Project area coal production to modeled coal production in AM5. Using this approach, the estimated total maximum impacts due to the direct impacts of the Proposed Action on the eighth highest 1-hour daily maximum and annual average NO_2 concentrations are 38.7 ppb and 1.8 ppb, respectively. The modeled cumulative concentrations of 1-hour and annual average NO_2 from all sources (including the Project area, Area F, and all other regional emission sources outside the Rosebud Mine) are 41.4 ppb and 4.3 ppb and are well below both the NAAQS and MAAQS (see **Section 3.3.3.3, Cumulative Impacts**).

Impacts on ambient SO_2 from AM5 emissions are localized and are primarily within or near the mine. The maximum impacts from AM5 emissions to the fourth highest 1-hour average daily maximum, second highest 3-hour average, second highest 24-hour average, and annual average SO_2 are 15.2 ppb, 9.3 ppb, 1.4 ppb, and 0.1 ppb, respectively, and are all well below the NAAQS and MAAQS (**Figure 20** and **Figure 21**). The maximum impacts occur within AM5 in all cases except for the 24-hour average SO_2, for which the maximum occurs directly south of the AM5 boundary. As discussed in **Section 3.3.3.3, Cumulative Impacts**, the impacts from the Other Regional Sources source group on SO_2, for which emissions from production in the existing Area B permit area comprise only a small fraction, are lower than the direct impacts for all forms of the NAAQS and MAAQS. Scaling the modeled impacts from AM5 emissions using the ratio of total Project area coal production to the modeled AM5 coal production results in estimated maximum total direct impacts on ambient SO_2 of 19.8 ppb, 12.1 ppb, 1.8 ppb, and 0.1 ppb for the fourth highest 1-hour average daily maximum, second highest 3-hour average, second highest 24-hour average, and annual average SO_2, respectively. The maximum modeled cumulative SO_2 concentrations from all sources are all well below the NAAQS and MAAQS with the maximum cumulative concentration relative to the standard being the fourth highest 1-hour SO_2 concentration of 33.2 ppb, which is less than 50 percent of the 1-hour SO_2 NAAQS (75 ppb).

Impacts on ambient concentrations of $PM_{2.5}$ and PM_{10} from AM5 emissions occur within and near the mine and are below the NAAQS and MAAQS. The maximum impacts from AM5 emissions on 24-hour average and annual average $PM_{2.5}$ are 2.6 $\mu g/m^3$ and 0.7 $\mu g/m^3$, respectively, and occur within the AM5 mine area (**Figure 22**). The modeled $PM_{2.5}$ impacts include both the $PM_{2.5}$ emitted from operations at the mine and the secondary $PM_{2.5}$ formed through atmospheric reactions of SO_2, NOx, and VOC emissions from AM5. Impacts from AM5 emissions outside the mine boundary are less than 1.6 $\mu g/m^3$ and 0.5 $\mu g/m^3$ for the 24-hour average and annual average, respectively, and decrease with increasing distance from the mine. The maximum $PM_{2.5}$ impacts from the Other Regional Sources source group are 7.8 $\mu g/m^3$ and 3.3 $\mu g/m^3$ for the 24-hour and annual average $PM_{2.5}$, respectively, and also occur within Area C. The total maximum direct impacts on the 24-hour and annual average $PM_{2.5}$ estimated by scaling the modeled AM5 impacts are 3.4 $\mu g/m^3$ and 0.9 $\mu g/m^3$, respectively. The maximum cumulative concentrations

accounting for all sources are 11.9 µg/m^3 and 5.9 µg/m^3 for the 24-hour average and annual average $PM_{2.5}$ and are well below the NAAQS and the MAAQS (see **Section 3.3.3.3, Cumulative Impacts**).

The direct impacts of AM5 emissions on PM_{10} are shown on **Figure 23**. The spatial patterns of the AM5 impacts are similar to those of $PM_{2.5}$ with localized impacts within and around AM5. The maximum impacts due to AM5 emissions on the second highest 24-hour average PM_{10} and annual average PM_{10} are 12.6 µg/m^3 and 4.0 µg/m^3, respectively, and both maximums occur within the AM5 boundary. Concentrations outside the AM5 permit area are less than 7 µg/m^3 for the second highest 24-hour average PM_{10} and 3 µg/m^3 for the annual average PM_{10}. As discussed in **Section 3.3.3.3, Cumulative Impacts**, the maximum impacts on PM_{10} from the Other Regional Sources are 70.0 µg/m^3 for the second highest daily average and 24.6 µg/m^3 for the annual average PM_{10} with both maxima occurring within Area C of the Rosebud Mine. The estimated total maximum direct impacts on the second highest 24-hour average PM_{10} and annual average PM_{10} (estimated by scaling modeled AM5 impacts with the ratio of the total Project area to the modeled AM5 coal production) are 16.4 µg/m^3 and 5.2 µg/m^3. The maximum cumulative concentrations from all sources of the second highest 24-hour and annual average are 84.1 µg/m^3 and 31.2 µg/m^3, respectively, which are well below both the NAAQS and the MAAQS.

Impacts for CO are discussed in **Section 3.3.3.3, Cumulative Impacts**. Cumulative CO concentrations from all sources are well below the NAAQS and MAAQS.

In addition to the CAPs regulated under the NAAQS, the MAAQS include standards for settleable PM, H_2S, fluoride in forage, and visibility. The settleable PM MAAQS was implemented for coarse particles (larger than PM_{10}), and impacts are expected to be minimal as permitting and enforcement measures are in place in the mine to prevent excess PM generation in the Project area. H_2S and fluoride emissions from the Project area are negligible; thus, minimal impacts are expected. The MAAQS for visibility is applicable only in federal and Tribal Class I areas. Northern Cheyenne is the only Class I area in the analysis area for air quality, and modeled visibility impacts due to Project emissions are shown to be negligible in the **Secondary Impacts on Air Quality Related Values** section.

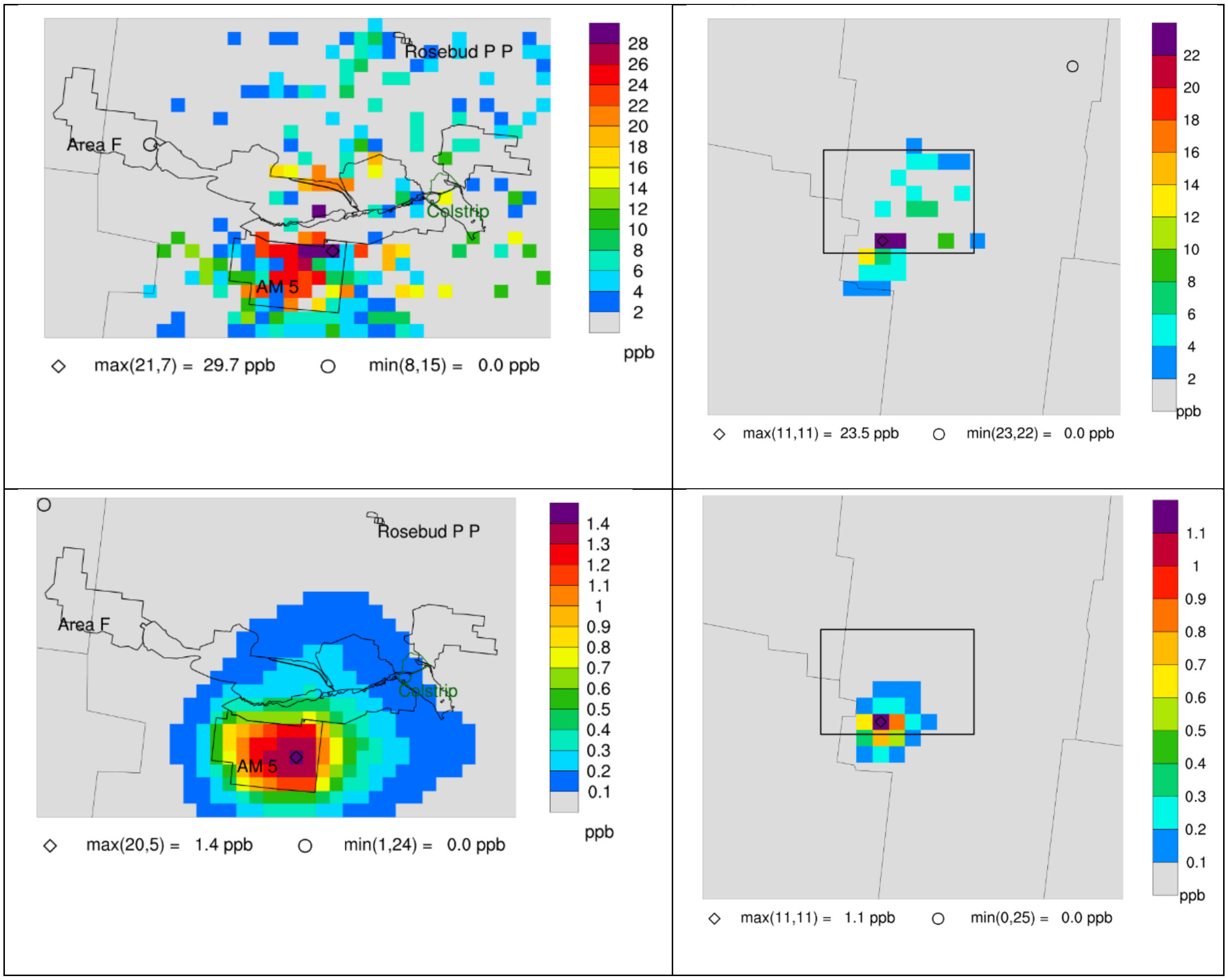


Figure 19. Impacts on the Eighth Highest 1-Hour Daily Maximum NO_2 (Top) and Annual Average NO_2 (Bottom) Air Concentrations Due to Emissions from the AM5 Expansion Area within the 1 km (Left) and 4 km (Right) Resolution Air Modeling Domains.

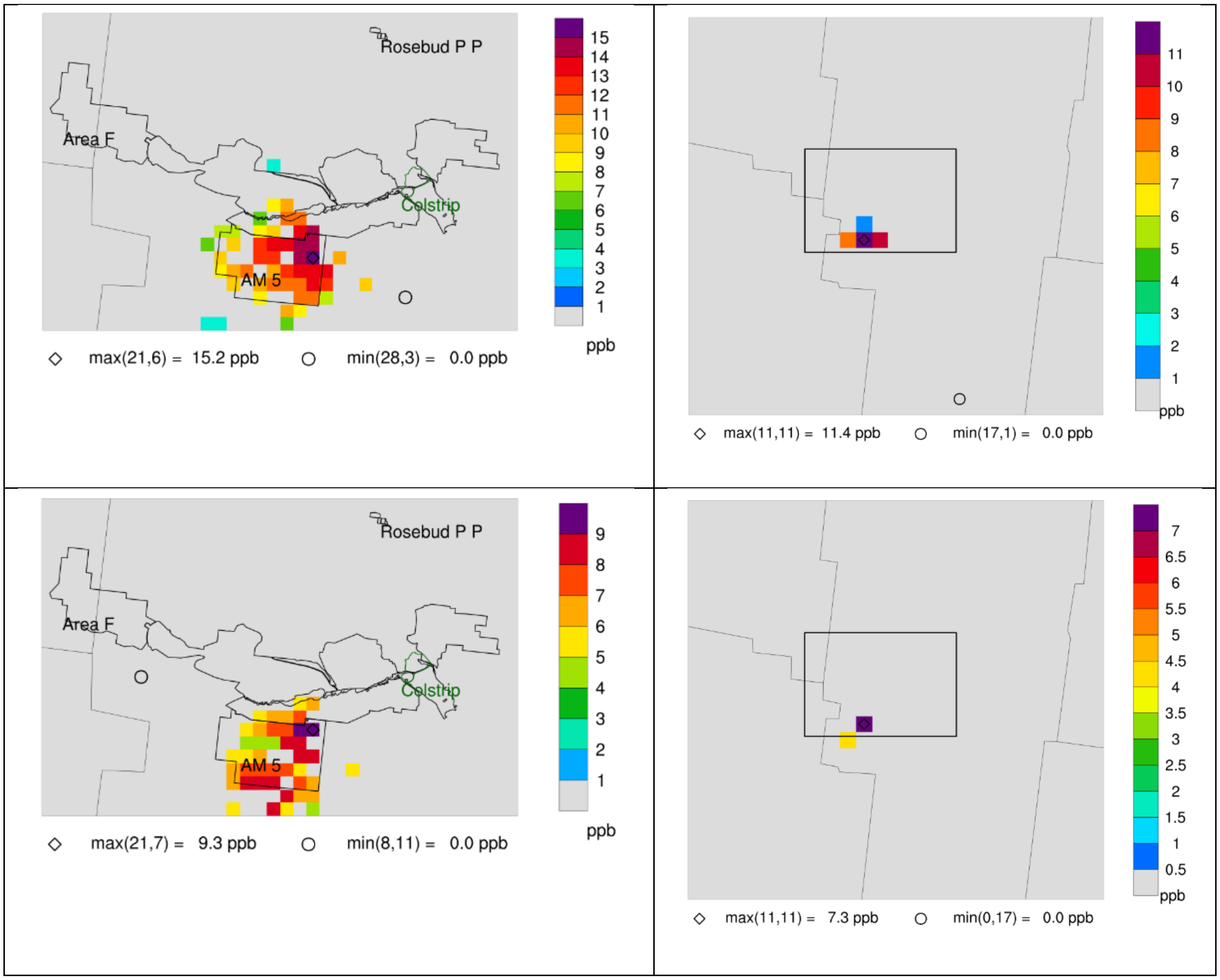


Figure 20. Impacts on the Fourth Highest 1-Hour Daily Maximum SO_2 (Top) and Second Highest 3-Hour SO_2 (Bottom) Air Concentrations Due to Emissions from the AM5 Expansion Area within the 1 km (Left) and 4 km (Right) Resolution Air Modeling Domains.

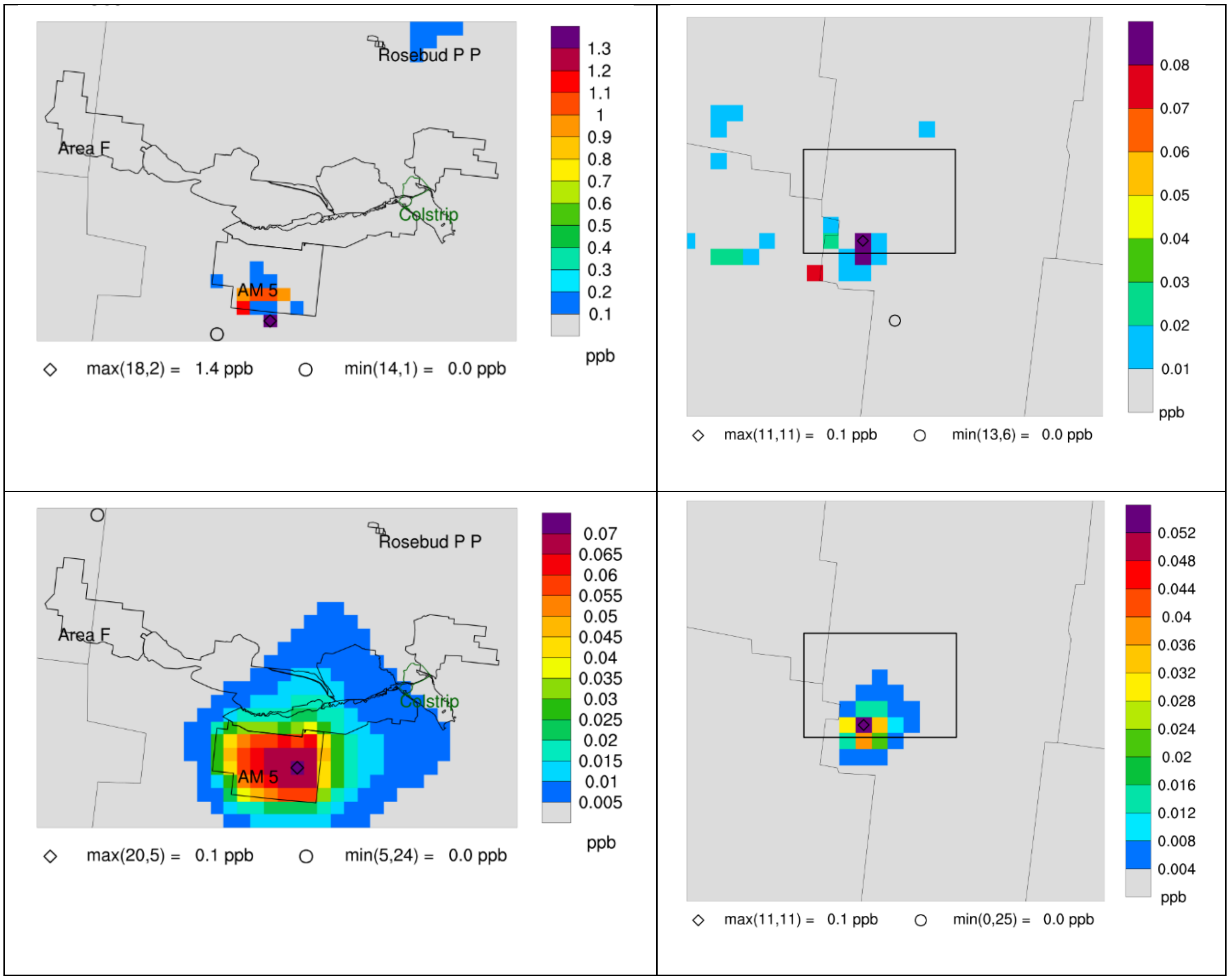


Figure 21. Impacts on the Second Highest 24-Hour SO_2 (Top) and Annual Average SO_2 (Bottom) Air Concentrations Due to Emissions from the AM5 Expansion Area within the 1 km (Left) and 4 km (Right) Resolution Air Modeling Domains.

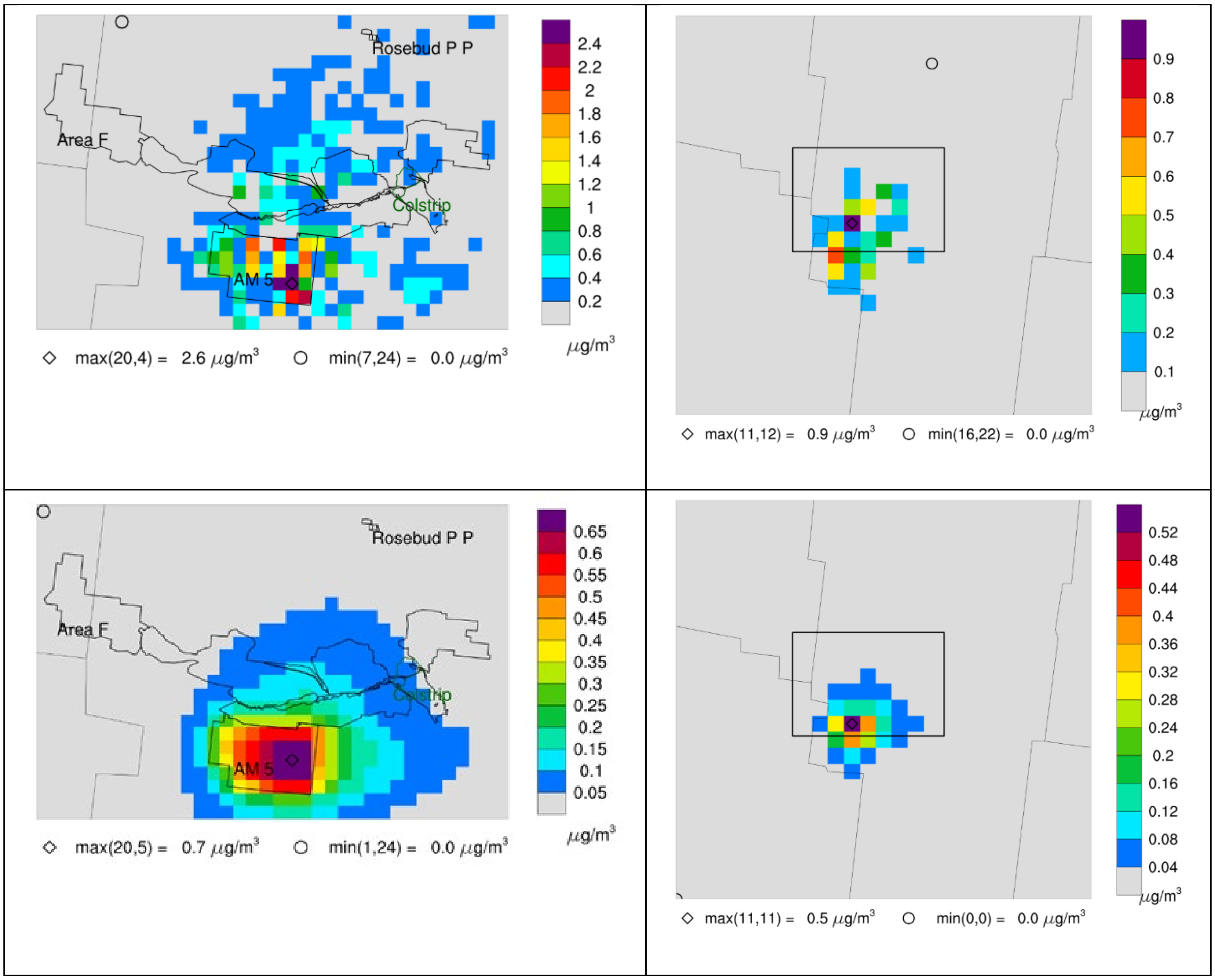


Figure 22. Spatial Distribution of Impacts on the Eighth Highest 24-Hour $PM_{2.5}$ (Top) and Annual Average $PM_{2.5}$ (Bottom) Air Concentrations Due to Emissions from the AM5 Expansion Area within the 1 km (Left) and 4 km (Right) Resolution Air Modeling Domains.

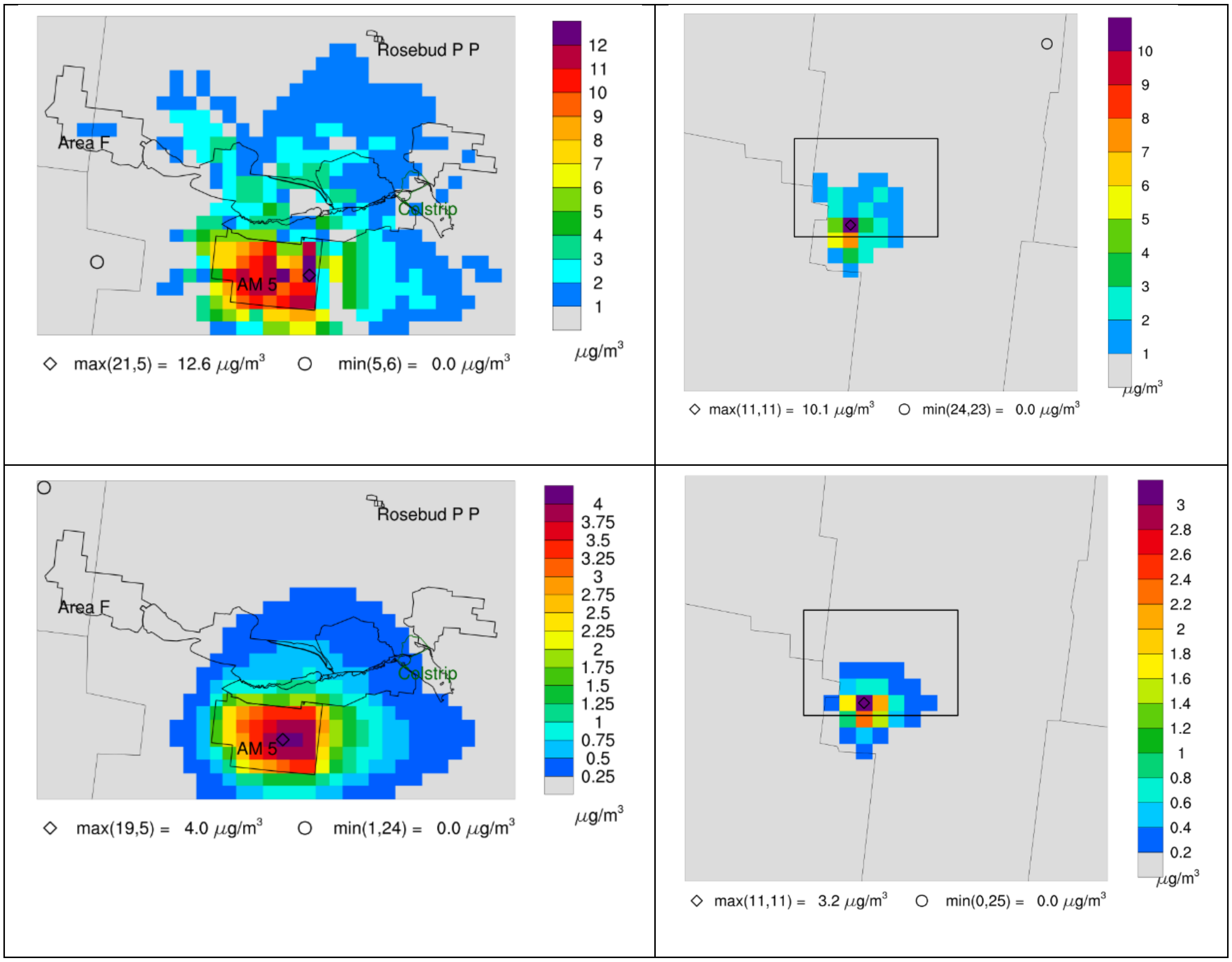


Figure 23. Spatial Distribution of Impacts on the Second Highest 24-Hour PM_{10} (Top) and Annual Average PM_{10} (Bottom) Air Concentrations Due to Emissions from the AM5 Expansion Area within the 1 km (Left) and 4 km (Right) Resolution Air Modeling Domains.

Direct Impacts on Hazardous Air Pollutants

Project area emissions of fugitive coal dust and DPM (see the **Project Area Hazardous Air Pollutant Emissions** section) would result in an increase in the ambient air concentration and deposition of HAPs. The emission, transport, and deposition of fugitive coal dust and DPM emissions from AM5 and other areas of the mine were modeled for the Area F EIS (OSMRE and DEQ 2018) using the maximum projected coal production from each area through 2031. As in the case of the CAP modeling, the AM5 expansion to Area B was treated as a separate source group in the modeling, while the existing Area B permit area was grouped with the other existing areas of the mine.

Figure 24 shows the spatial distribution of the annual average air concentration and annual deposition flux of fugitive coal dust PM_{10} resulting from AM5 emissions. The maximum air concentration and deposition flux of 0.44 µg/m^3 and 376 kilograms per hectare per year (kg/ha-year), respectively, occur within the boundaries of AM5 and decrease with increasing distance from the mine. The maximum air concentrations and deposition fluxes of the trace metal HAPs are provided in **Table 21** and were estimated using the maximum air concentration and deposition flux and the known trace metal concentration in AM5 coal (**Table 20**). Lead (Pb) is the only HAP regulated under the NAAQS and MAAQS. Although the form of the Pb NAAQS and MAAQS is quarterly average or rolling 3-month average (**Table 12** and **Table 13**) and not annual average, the direct impacts of AM5 on Pb concentrations would be negligible as the maximum annual average air concentration would be many orders of magnitude lower than the NAAQS and MAAQS. As is discussed in **Section 3.3.3.3, Cumulative Impacts**, the cumulative Pb concentrations resulting from fugitive coal dust emissions from all areas of the Rosebud Mine (including all emissions from the Project area) would also be negligible relative to the NAAQS and the MAAQS.

Table 21. Maximum Annual Average Air Concentration and Annual Deposition Flux of HAPs from AM5 Fugitive Coal Dust Emissions.

Trace Metal HAP	Maximum Annual Average Air Concentration[1] (µg/m^3)	Maximum Deposition Flux[1] (kg/ha-year)
Antimony	2.16E-07	1.84E-04
Arsenic	7.52E-07	6.43E-04
Beryllium	2.33E-07	1.99E-04
Cadmium	2.64E-08	2.26E-05
Chromium	1.79E-06	1.53E-03
Copper	2.96E-06	2.53E-03
Lead	1.76E-06	1.50E-03
Manganese	3.49E-05	2.98E-02
Mercury	3.08E-08	2.63E-05
Nickel	1.20E-06	1.02E-03
Selenium	2.99E-07	2.56E-04

Deposition flux = deposition per unit area per unit time.
µg/m^3 = micrograms per cubic meter.
kg/ha-year = kilograms per hectare per year
[1] These results conservatively consider all areas within the AM5 expansion area even though the public does not typically have access to these areas.

The spatial distribution of impacts from AM5 emissions on annual average DPM concentrations is shown on **Figure 25**. The DPM air concentrations exhibit a similar pattern to fugitive coal dust. The maximum concentration is 0.29 µg/m^3 and occurs within the AM5 boundary. Concentrations outside AM5 are less than 0.22 µg/m^3 and decrease rapidly with increasing distance from the mine. The cumulative impacts on DPM from all mine areas (including all production from Area B as modified by AM5) are discussed in

Section 3.3.3.3, Cumulative Impacts. There are currently no ambient air quality standards or other regulatory air thresholds for DPM concentrations.

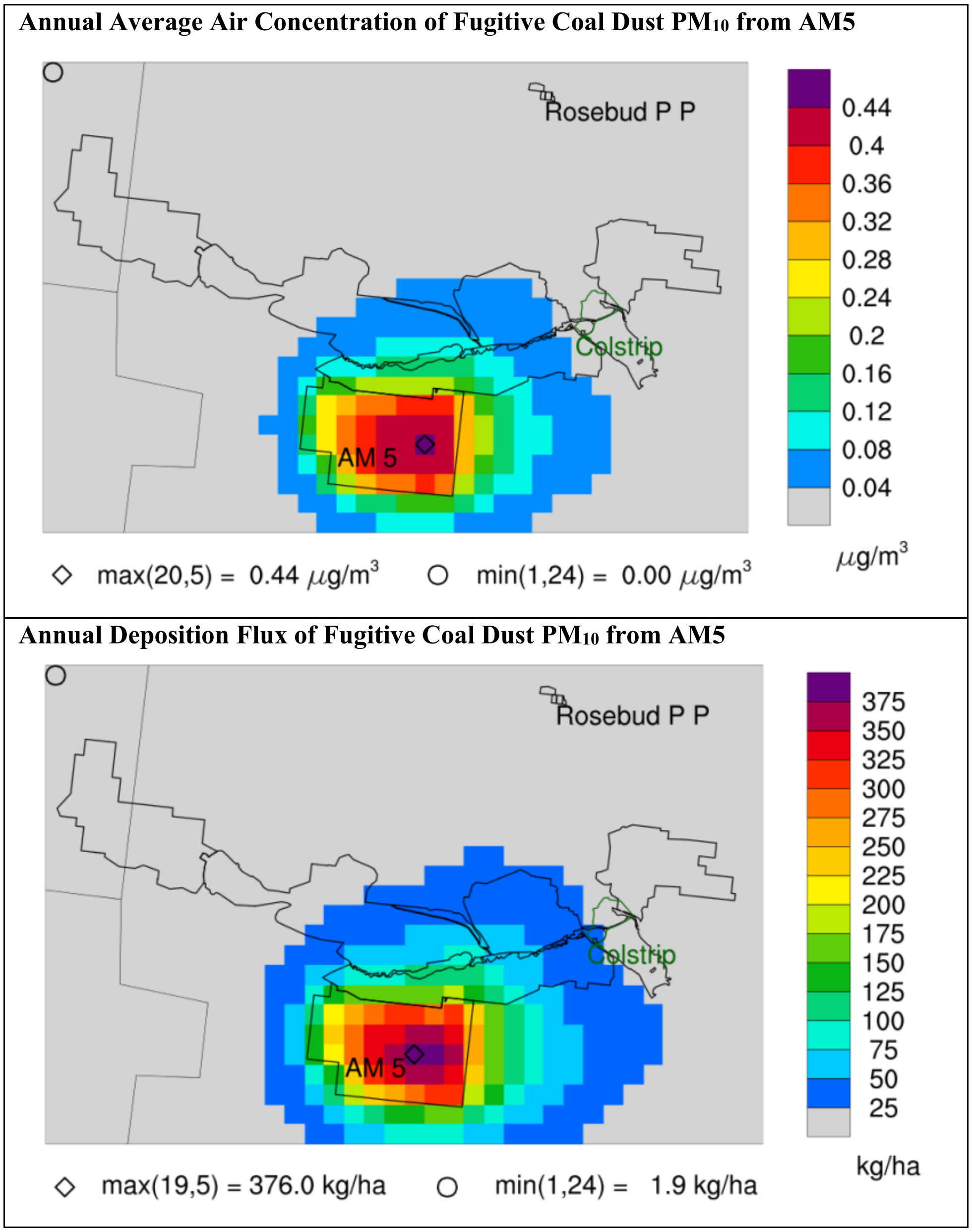


Figure 24. Spatial Distribution of Annual Average Air Concentration (Top) and Annual Deposition (Bottom) of Fugitive Coal Dust PM_{10} Due to AM5 Expansion Area Emissions.

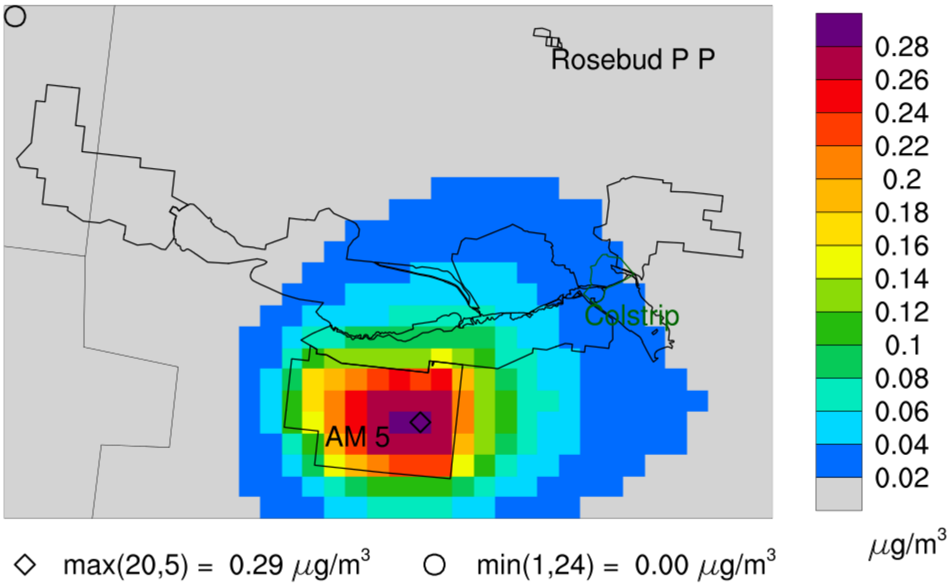


Figure 25. Annual Average Air Concentration of Diesel Particulate Matter Due to Exhaust Emissions from the AM5 Expansion Area.

Secondary Impacts

Secondary Impacts on Criteria Air Pollutants

Emissions of VOCs and NOx from the Proposed Action would lead to the atmospheric formation of O_3 downwind from the Project area. Similarly, the Project area emissions of VOCs, SO_2, and NOx would result in the formation of secondary organic aerosol, particulate sulfate, and particulate nitrate, respectively, which would contribute to ambient $PM_{2.5}$ concentrations. $PM_{2.5}$ impacts were already discussed in **Section 3.3.3.2, Direct Impacts on Criteria Air Pollutants**, since ambient $PM_{2.5}$ concentrations are the combination of directly emitted primary $PM_{2.5}$ and secondary $PM_{2.5}$ formed through atmospheric reactions. Secondary impacts on O_3 are discussed below.

The spatial distribution of direct impacts on the fourth highest maximum daily 8-hour average O_3 and second highest 1-hour daily maximum O_3 from AM5 emissions are presented on **Figure 26**. The maximum impacts from AM5 are 4.2 ppb and 2.1 ppb, respectively, and occur outside the southwest boundary of AM5. The total maximum direct impacts resulting from emissions from the Project area were estimated by scaling the modeled impacts from AM5 emissions using the ratio of the total Project area coal production to modeled coal production in AM5. Using this approach, the estimated total maximum impacts due to the direct impacts of the Proposed Action on the fourth highest maximum daily 8-hour average and second highest 1-hour daily maximum O_3 are 5.5 ppb and 2.7 ppb, respectively. The impacts from AM5 emissions on O_3 are less localized than those on directly emitted CAPs but are still well below the NAAQS and MAAQS. As is discussed in **Section 3.3.3.3, Cumulative Impacts**, the cumulative concentrations of O_3 in the analysis area are well below the NAAQS and the MAAQS.

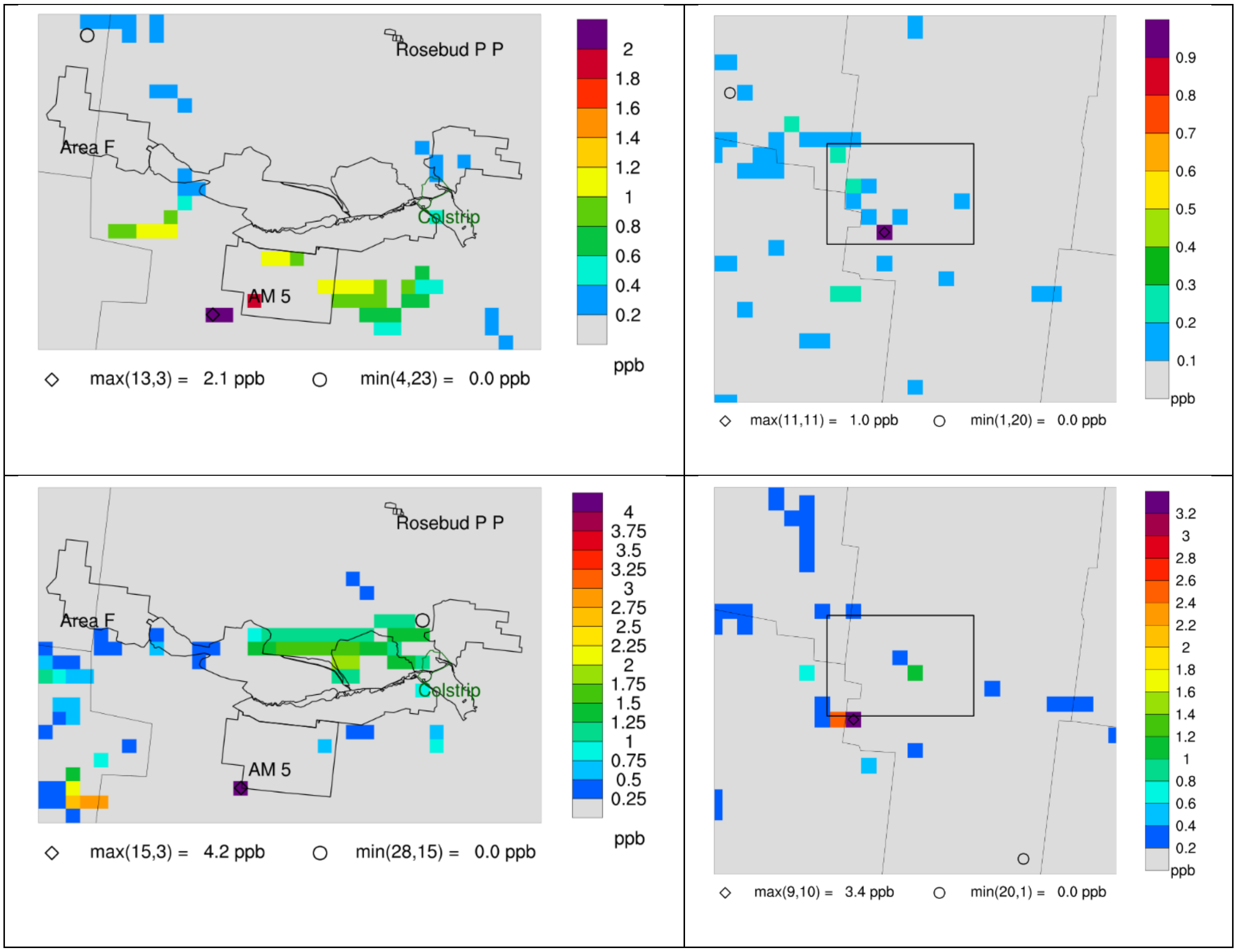


Figure 26. Spatial Distribution of Impacts on the Fourth Highest Maximum Daily Average 8-Hour O_3 (Top) and Second Highest 1-Hour Daily Maximum O_3 (Bottom) Air Concentrations Due to Emissions from the AM5 Expansion Area within the 1 km (Left) and 4 km (Right) Resolution Air Modeling Domains.

Secondary Impacts on Air Quality Related Values

In addition to impacting concentrations of CAPs and HAPs, Project area emissions would increase the deposition fluxes of sulfur and nitrate and degrade visibility in the analysis area.

Deposition of Nitrogen and Sulfur

The modeling performed for the Area F EIS (OSMRE and DEQ 2018) also determined the impacts on acidic deposition of sulfur and nitrogen species from each source group (the source groups used in modeling are described in **Section 3.3.1.2, Analysis Area and Methods**). The spatial distribution of the estimated secondary impacts on total deposition of sulfur and nitrogen from AM5 emissions is shown on **Figure 27**. The maximum sulfur and nitrogen deposition fluxes including both wet and dry deposition process are 0.1 kg/ha-year and 0.3 kg/ha-year, respectively, and occur within AM5. The total maximum direct impacts on sulfur and nitrogen deposition estimated by scaling the modeled AM5 impacts using the ratio of the total Project area coal production to the modeled AM5 coal production are 0.1 kg/ha-year and 0.4 kg/ha-year, respectively.

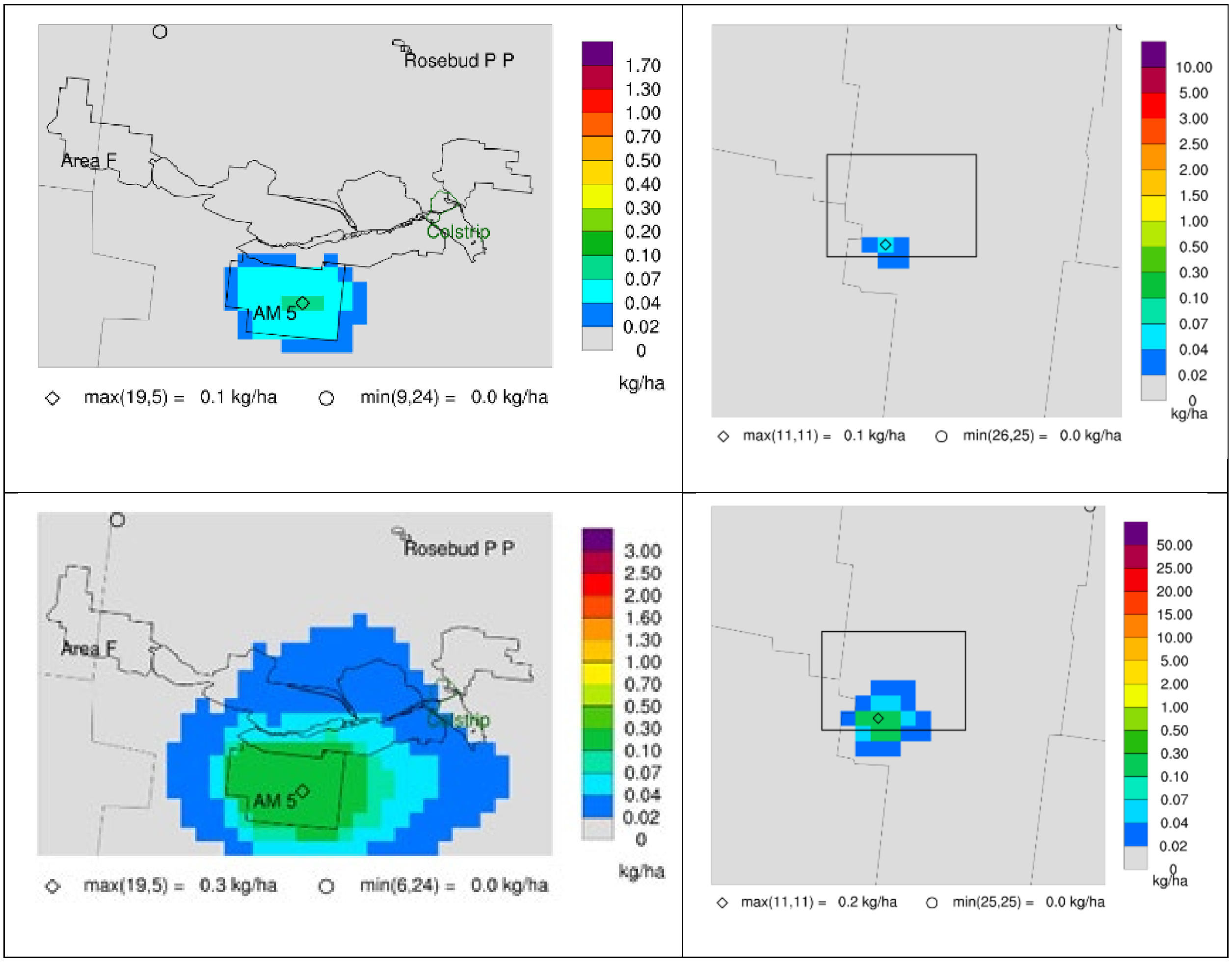


Figure 27. Spatial Distribution of Impacts on the Total Sulfur Deposition (Top) and Total Nitrogen Deposition (Bottom) Due to Emissions from the AM5 Expansion Area within the 1 km (Left) and 4 km (Right) Resolution Air Modeling Domains.

Modeled impacts on sulfur and nitrogen deposition were also determined at Northern Cheyenne, which is the only Class I area in the analysis area (**Figure 14**). There are no regulatory thresholds for sulfur or nitrogen deposition, so the relative intensity of impacts on deposition in Class I areas was determined by comparing the direct impacts on deposition to the modeled cumulative deposition in the absence of emissions from the Project area. The direct deposition fluxes were estimated by scaling the modeled impacts on deposition from AM5 emissions using the ratio of the total Project area coal production to the modeled AM5 coal production. The total cumulative deposition fluxes of nitrogen and sulfur were acquired from the Supporting Information for Air Quality Impact Analysis for the Area F EIS (Ramboll Environ 2017). The cumulative deposition fluxes at Northern Cheyenne in the absence of emissions from the Project area were then calculated by removing direct deposition fluxes from the total cumulative deposition.

The direct impacts on sulfur and nitrogen deposition fluxes in Northern Cheyenne are presented in **Table 22** along with the cumulative deposition fluxes in the absence of direct impacts. The direct impacts on the maximum nitrogen and sulfur deposition are 0.5 percent and 0.3 percent of the maximum modeled cumulative annual deposition without direct emissions.

Table 22. Impacts on Nitrogen and Sulfur Deposition Fluxes at Northern Cheyenne Due to Direct Emissions from the Project Area and Other Cumulative Sources.

Class I Area	Nitrogen (kgN/ha-yr)		Sulfur (kgS/ha-yr)	
	Maximum[1]	Average[2]	Maximum[1]	Average[2]
Direct	0.0115	0.0035	0.0025	0.0007
Rest of cumulative (i.e., without direct emissions)	2.1455	1.5354	0.7993	0.5339

kgN/ha-yr = kilogram nitrogen per hectare per year.
kgS/ha-year = kilogram sulfur per hectare per year.
[1] "Maximum" represents the maximum modeled value across all model grid cells spanning the Class I area.
[2] "Average" represents the average modeled value across all model grid cells spanning the Class I area.

Impacts on Visibility and Regional Haze

Impacts on visibility and regional haze were determined using the procedures outlined by the Federal Land Managers' Air Quality Related Values Work Group (FLAG 2010) to assess impacts on atmospheric extinction and corresponding changes in the haze index. The modeled concentrations of particulate sulfate, particulate nitrate, elemental carbon, organic carbon, coarse particles, and NO_2 from AM5 emissions were used to calculate the haze index in dv. The calculated haze index was then compared to annual average natural conditions to estimate the change in haze index (Δdv) and the number of days the Δdv exceeded 0.5 or 1.0 at Class I areas within the analysis area (Northern Cheyenne). Changes in haze index above 0.5 or 1.0 at Class I areas represent thresholds at which the source is contributing to or causing regional haze visibility impairment. The change in number of days per year where Δdv would be greater than 1.0 and 0.5.

Impacts from AM5 emissions would result in an estimated 3 days where Δdv exceeds 1.0 and 29 days where the Δdv exceeds 0.5. The 98th percentile of the Δdv due to direct impacts from AM5 would be 0.875. Direct impacts on visibility could not be estimated from scaling because the Δdv is nonlinear. However, the modeled coal production from the existing Area B permit area is only 30 percent of the coal production in AM5, and Area B is farther from Northern Cheyenne. Thus, the impacts of emissions from the existing Area B permit area would be a small fraction of the impacts from AM5 emissions.

3.3.3.3 Cumulative Impacts

Cumulative impacts on air quality have resulted from past and present actions. Past and current mining in existing areas of the Rosebud Mine have contributed to cumulative impacts on regional air quality along with operations at the other major existing sources in the analysis area. Major sources in the analysis area include the Colstrip Power Plant, the Rosebud Power Plant, and the Absaloka Mine. Emissions from these facilities are described in **Section 3.3.2.3, Regional Air Pollutant Sources and Emissions**. Continued operations of these facilities and other regional sources would continue to contribute to cumulative impacts (Colstrip Units 1 and 2 were retired in January 2020 and would not contribute to future cumulative impacts).

The cumulative impact analysis tiers to the modeling performed for the Area F EIS (OSMRE and DEQ 2018) that accounted for projected emissions from existing areas of the Rosebud Mine, the Colstrip Power Plant, the Rosebud Power Plant, future related mineral development (e.g., Rosebud Mine Area F), and other regional sources in the BLM-MT/DK 2025/2032 future year modeling platform (BLM 2016a, 2016b). The modeled cumulative impacts on CAPs, HAPs, and air quality related values are discussed below.

Cumulative Emissions

Detailed descriptions of the emissions used for the cumulative modeling analysis can be found in the Area F EIS (OSMRE and DEQ 2018). A brief description is provided below.

Projections of coal production in existing areas of the Rosebud Mine and Area F were provided by Western Energy through the year 2031 (Peterson 2017). The maximum coal production in each area was conservatively used to estimate future emissions. Descriptions of the estimation of emissions from the Project area are provided in **Section 3.3.3.2, Direct Impacts**. Estimates of emissions from Areas A, C, D, and F of the Rosebud Mine and the procedures used to estimate the emissions can be found in the Area F EIS (OSMRE and DEQ 2018). Westmoreland Rosebud also operates a portable crusher (MAQP #4436-00) that is used to crush scoria for use as road base. The maximum scoria process rate reported to DEQ between 2010 and 2015 was conservatively used to estimate emissions.

Projected future emissions from the Colstrip Power Plant and Rosebud Power Plant were based on the emissions reported to DEQ for 2015. Colstrip Units 1 and 2 were retired in January 2020 but had been previously included in the cumulative modeling analysis.

The BLM-MT/DK modeling platform was used to estimate emissions from all other regional sources. The BLM-MT/DK modeling platform has various oil and gas development scenarios for the BLM planning areas in Montana, South Dakota, and North Dakota. The "high" oil and gas development scenario was used to represent future energy development. Projections for non-oil and gas sources in the BLM-MT/DK inventory are primarily based on the USEPA 2025 projection of the 2011 National Emissions Inventory except for biogenic, wildland fire, lightning, and windblown dust emissions, which were based on the years 2012 and 2013.

Cumulative Impacts on Criteria Air Pollutants

The modeled cumulative impacts of CAPs and contributions from the Other Regional Sources source group are shown in Appendix D-6 (Figure D-6-1 through Figure D-6-13) of the in the Area F EIS (OSMRE and DEQ 2018). The Other Regional Sources group includes projected coal production from existing areas of the mine (including the existing Area B permit area) as well as the other regional sources in the modeling domain except AM5, Area F, the Colstrip Power Plant, and the Rosebud Power Plant.

These sources were treated separately in the modeling performed for the Area F EIS (OSMRE and DEQ 2018) as is discussed in **Section 3.3.1.2, Analysis Area and Methods**. Colstrip Units 1 and 2 were retired in January 2020 subsequent to the modeling study. Therefore, all modeled cumulative concentrations presented below are a conservative overestimate of actual cumulative air quality impacts.

The maximum modeled cumulative impacts on the eighth highest 1-hour daily maximum NO_2 and annual average NO_2 within the analysis area for air quality are 41.4 ppb and 4.3 ppb, respectively, with both maxima occurring within Area C of the mine (Figure D-6-1 and Figure D-6-2 in Appendix D-6 of the Area F EIS). Impacts occur due to traffic on State Highway 39 and Interstate 94, and concentrations are also elevated around the Absaloka Mine west of Rosebud. The contributions from other regional sources show a similar pattern but with lower magnitudes than the total cumulative impacts. All modeled cumulative NO_2 concentrations in the analysis area for air quality are well below the NAAQS and the MAAQS.

The spatial distribution of cumulative O_3 impacts and the contributions of the Other Regional Sources modeling group are provided on Figure D-6-3 and Figure D-6-4 in Appendix D-6 of the Area F EIS. The impacts are less localized around major regional sources than those of NO_2 due to the secondary nature of O_3 formation. The maximum second highest 1-hour daily maximum and fourth highest 8-hour daily maximum O_3 cumulative impacts on ozone are 62.9 ppb and 55.4, respectively, and are below both the NAAQS and MAAQS. The maximum cumulative impacts are modeled to occur north of the Rosebud Mine.

The cumulative impacts of $PM_{2.5}$ and PM_{10} are primarily localized around the mine and other major regional sources such as the Absaloka Mine (Figure D-6-5 through Figure D-6-8 in Appendix D-6 of the Area F EIS). Both the maximum cumulative impacts and contributions from the Other Regional Sources modeling group occur within the Rosebud Mine. The maximum modeled cumulative impacts on $PM_{2.5}$ (11.9 $\mu g/m^3$ for the eighth highest daily average and 5.9 $\mu g/m^3$ for the for the annual average) and PM_{10} (84.1 $\mu g/m^3$ for the second highest daily average and 31.2 $\mu g/m^3$ for the annual average) are all below the NAAQS and MAAQS. The Lame Deer "moderate" PM_{10} nonattainment area is the only nonattainment area in the analysis area (see **Section 3.3.2.4, Attainment Status**), and modeled cumulative 24-hour PM_{10} concentration in the grid cell of the violating monitor is 17.5 $\mu g/m^3$ and well below the 1987 24-hour NAAQS of 150 $\mu g/m^3$ (under which nonattainment was designated). Therefore, there are no modeled exceedances of the NAAQS or MAAQS.

The maximum modeled cumulative impacts on the fourth highest 1-hour daily maximum, second highest 3-hour average, second highest 24-hour average, and annual average SO_2 are 33.2 ppb, 28.0 ppb, 6.0 ppb, and 0.6 ppb, respectively (Figure D-6-9 through Figure D-6-12 in Appendix D-6 of the Area F EIS). The maxima all occur in the vicinity of the Colstrip Power Plant except the maximum annual average SO_2 in the 1 km resolution modeling domain, which occurs at the Rosebud Power Plant. The contributions of the Other Regional Sources group are smaller in magnitude with the highest impacts occurring within the mine and on the western boundary of the analysis area. There are no modeled exceedances, and all concentrations are well below the NAAQS and the MAAQS.

Figure D-6-13 in Appendix D-6 of the Area F EIS presents the spatial distribution of cumulative impacts on CO. The maximum cumulative impacts on the second highest 1-hour daily maximum CO and the second highest 8-hour block average CO are 1.2 ppm and 0.3 ppm, respectively. Both maxima occur within the boundary of the mine (1-hour maximum in Area C, 8-hour maximum in Area F). The modeled concentrations are all well below the NAAQS and MAAQS.

Cumulative Impacts on Air Quality Related Values

Nitrogen and Sulfur Deposition

The spatial distribution of cumulative impacts and the contribution of Other Regional Sources to sulfur and nitrogen deposition are shown on Figure D-6-14 and Figure D-6-15 of Appendix D-6 of the Area F EIS. The maximum total cumulative nitrogen deposition flux is 2.7 kg N/ha-year, and the maximum total cumulative sulfur deposition is 1.7 kg S/ha-year. As noted above, the cumulative modeling included Colstrip Units 1 and 2, which have since been retired. Therefore, the modeled cumulative nitrogen and sulfur deposition fluxes discussed here are a conservative overestimate of actual cumulative deposition impacts. The maximum nitrogen deposition flux occurs within Area C of the Rosebud Mine, whereas the maximum sulfur deposition flux occurs at the Rosebud Power Plant. Cumulative impacts on nitrogen and sulfur deposition at the Northern Cheyenne Class I area are provided in **Table 22**. The maximum nitrogen and sulfur deposition fluxes at Northern Cheyenne are 2.15 kg N/ha-year and 0.80 kg S/ha-year, and the contribution of the direct impacts on these deposition fluxes would be negligible. There are no regulatory thresholds for atmospheric deposition of air emissions.

Visibility and Regional Haze

Table 23 reports the change in haze index due to cumulative impacts compared to the annual average natural conditions at the Northern Cheyenne Class I area in terms of the 98th percentile change in haze index (Δdv). The contribution of the impacts from AM5 and the Other Regional Sources source group to the total cumulative change in haze index is also shown. AM5 and the other regional sources contribute 8.3 percent and 55.0 percent, respectively, of the total 98th percentile Δdv of 10.57 at the Northern Cheyenne Class I area. Due to the retirement of Colstrip Units 1 and 2 in January 2020, the modeled cumulative change in haze index is a conservative overestimate of actual cumulative visibility impacts.

Table 23. Cumulative Visibility Impacts and Contributions from AM5 (Area B South Extension) and Other Regional Source Emissions at the Northern Cheyenne Class I Area.

Class I Area	Change in Haze Index (98th percentile Δdv)			Contribution to Cumulative Change in Haze Index (%)	
	Cumulative	AM5	Other Regional Sources	AM5	Other Regional Sources
Northern Cheyenne	10.57	0.86	5.81	8.3	55.0

dv = deciviews.
Δdv = change in deciviews.
% = percentage.

Cumulative Impacts on Hazardous Air Pollutants

Cumulative impacts on regional air concentrations and deposition of HAPs would occur from both the existing permit areas and the Project area. The primary sources of HAPs at the mine are fugitive coal dust emission sources and diesel equipment. The emissions of DPM and HAP-containing fugitive coal dust from each area of the mine were estimated using the total $PM_{2.5}$ emissions from diesel equipment and PM_{10} emissions from fugitive coal dust sources. Trace metal HAP emission rates were quantified using the fugitive coal dust emission rate and the measured concentrations of the trace metal HAPs in AM5 coal (PPL Montana 2014). Estimated HAP emissions for the Project area are provided in **Section 3.3.3.2, Project Area Hazardous Air Pollutant Emissions**, and HAP emissions from the other areas of the mine are provided in the Area F EIS (OSMRE and DEQ 2018).

The spatial distribution of the fugitive coal dust PM_{10} air concentrations and deposition fluxes are presented on Figure D-6-16 of Appendix D-6 of the Area F EIS. The maximum air concentration and deposition flux of 0.47 $\mu g/m^3$ and 407.9 kg/ha-year, respectively, both occur within the boundaries of AM5 due to the localized impacts of low-level fugitive dust sources. The impacts outside the mine decrease rapidly with increasing distance. The estimated air concentrations and deposition fluxes of the trace metals with known concentrations in Rosebud Mine coal are provided in Table D-6-1 of Appendix D-6 of the Area F EIS. The maximum air concentration of Pb, which is the only HAP with an ambient air quality standard, is negligible when compared to the NAAQS and the MAAQS.

The spatial distribution of cumulative impacts on DPM air concentrations due to all diesel exhaust emissions from the Rosebud Mine is shown on Figure D-6-17 of Appendix D-6 of the Area F EIS. The maximum concentration of 0.37 $\mu g/m^3$ occurs within Area C, and in a similar fashion to fugitive coal dust concentrations, the impacts are localized within and around the mine. There are currently no ambient air quality standards or other regulatory air thresholds for DPM concentrations.

3.3.3.4 Unavoidable Adverse Impacts

The Project would result in minor, unavoidable, adverse impacts on air quality, but direct, secondary, and cumulative impacts would be lower than the health-based ambient air quality standards where applicable.

3.3.3.5 Irreversible and Irretrievable Impacts

There would be no known irreversible or irretrievable commitment of air quality resources.

3.4 GEOLOGY AND GEOCHEMISTRY

3.4.1 Introduction

The Rosebud Mine is located in the northwestern Powder River Basin where surface coal mining has occurred since 1924. The sections below provide an overview of the geology and geochemistry within the analysis area and the regulatory authorities governing it. The analysis area for geology is defined below in **Section 3.4.1.2, Analysis Area and Methods**.

This section also analyzes the environmental consequences, including the direct, secondary, and cumulative impacts, of the No Action Alternative (Alternative 1) and the Proposed Action (Alternative 2) with respect to analysis area geologic resources.

3.4.1.1 Regulatory Framework

Federal Requirements

There are no applicable federal regulations for geologic resources within or near the analysis area.

State Requirements

DEQ regulates permitting and operation of surface coal mines on state and federal lands within Montana under the authority of MSUMRA (82-4-221 *et seq.*, MCA) and its implementing rules (ARM 17.24.301-1309). Under ARM 17.24.322, Geologic Information and Coal Conservation Plan, detail is provided on the specific geologic information needed in a surface-mine permit application as well as the requirement that the application include a coal conservation plan.

MSUMRA prohibits DEQ from issuing a coal mining permit where the area of land described in the application includes land that has special, exceptional, critical, or unique characteristics or when mining or prospecting on that area would adversely affect the use, enjoyment, or fundamental character of neighboring land that has special, exceptional, critical, or unique characteristics (82-4-227(2), MCA). Land may have these characteristics if it possesses special, exceptional, critical, or unique scenic, historic, archaeologic, topographic, geologic, ethnologic, scientific, cultural, or recreational significance. Id.

Local Requirements

There are no applicable local regulations for geologic resources within or near the analysis area.

3.4.1.2 Analysis Area and Methods

Analysis Area

The analysis area for impacts on geology is the 15,153-acre Project area. Within the Project area is an 11,202-acre disturbance area where proposed Project activities would disturb 5,711 acres.

Analysis Methods

Impacts on geology were determined based on the information contained in Westmoreland Rosebud's Application. The Application provided details concerning geology and geochemistry related to proposed mining and reclamation actions.

3.4.2 Affected Environment

3.4.2.1 Regional Geology

The Rosebud Mine is located in the northwestern portion of the Powder River structural basin, a broad northeast-trending synclinal structural basin in eastern Wyoming and southeastern Montana bound on three sides by mountain uplifts (Mapel and Swanson 1977). The Powder River Basin is bounded on the west by the Bighorn Mountains, on the southwest by the Casper Arch, and on the south by the north end of the Laramie Mountains and by the Hartville uplifts. It is bounded on the east by the Black Hills, on the northeast by the Miles City Arch, and on the northwest by the Ashland Syncline (USGS 1962).

The Powder River Basin is about 230 miles long and 100 miles wide and represents an asymmetrical syncline whose trough is on the western side of the basin and parallels the Bighorn Mountains (USGS 1962). The western limb of the syncline contains steeply dipping strata, and the eastern limb contains gently dipping strata. During the Paleozoic and Mesozoic Eras, the Powder River Basin was part of a relatively stable interior platform that was at times flooded by epicontinental seas, resulting in the accumulation of thick marine sediments (USGS 1962). Overlying the thick Paleozoic and Mesozoic sediments are relatively thin accumulations of late-Cretaceous and Cenozoic sediments derived principally from continental source areas. The basin was formed through compressional deformation associated with the Laramide orogeny, which occurred from the late-Cretaceous through early-Tertiary eras.

The Paleocene Fort Union Formation is the predominant bedrock unit in the vicinity of the Rosebud Mine and consists of gently dipping (less than a few degrees) sedimentary rocks. The Fort Union Formation is composed of sandstone, siltstone, mudstone, claystone, and coal beds (Mapel and Swanson 1977; Roberts et al. 1999). The formation was deposited during the Paleocene from sediments accumulating during a tropical to subtropical climate in a vast area of shifting floodplains, sloughs, swamps, and lakes that occupied the central part of the United States (Mapel and Swanson 1977). As a result of the depositional setting, at a regional scale changes occur within the rock deposits with channel sandstones laterally changing into siltstones and shales and coal beds pinching out laterally or abruptly stopping. In descending order, members of the Fort Union Formation are the Tongue River, Lebo, and Tullock; exposures of only the Tongue River Member occur in the analysis area (**Figure 28**). The Lebo Shale Member underlies the Tongue River Member, ranging in thickness between 95 and 200 feet in the area of the Rosebud Mine (Application Appendix I). The Lebo Shale Member consists of gray smectitic shale and mudstone with lenses of gray and yellow and very fine- to medium-grained sandstone with a few thin coal beds (Vuke et al. 2001). Northeasterly trending high-angle normal faults locally modify and steepen the dip of the sedimentary sequence (Roberts et al. 1999).

3.4.2.2 Analysis Area Geology and Geochemistry

Rosebud Mine Area B lies within the East Fork Armells Creek and Middle Rosebud Creek drainage basins. **Figure 28** presents the surface geology for the analysis area; **Figure 29** presents a generalized column of the local stratigraphy; **Figure 30**, **Figure 31**, and **Figure 32** provide geologic cross sections through the Project area. In the Colstrip area, the Fort Union Formation is 445 feet thick and thickens to the south to a maximum of 2,125 feet (Application). Geologic formations that are exposed at the surface are limited to the Tongue River Member of the Paleocene Fort Union Formation, and Quaternary Alluvium. Quaternary-age alluvium and colluvium overlie the Tongue River Member locally, mostly along drainageways. Within the analysis area, relatively thin deposits of silty clay and gravelly sand comprise the Quaternary alluvial fill occurring within portions of Richard Coulee (**Figure 28**). Thin unmapped unconsolidated alluvial deposits are also present in the Lee and Rape Coulee drainages and

associated tributaries. Sandstone, claystone, interbedded claystone and sandstone, and subbituminous coal beds of the Tongue River Member comprise the remainder of the stratigraphic sequence in the analysis area. Four inferred normal faults are mapped in the northwest corner of the existing Area B portion of the analysis area, and one inferred normal fault is mapped between Richard and Lee Coulees in the southeast corner of the analysis area (**Figure 28**). Faults in the area typically have small offsets.

The sandstone in the analysis area is a fine- to very-fine-grained silty unit and is gray to light gray in color and light yellow-brown where weathered. The sandstone is frequently massive and sometimes contains stacked, cross-bedded channel sequences encompassing disseminated pyrite along with pyrite and hematite concretions. The claystone is predominantly gray to dark gray and silty to sandy with a sparse to moderate carbonaceous content. It commonly includes dark to very dark carbonaceous-rich clay intervals containing pyrite. According to Westmoreland Rosebud's Application, there is no evidence that significant or unique geologic formations or sites are present in the analysis area.

Coal targeted for removal in the analysis area is within the Tongue River Member of the Fort Union Formation. Project activities would disturb 5,711 acres within the proposed 11,202-acre disturbance area. The analysis area includes an estimated total recoverable reserve of 147.2 million tons of coal, of which 104.3 million tons is in the proposed AM5 expansion area (Application).

The highest coal bed in the analysis area stratigraphic sequence is the Rosebud Coal bed. This bed averages 22.6 feet thick over the permit area (Application Appendix D). Typically, the first 1-foot layer of the Rosebud deposit is high in sulfur content, generally represented by pyrite and marcasite. The lowest 0.8-foot portion of the Rosebud Coal bed also has a high sulfur content represented by the occurrence of pyrite.

During the coal-extraction process in other permit areas of the Rosebud Mine, the high-sulfur zone occurring in the upper portions of the Rosebud Coal is removed and recovered. This material is trucked to the nearby Rosebud Power Plant, which is designed to burn waste coal in its boilers. The main portion of the Rosebud Coal bed is burned in the Colstrip Power Plant. The higher-sulfur zone present near the base of the bed is not recovered. A similar coal-extraction process would be used for the Project area as described in **Section 2.2.2, General Sequence of Operations**. Coal from the proposed Project would only go to Colstrip Units 3 and 4 and the Rosebud Power Plant.

Natural or spontaneous combustion of the Rosebud Coal bed has locally thermally metamorphosed the overlying rock units, creating reddish bands of rock called clinker (locally called scoria). The clinker beds generally cap the hills overlying the drainage valleys due to the resistance to erosion. Clinker is reported to occur in thicknesses ranging from 10 to 300 feet (Vuke et al. 2001). Clinker is mined in the existing Area B portion of the analysis area and in other permit areas of the Rosebud Mine. It is used as a road-surfacing material.

Within the analysis area, the average overburden thickness ranges from a few feet to more than 100 feet (Application Appendix I). All overburden material removed during the mining process would be backfilled into the pit as spoil to reconstruct the postmining topography as described in **Section 2.4.5, Reclamation Plan**, and shown on **Figure 9**.

The next coal seam located below the Rosebud Coal bed is the McKay Coal bed, which averages 7.9 feet thick (Application Appendix D). Between the two major coal beds is the interburden, which is composed of similar lithologies to the overburden, except that it does not contain clinker. The interburden material consists of sandstone and claystone and ranges in thickness from a few feet to more than 100 feet (Application Appendix I). The sandstone and claystone located below the McKay Coal is referred to as the underburden or Sub-McKay and includes the remainder of the Tongue River Member below the

McKay Coal. The lithologies of this group are similar to the overburden and interburden, except what may be more laterally continuous sandstones.

The weighted-average proximate coal quality (as-received basis) of the Rosebud Coal bed in the Project area is 8,378 British thermal units (Btus) per pound, 0.91 percent sulfur, 25.44 percent moisture, a volatility of 28.95 percent, a fixed carbon of 35.10 percent, and 10.41 percent ash (Application Appendix D). The coal quality of the McKay Coal bed is inferior to that of the Rosebud Coal bed due to a higher sulfur content and higher iron and sodium content in the ash. Because of these quality issues, the Board of Natural Resources and Conservation of the State of Montana on June 4, 1979, prohibited the use of the McKay Coal, either as an exclusive fuel or in combination with the Rosebud Coal, in Colstrip Units 1 and 2. Additionally, Westmoreland Rosebud's existing contracts, similar to the Colstrip Units 3 and 4 Contract as the result of a State agency ruling, call for the production and sale of Rosebud coal only (Application 17.24.322).

The suitability of overburden to be used as backfill was determined by Westmoreland Rosebud based on data collected from 88 core-hole samples between 2008 and 2013 and included in Application Appendix D. Overburden material in the Project area is deemed suitable based on the following parameters: pH between 5.5 and 8.5, electrical conductivity less than or equal to 8.0 deci-Siemens/meter, saturation percentage between 25 and 90 percent, sodium adsorption ratio less than or equal to 20, boron less than or equal to 5 parts per million (ppm), molybdenum less than or equal to 1.0 ppm, nitrate-nitrogen less than or equal to 130 ppm, selenium less than or equal to 0.1 ppm, and acid-base potential greater than 5 tons per kiloton. Some individual samples exceeded suitability criteria for the parameters evaluated, but within each drillhole, weighted average concentrations and values were typically suitable (Application Appendix D). Of the exceedances, conductance and selenium were the most frequently exceeded, although relatively high sodium adsorption ratio and molybdenum were also common. Based on the weighted average concentrations and values and the blending or mixing of overburden associated with mining activities, the overburden quality is suitable and its placement near the surface after mining is not likely to limit vegetative establishment or postmine land uses (Application Appendix D).

Acid mine drainage and large concentrations of iron and other metals generally do not occur in coal-mine overburden spoil in the area because the natural buffering capacity of the overburden generally prevents acid drainage (Canon 1984). Acid- or toxic-forming materials have not been identified in the overburden (Application Appendix D).

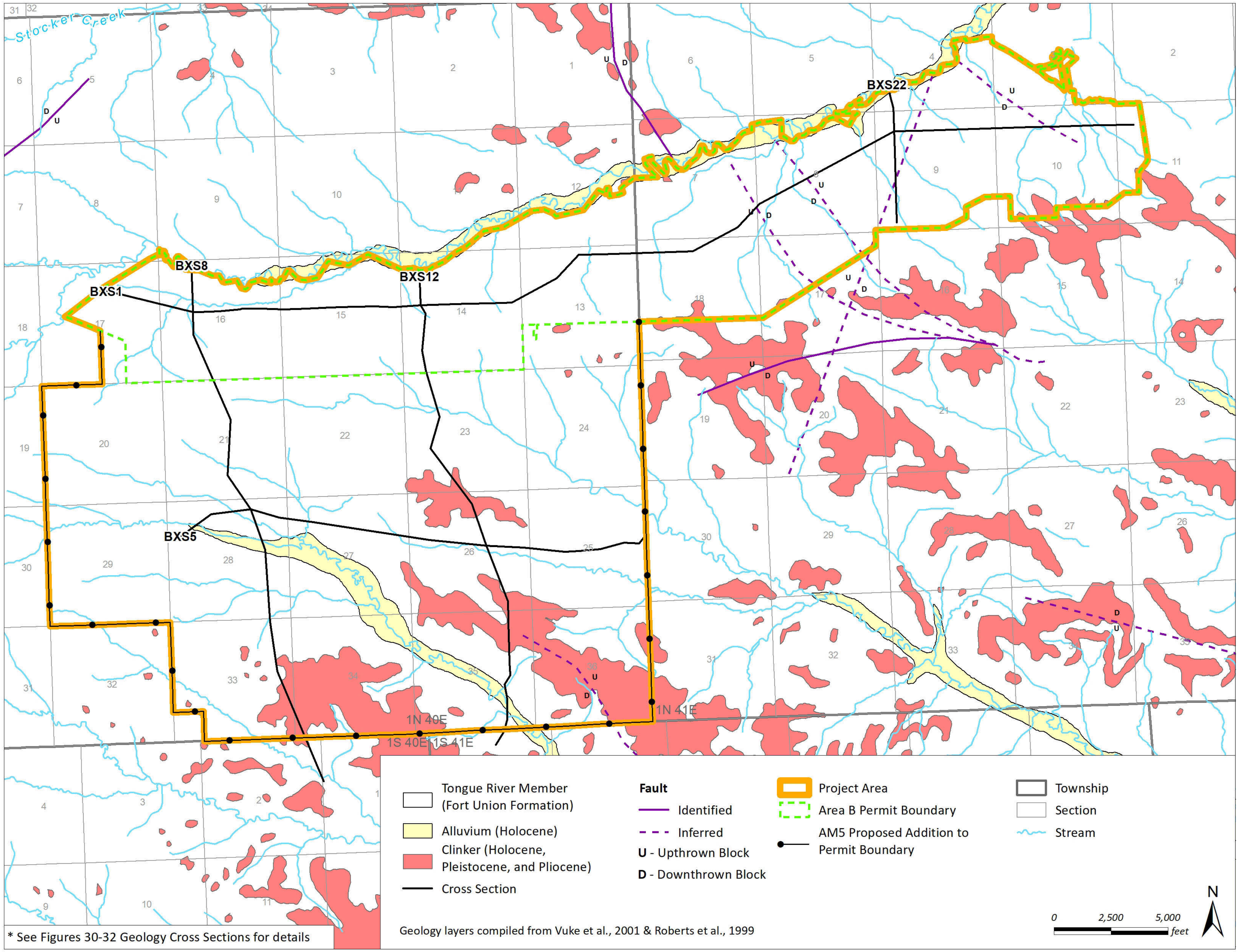


Figure 28. Surface Geology in the Analysis Area.

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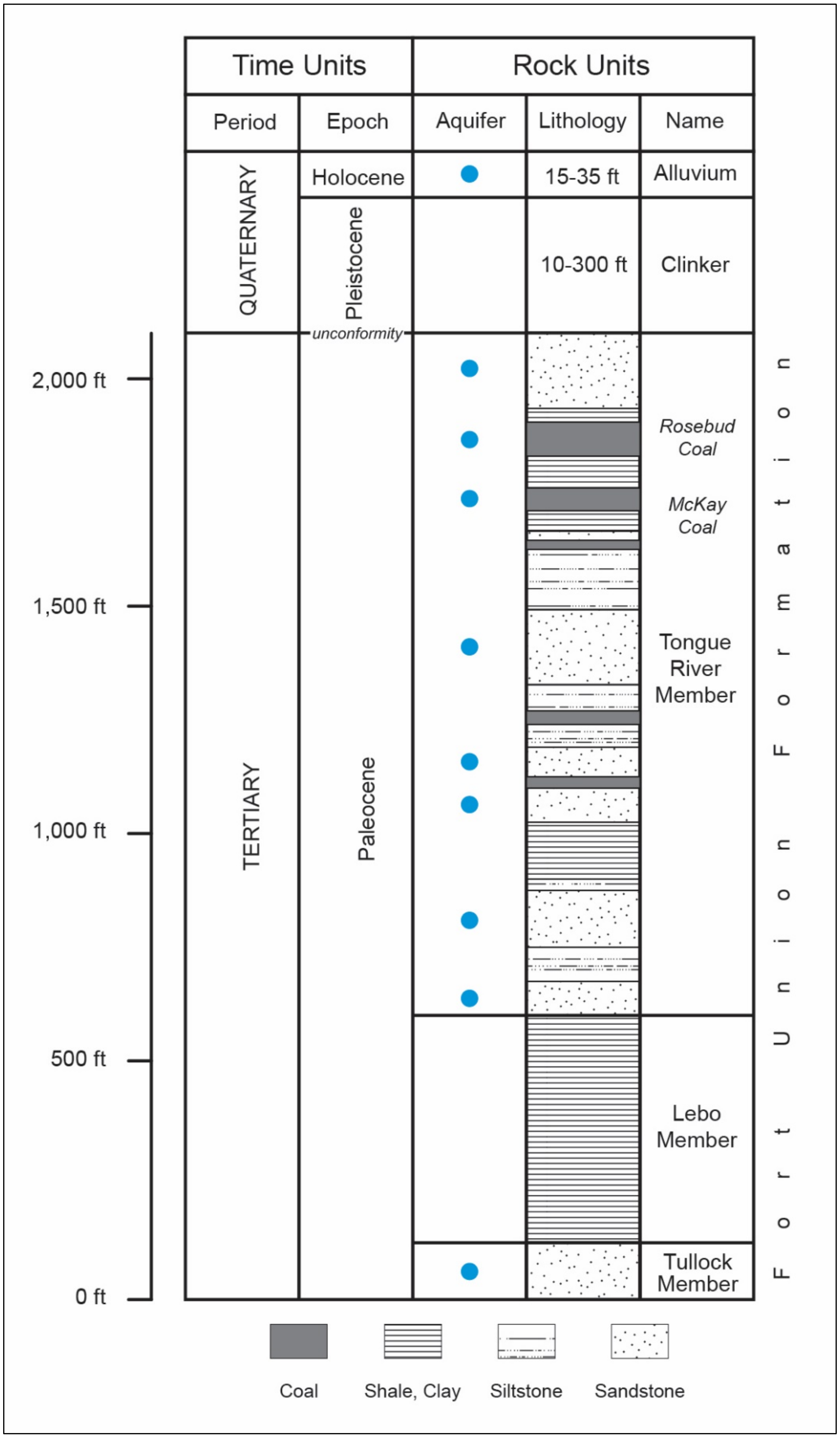

Figure 29. Generalized Column of the Local Stratigraphy.

Y-axis represents thickness of Fort Union Formation. Note: this figure exaggerates the relative thickness of the coals, but is useful for showing the sequence of the coal beds. Source: KC Harvey 2012.

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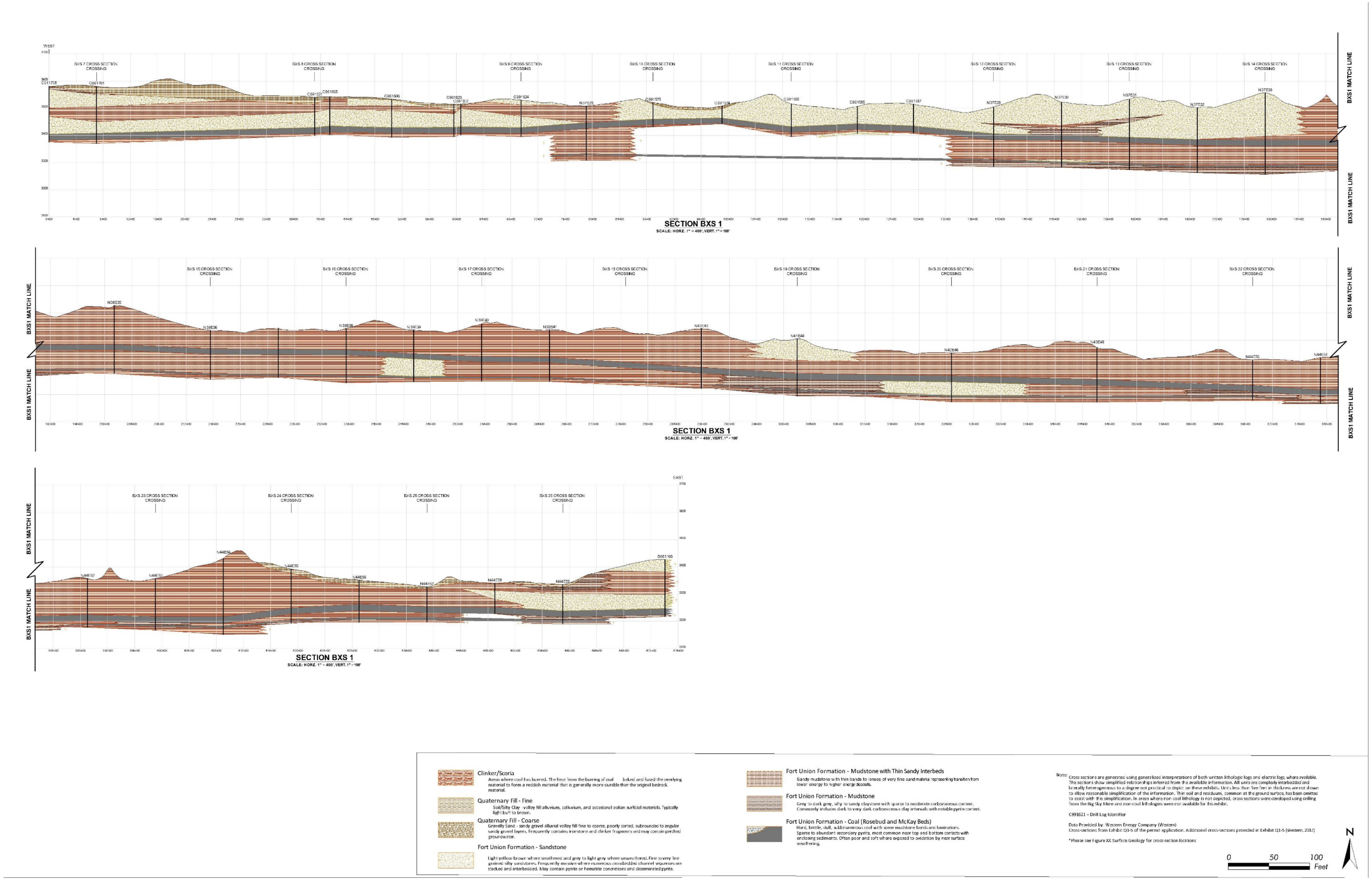

Figure 30. Geologic Cross Sections (Part 1 of 3).

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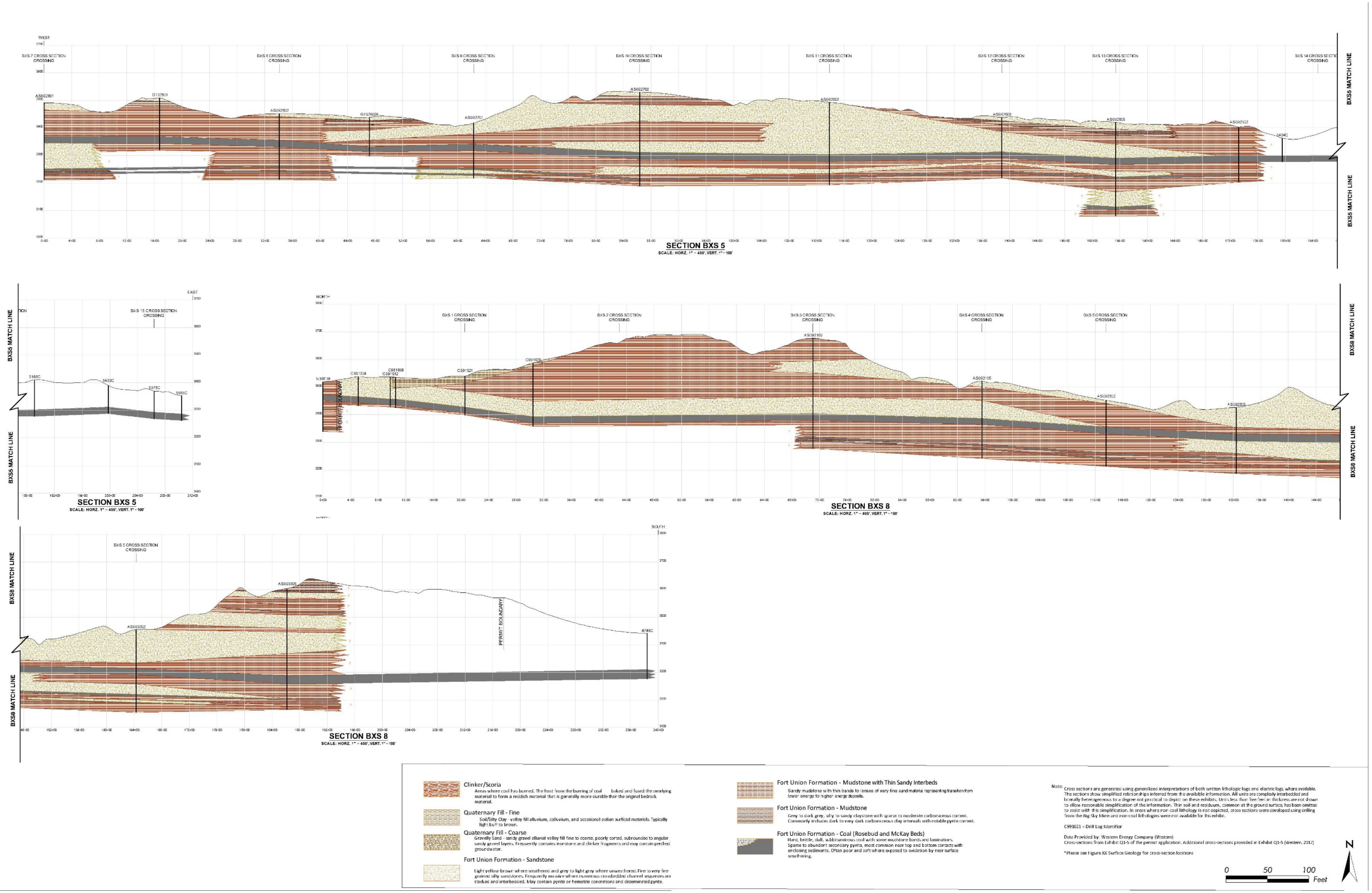

Figure 31. Geologic Cross Sections (Part 2 of 3).

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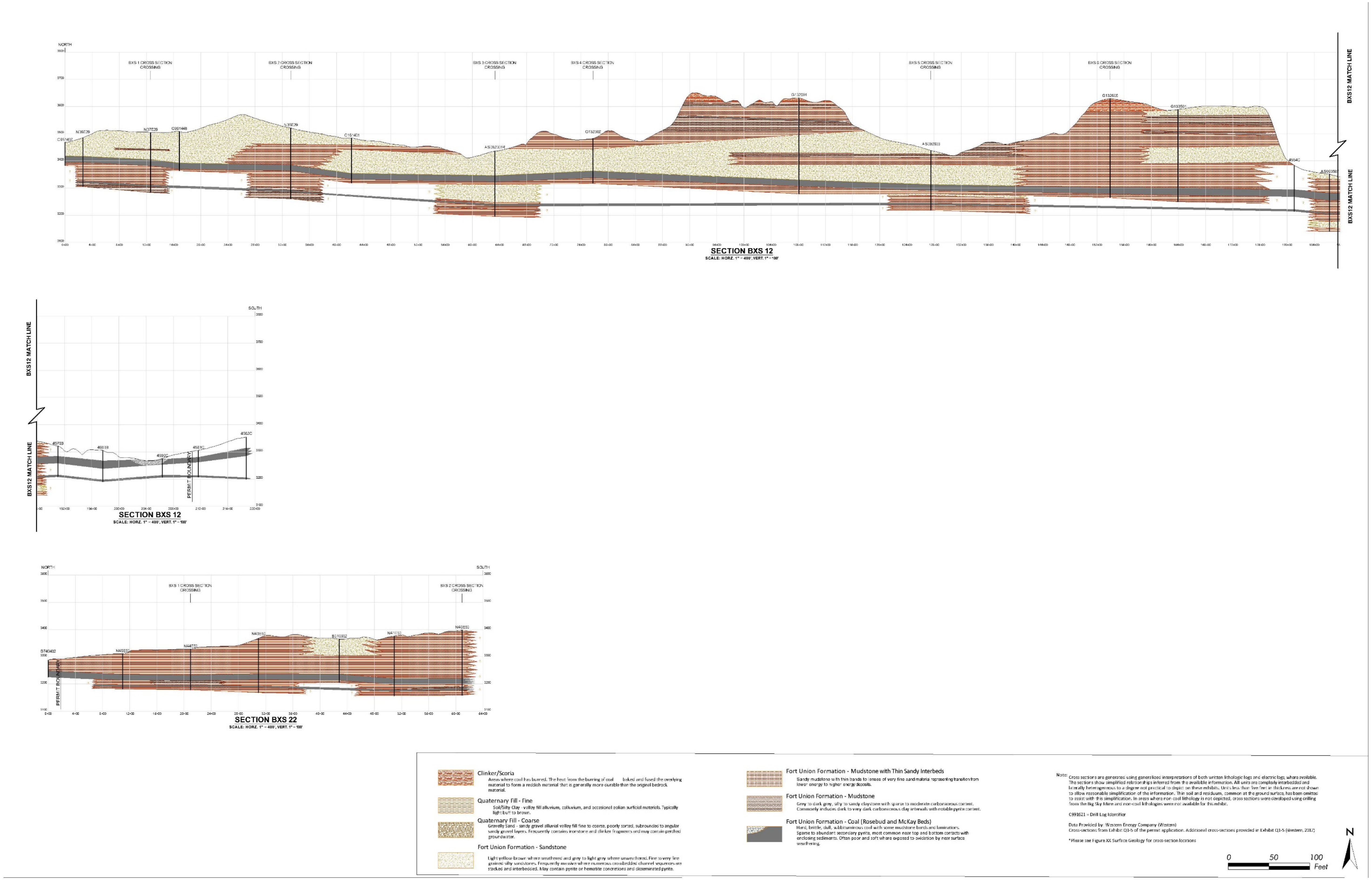

Figure 32. Geologic Cross Sections (Part 3 of 3).

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3.4.3 Environmental Consequences

3.4.3.1 Alternative 1 – No Action

Under the No Action Alternative, the AM5 amendment (proposed Project) would not be permitted. Westmoreland Rosebud would complete mining and reclamation in the Area B permit area according to its currently approved operating permit. Mining is permitted in Area B until 2030, and initial stages of reclamation would be completed within 2 years of the cessation of mining. There would be no Project impacts on the analysis area geologic resources described above in **Section 3.4.2.2, Analysis Area Geology and Geochemistry,** because none of the disturbances associated with development of the Project would occur.

The No Action Alternative would not change the status of the existing Area B permit area or other permit areas, including Area F, of the Rosebud Mine (**Section 2.2, Existing Operating Permits, Disturbance, and Reclamation**), nor would it affect the federal coal lease MTM 80697 (tracts in Areas B and C) modification application, which is currently being evaluated by the Bureau of Land Management (**Section 3.1.4.2, Related Future Actions**). Impacts on geology due to current and future mining and reclamation in the existing Area B permit area and other permit areas of the Rosebud Mine would continue.

3.4.3.2 Alternative 2 – Proposed Action

Direct Impacts

Impacts from mining under the Proposed Action would result in the disturbance of 5,711 acres within the analysis area and the direct removal of an estimated 104.3 million tons of coal not currently approved under the existing Area B operating permit. Westmoreland Rosebud would recover as much of the Rosebud coal seam as is possible under prevailing pit conditions with some coal left unmined when necessary to ensure the safety of the working area (Application 17.24.322). Because all recoverable and marketable coal would be mined, the Proposed Action complies with the requirements of the Coal Conservation Plan listed in ARM 17.24.322. In addition, the removal of clinker/scoria for use on roadways would remove the rock from its undisturbed location and distribute it throughout the analysis area. The mining process would alter the overburden geology in the analysis area. The removal of overburden and the Rosebud Coal and the subsequent replacement of spoil would result in the alteration of the horizontal continuity of the overburden that would last until the spoil is eroded away.

The spoil would consist of a mixture of geologically distinct vertical layers of sandstone, siltstone, mudstone, and claystone. As a result, the physical characteristics of the overburden as spoil would be altered and the spoil would represent a deposit consisting of fragments of the overburden geologic deposits (sandstone, siltstone, mudstone, and claystone) and the resulting fine-grained sediment generated due to the destruction of these stones into fragments. In addition, the spoil would contain nonhazardous construction, mining, or agricultural debris allowed by DEQ for disposal in the mine pits (Application). The spoil would consist of a well-graded heterogeneous mixture of fragments of rock, sediment, and nonhazardous construction debris of wood, metal, and concrete. The volume of debris disposed of in the mine pits is minimal compared to the overall volume of spoil. The fragments of rock would likely vary in size; vertical distribution would occur with large rock fragments rolling into the bottom of the pit, creating a rubble zone as spoil was backfilled. To ensure that there is not a low-permeability barrier at the soil-spoil interface (i.e., to aid ground water movement), graded spoil would be scarified before placement of soil. If acid, acid-forming, toxic, toxic-forming, or other deleterious geologic materials were

identified as part of implementation of the Spoil Monitoring Plan, they would not be buried as spoil or stored close to streams, negating their impact on hydrogeological resources.

Secondary Impacts

Spoil deposits would be created within the valley bottoms of Richard and Lee Coulees. These spoil deposits would be located next to geologically unaltered and unmined areas that comprise the hills separating the drainages and would enhance the vertical relief between the coulees as the more easily erodible spoil deposits preferentially eroded relative to the unaltered material comprising the hills.

3.4.3.3 Cumulative Impacts

The analysis area for evaluation of cumulative impacts on geology includes all permit areas of the Rosebud Mine, including past and ongoing mining areas. Past and present mining at the Rosebud Mine have resulted in cumulative impacts on the overall geologic formations in the region and the loss of horizontal continuity in geologic beds overlying the coal. Future mining of other active permit areas at the Rosebud Mine would result in similar cumulative impacts.

3.4.3.4 Unavoidable Adverse Impacts

Short-term unavoidable adverse impacts on geology would occur during mining as topsoil and spoil piles are created and clinker/scoria pits are mined. After mining and reclamation activities, the removal of the Rosebud Coal and clinker/scoria would represent unavoidable adverse impacts on geology.

3.4.3.5 Irreversible and Irretrievable Impacts

Removal of the Rosebud Coal and the associated overburden would be an irreversible and irretrievable impact on geologic features and coal reserves. This would represent an irreversible impact on the analysis area geology. After the spoil eroded below the depth of mining, the underlying unaltered rocks below the mined-out former Rosebud Coal would begin to be exposed. Because the geology below the Rosebud Coal would not be altered by the Proposed Action, impacts related to the Proposed Action would cease after the spoil eroded away.

3.5 WATER RESOURCES – SURFACE WATER

3.5.1 Introduction

This section describes surface water resources that occur within the analysis area defined below in **Section 3.5.1.2, Analysis Area and Methods**, including descriptions of regulatory requirements to protect surface water resources and characterization of surface water resources within the analysis area (climate, floodplains, hydrologic balance, surface water hydrology, and surface water quality associated with springs, streams, and ponds).

This section also analyzes the environmental consequences including direct, secondary, and cumulative impacts of the No Action Alternative and the Proposed Action (Alternative 2) with respect to surface water resources.

3.5.1.1 Regulatory Framework

Federal Requirements

Federal surface water quantity and quality regulations applicable to the analysis area include the Clean Water Act of 1972 and Clean Water Act Amendments of 1977, which require federal agencies to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." The Clean Water Act (CWA), 33 USC Section 1251 *et seq.*, requires that applicants for federal permits or licenses for activities that may result in a discharge to waters of the U.S. obtain certification from the state under Section 401 of the act that the discharge would comply with state water quality standards. Section 404 permits, issued by the U.S. Army Corps of Engineers (Corps), require 401 certification. Refer to **Section 3.5.1.1, Regulatory Framework**, State Requirements, Surface Water Quantity and Quality for more information on state requirements related to the CWA.

For industrial sources, national effluent limit guidelines (ELGs) have been developed for specific categories of industrial facilities and represent technology-based effluent limits. The analysis area is in an industrial category that is specifically identified and included in the ELGs at 40 CFR 434, Coal Mining. The federal ELGs that apply to discharges from the Project area are for alkaline mine drainage (Subpart D), western alkaline coal mining (Subpart H), and precipitation discharge events (Subpart F). ELGs after application of the best practicable control technology currently available are provided in **Table 24** for new coal facilities. Alkaline mine drainage is defined as having a pH equal to or greater than 6.0, a total iron concentration of less than 10 milligrams per liter (mg/L), and a net alkalinity greater than zero before any treatment.

Table 24. Effluent Limit Guidelines for New Coal Mine Point Source Discharges.

Parameter	1-Day Maximum	30-Day Average
Iron, total (mg/L)	6.0	3.0
Total suspended sediments (mg/L)	70.0	35.0
pH (s.u.)	6.0–9.0	6.0–9.0
Settleable solids[1] (mL/event)	0.5	NA

Source: 40 CFR 434, Subparts D and F.
mg/L = milligrams per liter; s.u. = standard units; mL = milliliters.
[1] Settleable solids limits are for discharges caused by precipitation events less than or equal to the 10-year, 24-hour precipitation event.

Subpart H is applicable to alkaline mine drainage at western coal mining operations from reclamation areas, brushing and grubbing areas, topsoil stockpiling areas, and graded areas. Subpart H requires

approval of a site-specific Sediment Control Plan designed to prevent an increase in the average annual sediment yield from current undisturbed conditions. The Sediment Control Plan must identify best technology currently available (BTCA) and must describe design specifications, construction specifications, maintenance schedules, and criteria for inspection, as well as expected performance and longevity of the BTCA. BTCA must be designed, implemented, and maintained as specified in the approved Sediment Control Plan.

USEPA has delegated authority to the state, through DEQ, for administering nonpoint source pollution prevention programs, the Montana Pollutant Discharge Elimination System (MPDES) program for point sources, and water quality standards. The Montana Water Quality Act provides a regulatory framework for protecting, maintaining, and improving the quality of water for beneficial uses.

State Requirements

State surface water quantity and quality regulations applicable to the analysis area include MSUMRA, which contains reclamation requirements to protect the hydrologic balance and achieve postmine land use performance standards. Hydrologic balance is defined as "the relationship between the quality and quantity of water inflow to, water outflow from, and water storage in a hydrologic unit such as a drainage basin, aquifer, soil zone, lake, or reservoir, and encompasses the dynamic relationships among precipitation, runoff, evaporation, and changes in ground water and surface water storage per 82-4-203(25), MCA." The Montana Water Quality Act, which prevents degradation of surface and ground waters due to discharges of mine wastewater and storm water, is also applicable. Both MSUMRA and the Montana Water Quality Act are discussed in more detail below. State water rights requirements are described in **Section 3.7, Water Resources – Water Rights**.

MSUMRA bases its conditions for approval of an application for a coal mine operating permit on demonstration by the applicant that "the assessment of the probable cumulative impact of all anticipated mining in the area on the hydrologic balance has been made by the department [DEQ] and the proposed operation of the mining operation has been designed to prevent material damage to the hydrologic balance outside the permit area" under 82-4-227(3)(a), MCA; ARM 17. 24.314(5); and ARM 17.24.405(6)(c). MSUMRA defines "material damage" as follows: "with respect to protection of the hydrologic balance, degradation or reduction by coal mining and reclamation operations of the quality or quantity of water outside of the permit area in a manner or to an extent that land uses, or beneficial uses of water, are adversely affected, water quality standards are violated, or water rights are impacted. Violation of a water quality standard, whether or not an existing water use is affected, is material damage." The permit application must contain a detailed description of the "measures to be taken during and after mining activities to minimize disturbance to the hydrologic balance on and off the mine permit area and prevent material damage to the hydrologic balance outside the permit area" under ARM 17.24.314(1). Material damage criteria are established for the evaluation of both surface and ground water quality and quantity, and are used to determine if water quality or quantity outside the permit area would be impacted to the extent that land uses or beneficial uses of water are adversely affected, water quality standards outside the permit area would be violated, or water rights outside the permit area would be impacted by the proposed mine operations. An approved application for a coal mine operating permit allows adverse impacts on water quality and quantity within the permit boundary if the proposed mining includes measures to minimize disturbance on and off the mine plan area and to prevent material damage to the hydrologic balance outside the permit area (ARM 17.24.314(1)). This EIS is not the cumulative hydrologic impact assessment required in 82-4-227(3)(a), MCA; ARM 17.24.314(5); and ARM 17.24.405(6)(c) and makes no determinations regarding material damage (or any other MSUMRA requirement). The cumulative hydrologic impact assessment and determination of whether the permit is designed to prevent material damage is conducted by DEQ as part of their written findings on the permit decision.

Surface Water Quantity and Quality

The rules implementing MSUMRA (ARM 17.24.301 through 1309) provide requirements to protect water quality and quantity, including water quality performance standards and the use of best technology currently available to protect water resources. The regulations limit or prevent stream-channel disturbances within 100 feet of a perennial or intermittent stream or a stream reach with a biological community (as defined by ARM 17.24.651(3)) and to the stream itself. Disturbances within 100 feet may be approved provided requirements are met for reclaiming drainage basins to restore the original stream function and prevent, during and after mining, adverse impacts on water quantity and quality and other environmental resources of the stream and lands within 100 feet of the stream. The regulations provide requirements for the design, construction, stabilization, and maintenance of water diversions, sediment ponds, and other treatment facilities (e.g., discharge structures and acid- and toxic-forming spoil impoundments). The regulations also require surface water monitoring and reporting. 82-4-203, MCA provides definitions for ephemeral drainages and intermittent and perennial streams:

- “’Ephemeral drainageway’ means a drainageway that flows only in response to precipitation in the immediate watershed or in response to the melting of a cover of snow or ice and is always above the local water table.”
- "’Intermittent stream’ means a stream or reach of a stream that is below the local water table for at least some part of the year and obtains its flow from both ground water discharge and surface runoff.”
- “’Perennial stream’ means a stream or part of a stream that flows continuously during all of the calendar year as a result of ground water discharge or surface runoff.”

DEQ is responsible for administering the Montana Water Quality Act, which prevents degradation of surface and ground waters due to discharges of mine wastewater and storm water (implementing rules: ARM 17.30 Subchapters 11, 12, and 13). Montana’s nondegradation rule applies to any human activity resulting in a new or increased source that may cause degradation of high-quality waters. The analysis area would be considered a new source. High-quality waters include all state surface waters except those “not capable of supporting any one of the designated uses for their classification” or those that “have zero flow or surface expression for more than 270 days during most years.” For all state waters, existing and anticipated uses and the water quality necessary to protect those uses must be maintained. For high-quality waters outside the permit boundary, degradation may be authorized by DEQ following procedures described in ARM 17.30.708, or it may be determined that the changes in existing water quality are nonsignificant as described in ARM 17.30.715 or 17.30.716. The nondegradation rules do not apply to nonpoint sources of pollution to water resources within (or outside) the permit boundary.

DEQ also administers several sections of the CWA pursuant to an agreement between the state and USEPA. DEQ developed water quality classifications and standards, as well as a permit system to control discharges into state waters. Mining operations must comply with state regulations and standards for surface water and ground water. MPDES permits are required for point discharges of wastewater to state surface water. MPDES permits regulate discharges of wastewater by establishing effluent limitations based on, when applicable, technology-based effluent limits, state surface water quality standards including numeric and narrative requirements, and nondegradation criteria.

Section 303(d) of the CWA requires states to assess the condition of state waters to determine where water quality is impaired (does not fully support uses identified in the stream classification or does not meet all water quality standards) or threatened (is likely to become impaired in the near future). The result of this review is the compilation of a 303(d) list, which states must submit to USEPA biannually. Section 303(d) also requires states to prioritize and target waterbodies on their list for development of water

quality improvement strategies, and to develop such strategies for impaired and threatened waters such as Total Maximum Daily Loads (TMDLs). A TMDL, as defined by USEPA, is a pollution budget that includes a calculation of the maximum amount of a pollutant that can occur in a waterbody and allocates the necessary reductions to one or more pollutant sources. A TMDL serves as a planning tool and potential starting point for restoration or protection activities with the ultimate goal of attaining or maintaining water quality standards.

Streams near the Rosebud Mine are on the current 303(d) list (DEQ 2018). The 303(d) list lists causes (a chemical or physical condition that could affect uses) and sources (an activity that could contribute to that condition). Causes are listed with high, medium, or low confidence; and sources are listed as either confirmed or unconfirmed. Rosebud Creek is listed for loss of riparian habitat due to physical substrate habitat alterations and impacts on the creek due to dam construction for flood control. East Fork Armells Creek from Colstrip to its confluence with West Fork Armells Creek is listed for alteration in streamside or littoral vegetative cover, habitat alterations, and total phosphorus due to grazing in riparian or shoreline zones, aluminum and iron due to natural sources, nitrate+nitrite and total nitrogen due to agriculture, and specific conductivity and total dissolved solids (TDS) due to transfer of water from an outside watershed and coal mining. East Fork Armells Creek upstream of Colstrip is listed for alteration in streamside or littoral vegetative cover due to grazing in riparian or shoreline zones.

Classification and Standards

Montana’s surface water quality is regulated through classifications and standards, which 75-5-301, MCA states:

> (1) establish the classification of all state waters in accordance with their present and future most beneficial uses, creating an appropriate classification for streams that, due to sporadic flow, do not support an aquatic ecosystem that includes salmonid or nonsalmonid fish;
>
> (2) formulate and adopt standards of water quality, giving consideration to the economics of waste treatment and prevention.

Stream classification is described under ARM 17.30.606, with spatial description provided under ARM 17.30.611 generally classifying waters in the affected environment under the C-3 classification (ARM 17.30.629). Narrative water quality standards found at ARM 17.30.637 also apply to C-3 waters of the state. One specific general prohibition from ARM 17.30.637(4) says “Treatment requirements for discharges to ephemeral streams must be no less than the minimum treatment requirements set forth in ARM 17.30.1203. Ephemeral streams are subject to ARM 17.30.635 through 17.30.637, 17.30.640, 17.30.641, 17.30.645, and 17.30.646 but not to the specific water quality standards of ARM 17.30.6.20 through 17.30.629.”

Streams within the Project area including Lee, Richard, and Rape Coulees are considered ephemeral, and as such the general prohibition of ARM 17.30.637(4) applies to these ephemeral streams. The C-3 classification standards for other waters of the state (defined by 75-5-103(34), MCA) are applicable, other than in waterbodies solely used for treating, transporting, or impounding pollutants (under ARM 17.30.611), which includes sedimentation ponds and traps associated with the mine’s drainage control plan.

Class C-3 waters “are to be maintained suitable for bathing, swimming, and recreation, and growth and propagation of nonsalmonid fish and associated aquatic life, waterfowl, and furbearers.” The quality of C-3 waters is “naturally marginal for drinking, culinary, food-processing purposes, agriculture, and industrial water supply” under ARM 17.30.629(1). Montana surface water quality standards for inorganic

pollutants applicable to perennial and intermittent streams, ponds, and springs in the analysis area are provided in **Table 25** (DEQ 2019).

The standards listed in **Table 25** presumably would apply only to perennial and intermittent streams, ponds, and springs in the analysis area. Discharges to ephemeral streams would be subject to general treatment standards (ARM 17.30.635), general operation standards (ARM 16.30.636), and general prohibitions (ARM 17.30.637), but would not be subject to the water quality standards listed in **Table 25**.

Table 25. Montana Surface Water Quality Standards for C-3 Waters.

Parameter – Category[1]	Human Health Standard	Aquatic Life Standard[2]	
		Acute	Chronic
Temperature (°F) – H	—	• 3ºF maximum increase for naturally occurring range of 32º to 77ºF • In range of 77° to 79.5°F, no increase to above 80ºF • 0.5ºF maximum increase for naturally occurring 79.5ºF or greater • 2ºF per hour maximum decrease for naturally occurring temperatures above 55ºF; 2ºF maximum decrease for naturally occurring range of 32º to 55ºF	
pH (s.u.)[3]	—	—	—
Dissolved oxygen[4] – T	—	• 5.0 (early life) • 3.0 (other life stages)	• 6.0 (7-day mean, early life) • 4.0 (7-day mean minimum, other life stages) • 5.5 (30-day mean, other life stages)
Escherichia coli	**April 1–October 31:** geometric mean may not exceed 126 colony-forming units per 100 milliliters, and 10 percent of the total samples may not exceed 252 colony-forming units per 100 milliliters during any 30-day period **November 1–March 31:** geometric mean may not exceed 630 colony-forming units per 100 milliliters, and 10 percent of the total samples may not exceed 1,260 colony-forming units per 100 milliliters during any 30-day period	—	—
Turbidity (NTU)[8] – H	—	Increase above ambient no more than 10 NTUs	Increase above ambient no more than 10 NTUs
Nitrate+nitrite, as N – T	10	No excessive amounts that would produce undesirable aquatic life	
Ammonia, as N – T	—	Calculated based on stream pH	Calculated based on stream pH and temperature
Total nitrogen	—	—	
Total phosphorus	—	—	
Aluminum[5] – T	—	0.75	0.087
Antimony[5]– T	0.0056	—	—
Arsenic[5] – C	0.01	0.34	0.15
Barium[5] – T	1.0	—	—
Beryllium[5] – C	0.004	—	—

Table 25. Montana Surface Water Quality Standards for C-3 Waters.

Parameter – Category[1]	Human Health Standard	Aquatic Life Standard[2]	
		Acute	Chronic
Cadmium[5] – T	0.005	0.0074	0.0024
Chromium[5] – T	0.1	5.61/0.016[6]	0.27/0.011[6]
Copper[5] – T	1.3	0.052	0.031
Fluoride[5] – T	4.0	—	—
Iron[5] – H	—	—	1.0
Lead[5] – T	0.015	0.477	0.019
Mercury[5] – T, BCF>300[7]	0.00005	0.0017	0.0009
Nickel[5] – T	0.1	1.52	0.169
Selenium[5] – T	0.05	0.020	0.005
Silver[5] – T	0.1	0.044	—
Zinc[5] – T	2.0	0.388	0.388

Source: Circular DEQ-7, Montana Numeric Water Quality Standards (DEQ 2019); ARM 17.30.629.
All units are in milligrams per liter (mg/L) unless otherwise indicated.

1 T = toxic; C = carcinogen; H = harmful (aquatic life).

2 Many metals standards are hardness-dependent; for this table, values presented are based on a hardness of 400 mg/L. DEQ-7 states that 400 mg/L is to be used to calculate hardness-dependent metals standards when hardness is greater than or equal to 400 mg/L. Hardness in most surface water samples in the analysis area is greater than 400 mg/L.

3 s.u. = standard units. Under ARM 17.30.629(2)(c), induced variation in pH within a range of 6.5 to 9.0 must be less than 0.5 pH unit; natural pH outside this range must not change; natural pH above 7.0 must be maintained above 7.0.

4 Dissolved oxygen standards are water column concentrations; see DEQ-7 for other notes.

5 All metals standards except aluminum are based on total recoverable concentrations. Aluminum standards are based on dissolved aluminum concentrations and are valid only in a pH range of 6.5 to 9.0.

6 Aquatic life chromium standards are for trivalent/hexavalent forms.

7 Mercury has a bioconcentration factor of greater than 300 (developed by USEPA).

8 NTU = nephelometric turbidity units.

mg/L = milligrams/liter; "—" = no applicable standard.

Primary pre-mining land uses in and downslope of the analysis area are grazing/pasture land, cropland, and wildlife habitat. There is little scientific consensus on recommended water quality limits for livestock, which is assumed to be appropriate for wildlife. The values presented in several studies are shown in **Table 26**. The state and USEPA have not established ambient water quality criteria for livestock or wildlife.

Table 26. Recommended Water Quality Concentration Limits for Livestock.

Analyte	NRC 1972	Bagley 1997	Sigler & Bauder 2006	Raisbeck et al. 2008	Olkowski 2009	Pick 2011	Pfost et al. 2012	Meehan et al. 2015
Aluminum	5				5	5	5	5
Arsenic	0.2	0.2	0.2	1	0.025	0.01	0.2	0.2
Barium						10		10
Bicarbonate								
Boron	5				5	5	5	
Cadmium	0.05	0.05	0.05		0.08	0.05	0.05	0.05
Calcium					1,000	500		1,000
Chloride						1,500		
Chromium	1	1	1		0.05	1	1	1
Copper	0.5	0.05	0.5		0.5	0.5	0.5	0.5
Fluoride	2	2	2	2	1	2	2	2
Iron						0.3		
Lead	0.1	0.1	0.1		0.1	0.1	0.05	0.1
Magnesium						125		
Manganese						0.05		
Mercury	0.01	0.01	0.01		0.003	0.01	0.01	
Molybdenum				0.3	0.5			0.5
Nickel			1					1
Nitrate (as N)	23	100	100	114	23	100	23	100
Nitrite (as N)	2.3	33	10	23	3	10	2.3	33
pH		8.3				8.5	7.5	9
Selenium	0.05			0.1	0.05	0.05	0.05	0.05
Sodium				1,000				1,000
Sulfate		1,000	2,500	1,000	1,000	1,000	2,000	500 - 1,000
TDS		10,000	5,000		3,000	10,000	10,000	10,000
Vanadium	0.1	0.1	0.1		0.1	0.1	0.1	0.1
Zinc	25	25	25		50	25	24	25

Note: Metal limits are for both dissolved and total metals.

In southeastern Montana, ambient surface water concentrations of sodium, sulfate, and TDS often naturally exceed recommended concentrations for these parameters, particularly in stock ponds. Cattle will adapt to higher TDS concentrations, and wildlife likely also will adapt to higher TDS concentrations, but sulfate in particular can affect animal weight gain and health (MSU 2014). Aquatic life data collected by DEQ in streams in southeastern Montana, including East Fork Armells Creek (DEQ 2017), indicate that these streams support an assemblage of species that are tolerant of naturally occurring sodium, sulfate, and TDS concentrations that exceed the recommended concentrations, which is similar to the community assemblage identified in a survey from the 1970s. In most situations, the naturally occurring minerals in water do not result in acute toxicosis but lead to chronic conditions of poor animal performance or increased health problems (National Research Council 2005). TDS toxicity in animals depends on the type and combination of ions in solution (Timpano et al. 2010). TDS concentrations exceeding 500 to 1,000 mg/L may be harmful to sensitive crops in southeastern Montana, and 3,150 mg/L is about the maximum TDS concentration tolerated by most plants (Ferriera 1984). However, waters with higher TDS concentrations support wetlands in the analysis area. Plant response and tolerance to water quality conditions is highly variable and can be influenced by interactions between conditions associated with water (constituents, irrigation method, and drainage); soil (profile, biota, fertility, and drainage); plants (variety, growth stage, and density); and climate (air quality and seasonality) (Maas and Grattan 1999).

Local Requirements

The Federal Emergency Management Agency (FEMA) has mapped the floodplains in the analysis area as Special Flood Hazard Areas (Zone A), which are areas subject to inundation by the 100-year flood. Detailed hydraulic analyses have not been performed for Special Flood Hazard Areas, so no base flood elevations or flood depths have been estimated (FEMA 2015). Anyone planning new development within a designated Special Flood Hazard Area, including excavation, placement of fill, storage of equipment or materials, roads, culverts, bridges, and other activities, must obtain a permit for such development from the local floodplain administrator. This administrator is designated by the city or county government. The following links provide state and local resources and guidance associated with floodplain management including points of contact for Rosebud County, required permitting forms, and the 2014 Model Floodplain Hazard Management Regulations (revision 2017):

- http://dnrc.mt.gov/divisions/water/operations/floodplain-management
- http://dnrc.mt.gov/divisions/water/operations/floodplain-management/contacts
- http://dnrc.mt.gov/divisions/water/operations/floodplain-management/property-owner-resources
- http://dnrc.mt.gov/divisions/water/operations/floodplain-management/permitting-and-regulations

The purpose of the Floodplain Development Permit is to review and permit appropriate uses within Special Flood Hazard Areas that will not be seriously damaged or present a hazard to life if flooded, thereby limiting the expenditure of public tax dollars for emergency operations and disaster relief.

Anyone planning to do work on or near a waterway in Montana must submit a 310 Joint Application Form 270 for Proposed Work in Montana's Streams, Wetlands, Floodplains, and Other Water Bodies to the conservation district in which the activity will take place (refer to the following link for the Rosebud Conservation District: http://dnrc.mt.gov/divisions/cardd/conservation-districts/what-is-a-conservation-district). Projects must be designed and constructed to minimize adverse impacts on the stream and stream banks. The Project must be reviewed to determine the impacts of soil erosion and sedimentation; the impacts of stream alteration; the impacts on stream flow, turbidity, and water quality; the impacts on fish and aquatic habitat; whether there are modifications or alternatives that would reduce disturbance to the stream and its environment; and whether the Project would create harmful flooding or erosion problems.

3.5.1.2 Analysis Area and Methods

Analysis Area

Surface water impacts from mining activity may include changes in surface water quantity (presence or flow could apply) or quality for springs, seeps, streams, and ponds. The analysis area associated with surface water impacts encompasses surface watersheds extending through and downstream from the 9,108-acre proposed permit area that receives surface water drainage from the 5,547-acre disturbance area as modified by AM5. This analysis area primarily includes the Richard Coulee and Lee Coulee drainages of the Rosebud Creek watershed (**Figure 33**), as well as disturbance areas within the existing Area B permit boundary. Surface water features were inventoried within 1 mile surrounding and 3 miles downgradient of the permit boundary.

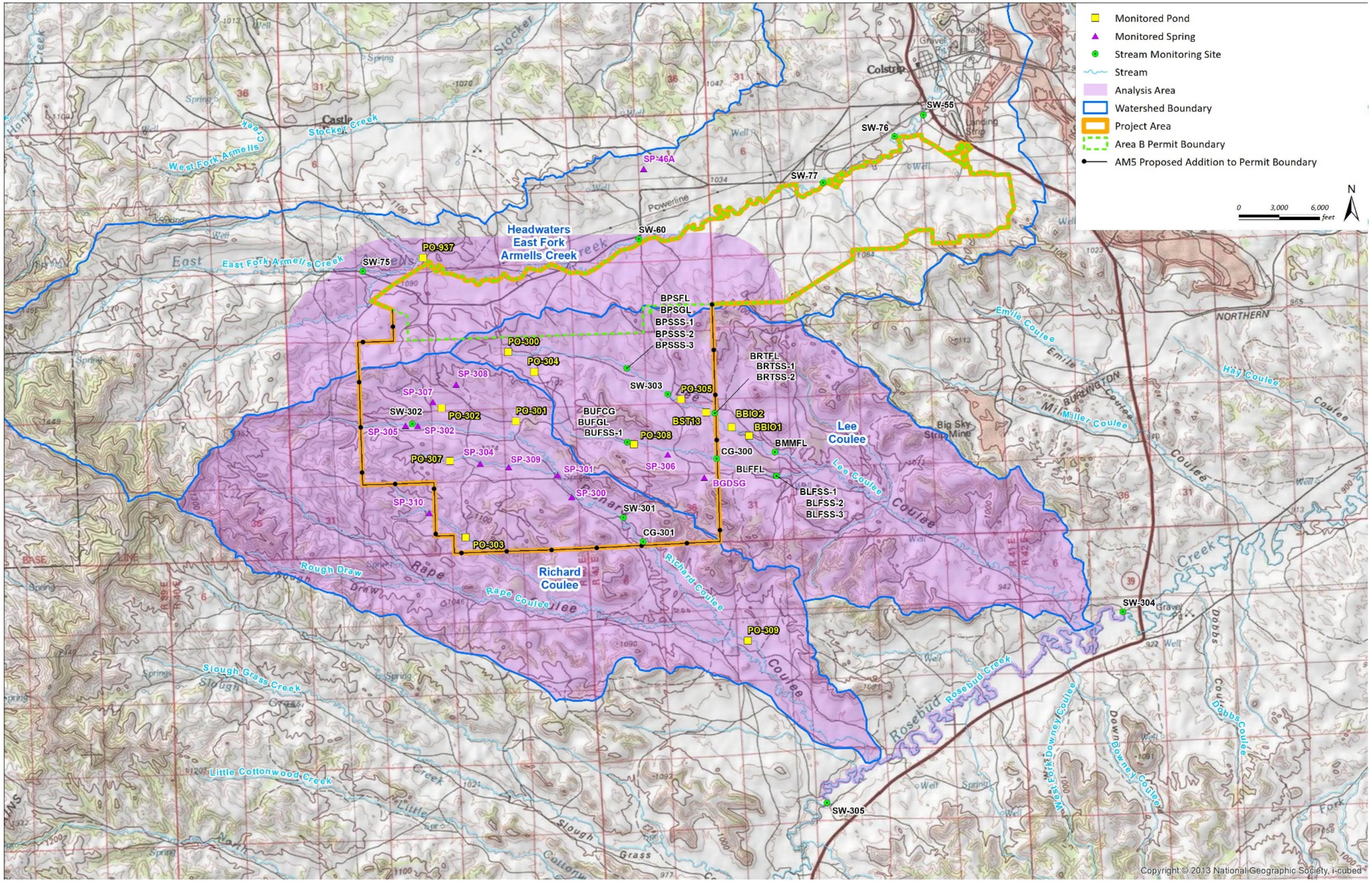

Figure 33. Surface Water Analysis Area.

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Analysis Methods

Existing hydrologic and water quality conditions in the analysis area are represented by data collected primarily since 2013 and supplemented with data collected by Big Sky Mine prior to 2013. During the monitoring period, climate conditions represented a wide range of very wet to very dry conditions, as described in **Section 3.5.2.1, Climate**, which may differ from long-term variability of those conditions.

Impacts on peak stream flows were quantitatively analyzed using USGS regression equations developed for Montana (Sando et al. 2018). Westmoreland Rosebud used the USDA Water Erosion Prediction Project (WEPP) and Sediment, Erosion, Discharge by Computer Aided Design (SEDCAD) models to evaluate the impact of mining disturbance on sediment yields in drainages in the analysis area (Application Appendix V). The WEPP model was used to estimate average annual sediment yield based on existing vegetation and land use in the analysis area. Sediment yield from the postmine reclaimed land in the analysis area was modeled using SEDCAD. Other impacts were evaluated qualitatively or quantitatively based on data provided by Westmoreland Rosebud in its water quality database, information provided by Westmoreland Rosebud in the Area B/AM5 Application 2018 and Appendices, information collected in a June 2018 field visit to the Project area, information provided by DEQ on the Rosebud and Big Sky Mines, and the analysis provided in **Section 3.6, Water Resources – Ground Water**.

3.5.2 Affected Environment

3.5.2.1 Climate

The analysis area is in the Northwest Great Plains Ecoregion, which encompasses the Missouri Plateau section of the Great Plains. The region has a semiarid climate and flat to rolling topography of shale and sandstone punctuated by occasional buttes. Native grasslands persist in rangeland areas. Daily precipitation and other climate data are recorded at a weather station in Colstrip (NOAA 2018), summarized below, and at multiple private weather stations within the Rosebud Mine property (Application Appendix C). Precipitation is variable, ranging from 5 to nearly 25 inches per year (over the past 40 years) and averaging 15 inches. Between 1980 and 2016, precipitation tended to shift from below average (1980 to 1990) to average (1990 to 1999) to a drier period (1999 to 2004) to a wetter period (2005 to 2016). The wettest months are May and June, and the driest are November through February. Large precipitation events of 1 to 3 inches in a day were observed, and monthly precipitation totals of 4 to 10 inches have been recorded in April through September. Large multiday events occurred on May 20 to 22, 2011, when 4.8 inches of precipitation fell, and on May 19 to 31, 2013, when 7.6 inches of precipitation fell (with 5.5 inches falling on the last 2 days). The two wettest years during the past 40 years occurred in 2016 (25.0 inches) and in 2011 (23.9 inches). The two driest years during the past 40 years occurred in 1979 (5.8 inches) and in 2012 (7.4 inches). The years 2015 and 2017 were slightly drier than average (each 12 inches).

Average annual snowfall over the past 40 years was 39 inches, with the highest average monthly accumulation observed in January (7.5 inches) and with December, February, and March accumulations averaging 6.3 to 7.2 inches. From 2012 through 2018, months with the highest snow accumulation included February 2018 (34.5 inches), December 2016 (17.5 inches), and March 2014 (15.5 inches). The highest annual snow accumulation on record was 2018 with a total of 87.2 inches. Annual accumulations ranged from above average (46 to 87 inches) in 2011, 2013–2014, 2017, and 2018; below average (31 to 34 inches) in 2015 and 2016; and low (6.8 inches) in 2012.

3.5.2.2 Floodplains

Section 1.1.1.1, Regulatory Framework, Local Requirements provides background information on locally mapped floodplains by FEMA.

3.5.2.3 Hydrologic Balance

Precipitation as rain and snow, described in **Section 3.5.2.1, Climate**, is the source of water to the hydrologic system in the Project area. Most of the precipitation is returned to the atmosphere by evaporation from waterbodies, plants, and the ground surface, as well as transpiration from plants. Annual pan evaporation at the Rosebud Mine was calculated to range from 30.95 to 35.67 inches per year (Application Appendix C, Section 2.1.4), while evapotranspiration at Colstrip was calculated using the Blaney-Criddle formula to average nearly 28 inches per year (Application Appendix C, Section 2.1.5), both exceeding average annual precipitation of 15 inches per year. The loss of moisture by evapotranspiration is a major factor in the water balance for this semiarid area. Sublimation, the direct conversion of ice or snow to water vapor, occurs during the winter months (November through March), and in the Colstrip area has been estimated to transfer about half of the winter precipitation, or about 2.5 inches, back into the atmosphere (Application Appendix C, Section 2.1.6). Water loss metrics associated with the water balance are not available in the Area B Application; however, specific water loss metrics were provided in the Area F Application Appendix B. Interception loss of precipitation occurs as a result of vegetative cover absorbing the water or evaporation from the vegetation and is estimated to range from about 0.5 to 1.8 inches per year (Area F Application Appendix B, Table B-1). Infiltration is the movement of water into and through the soil. Based on soil type, the average infiltration rate in the Project area is 2.3 inches per hour (Area F Application Appendix B, Table B-4). This substantially reduces runoff because most precipitation events in the area have intensities of less than 2 inches per hour. When the rainfall or snowmelt rate exceeds the infiltration rate, water flows overland to drainage channels. Soil can absorb significant quantities of water infiltrating in the subsurface. Soil in the Project area has a capacity to hold water that averages 0.1 inch per inch of soil (Area F Application Appendix B, Table B-4). Soil moisture content is typically highest in the spring and early summer and driest in late summer. Soil can be a major factor in water storage, from where water can be evaporated to the atmosphere or taken up by plants. Ground water recharge, discharge, and storage are also parts of the hydrologic balance in the Project area and are discussed in **Section 3.6, Water Resources – Ground Water**. When a land surface is disturbed by human activities, there may be changes in vegetative cover, soil cover, and topography, resulting in changes to the hydrologic balance.

3.5.2.4 Surface Water Hydrology

Springs

Numerous springs occur in the analysis area. Westmoreland Rosebud inventoried springs in the analysis area and documented the locations of 36 springs (Application Appendix O). Eleven of those springs are located adjacent to tributaries or mainstems of Rape Coulee (SP-310); Richard Coulee (SP-300, 301, 302, 304, 305, 307, 308, and 309); and Lee Coulee (SP-306, BGDSG) (**Figure 33**). One spring (SP-46A) is located in the East Fork Armells Creek drainage basin and is not included in this characterization due to its distance from AM5 disturbance areas (more than 3 miles). Westmoreland Rosebud has been monitoring the following 11 springs: (Application Appendix O, Figure 57, Table 25, Attachment F; Application Appendix B, Attachment C-2):

- Monitored at least annually since 1985: BGDSG
- Monitored monthly since 2013: SP-300, SP-301, SP-302

- Monitored monthly since 2015: SP-304, SP-306
- Monitored monthly since 2016: SP-305, SP-307, SP-308, SP-309, SP-310

The likely ground water source for monitored springs is alluvium or overburden except for SP-306, which is sourced from spoil (see **Section 3.6, Water Resources – Ground Water**). The springs provide sources of water for wildlife and livestock use and supply water to some existing ponds and wetlands (see **Section 3.9, Wetlands**). Some of the springs have been improved by ranchers to increase water availability for livestock use. No water rights appear to be associated with any of the 11 monitored springs (see **Section 3.7, Water Resources – Water Rights**).

The monitored springs are typically located in ephemeral drainages where shallow or perched ground water seeps from alluvium, overburden, or spoil sources at relatively low discharge rates; flows for limited stretches; and is lost to evapotranspiration or infiltration. Spring discharge volumes and rates vary with season and climatic conditions. Spring flows were quantifiable in 7 of the 11 springs (SP-300, 301, 304, 306, 307, 309, and BGDSG) during their monitoring periods, and the springs without measurable flows were observed to have wet, ponded, or frozen conditions (Application Appendix B, Attachment C-2). Over the past decade, the highest spring flow occurred at SP-300 in March 2020 at 8.5 gallons per minute (gpm).

Streams

The analysis area includes portions of the Richard and Lee Coulee drainage basins that convey surface water in a southeasterly direction to Rosebud Creek and includes a portion of the East Fork Armells Creek drainage basin that conveys surface water in an easterly then northerly direction to Armells Creek (**Figure 33**). Rosebud Creek and Armells Creek are both tributaries of the Yellowstone River. The Application includes surveyed pre-mine channel cross-sections (Application Appendix J, Exhibit J-1); geomorphic characteristics (e.g., drainage area, slope, length, relief, stream length, and channel sinuosity) (Application Appendix J, Table J-2); and other information on the watersheds in the analysis area. The sections below describe flow conditions in each of the individual analysis area streams.

When the ground water table is consistently below the channel bottom, ground water discharge is not a source of water to a creek, and ephemeral flow occurs only during and after snowmelt runoff or rainfall events. When the ground water table is above the stream channel during part of the year, a stream is intermittent and flows not only when surface runoff enters the channel, but also when ground water discharges to the stream surface as baseflow (82-4-203, MCA). Baseflow is the contribution of near-channel alluvial ground water and deeper bedrock ground water to a stream channel. A perennial stream flows continuously in its channel, either because it has a constant source of surface runoff (such as from springs) or because the ground water table is above the channel bottom for all the year, providing baseflow. Richard Coulee (including Rape Coulee) and Lee Coulee are dominated by ephemeral flow characteristics in the analysis area with minor water flow contributions from springs described in the previous section. East Fork Armells Creek includes ephemeral flow characteristics that transition to intermittent flow characteristics along the northeast edge of Area B.

Richard Coulee

In the AM5 expansion area, the Richard Coulee channel elevation is above alluvial, overburden, and Rosebud Coal ground water elevations and, therefore, is dominated by ephemeral flow characteristics with minor water flow contributions from springs (see the **Springs** section). The Richard Coulee channel elevation has been estimated (Application Appendix O) to intersect the overburden ground water level near spring SP-300 (**Figure 33**) and the Rosebud Coal level at its outcrop near surface water monitoring

site SW-301 (**Figure 33**) where alluvial ground water level is below the channel elevation. At the southern boundary of the AM5 proposed addition to the permit boundary, the Richard Coulee channel elevation is 10 to 15 feet above alluvial ground water.

Richard Coulee includes three surface water monitoring sites near the upstream (SW-302) and downstream (SW-301 and CG-301) portions of the permit boundary. CG-301 was installed in November 2017, and eight monitoring events through March 2020 reflected recorded crest gage measurements at the installation of up to 1.9 feet (March 2020).

SW-302 is in the upstream portion of the AM5 expansion area between two springs (SP-305 is 500 feet upstream, and SP-302 is 430 feet downstream from SW-302) and between two inventoried wetlands (G-514 is 900 feet upstream, and G-515 extends through SW-302) (Application Appendix O, Figures 13 and 63C). A third connected wetland (G048) is downstream from SW-302. Although flow from both springs has not been quantifiable during their monitoring periods, field notes indicate that recorded flows at SW-302 are influenced by spring flows (during lower flows) and rain/snow events (during higher flows). Wetland G-514 is an impoundment fed by a seep. Wetlands G515 and G048 are in drainage wetlands fed by springs SP-305 and SP-302 (Application Appendices E and O). SW-302 surface water flow conditions were monitored by measuring instantaneous depth of flow in a trapezoidal flume manually monthly since August 2013 and automatically with a pressure transducer daily since November 2013. Surface water flow rates were then calculated by entering measured water depths into a flume equation. A comparison between automated flume measurements and monthly manual measurements show reasonable agreement between the two measurements. Through the monitoring period, average daily flow rates at SW-302 ranged from 0 to 453 gpm (January 2015) with a total average daily flow rate of 10 gpm. (Application Appendices B and O). Ground water monitoring near SW-302 indicates that alluvial ground water levels are below the channel thalweg (line of lowest elevation).

SW-301 is in the downstream portion of the AM5 expansion area and situated 0.8 mile downstream from spring SP-300, which is consistently flowing (up to 2.7 gpm) to sustain an inventoried wetland G-054 between the spring and SW-301 (Application Appendix O, Figure 63D). Field notes indicate that flow from SP-300 occasionally reaches SW-301. The length of Richard Coulee that coincides with wetland G-054 includes remnants of historical dams that impede surface water flow (Application Appendix E). In September 2015, the measured wetted area of wetland G-054 was 27,700 square feet and contained woody debris and relatively abundant aquatic vegetation, and the aquatic life survey identified 28 species at the wetland (Application Appendix F). SW-301 surface water flow conditions were monitored with similar methods as SW-302 described above since October 2013 (manual monthly) and since November 2013 (automated daily). A comparison between automated flume measurements and monthly manual measurements show fair agreement between the two measurements. Through the monitoring period, average daily flow rates at SW-301 ranged from 0 to 31 gpm (November 2015) with a total average daily flow rate of 6 gpm. Ground water monitoring records indicate that alluvial ground water levels near SW-301 are 11 feet below the channel thalweg (line of lowest elevation) and may indicate that low permeability of the underlying geology impedes channel infiltration and sustains the wetland in this area (Application Appendices B and O).

Lee Coulee

In the AM5 expansion area, the Lee Coulee drainage channel elevation is above alluvial, overburden, and Rosebud Coal ground water elevations and, therefore, dominated by ephemeral flow characteristics with minor water flow contributions from springs (see the **Springs** section). The Fossil Fork of Lee Coulee channel elevation intersects the Big Sky Mine spoil ground water level near spring SP-306. In Lee Coulee, pond PO-305 (**Figure 33**) was excavated below the overburden and Rosebud Coal ground water levels. Downstream from PO-305, the Lee Coulee channel is below the Rosebud Coal level at its outcrop

near pond BBIO2 (**Figure 33**), and the Big Sky Mine Lee Coulee wet reach experiences wet conditions during periods of above average precipitation and dry conditions during periods of average and below average precipitation (Application Appendix O).

Lee Coulee includes seven surface water monitoring sites. Three of the seven sites (BUF, BLF, and CG-300) are located on a major tributary to Lee Coulee and collectively include eight separate installations of monitoring equipment. Six of those eight installations (BUFCG, BUFGL, BUFSS-1, BLFSS-1, BLFSS-2, and BLFSS-3) were historically monitored by the Big Sky Mine. One of those eight installations (CG-300) was installed in November 2017 where a tributary to Lee Coulee crosses the eastern edge of the AM5 permit boundary, and nine monitoring events through March 2020 reflected recorded crest gage measurements at the installation of up to 1 foot (April 2018). Another of those eight installations (BLFFL) was historically monitored by the Big Sky Mine downgradient from the AM5 expansion area boundary with a continuous flow recorder since May 2012, recording infrequent flow events, the largest of which was recorded from May 29 through May 31, 2013, with a maximum flow rate of 676 gpm. The BUF sites (upstream from mining) rarely recorded flow.

Four of the seven sites (BPS, BRT, BMM, and SW-303) are located on Lee Coulee and collectively include 10 separate installations of monitoring equipment. Five of those 10 installations (BPSGL, BPSSS-2, BPSSS-3, BRTSS-1, and BRTSS-2) were historically monitored by the Big Sky Mine and have no flow data recorded, although flows have been recorded at the flumes co-located with these installations (BPSFL and BRTFL). One of those 10 installations (BPSSS-1) was historically monitored by the Big Sky Mine and has occasional recorded flows up to 4 feet deep. The most recent flow event field recorded was in April 2017 at 0.22 feet deep. Another of those 10 installations (SW-303) is a future monitoring site to be located near where Lee Coulee crosses the eastern edge of the AM5 expansion area boundary. Three of those 10 installations (BPSFL, BRTFL, and BMMFL) are active monitoring sites historically managed by the Big Sky Mine.

BPSFL is located within the AM5 permit boundary where Lee Coulee crosses the western edge of the Big Sky Mine permit boundary near one active alluvial well (BAL2011) monitored for ground water level since the mid-1980s and near a shallow vernal pool (Pool 4-4/8) exhibiting no wetland vegetation. Well BAL2011 has experienced water level declines from the mid-1980s to 2010 followed by a general increase in water level purported to be related to precipitation fluctuations (Application Appendix O). Ground water monitoring records of BAL2011 indicate that alluvial ground water levels near BPSFL are 20 feet below the channel thalweg. Dry alluvial wells persist in the Fossil Fork tributary of Lee Coulee. Pool 4-4/8, near BPSFL, reportedly has a relatively insignificant surface water connection to Lee Coulee. In September 2015 and July 2016, Pool 4-4/8 was dry and unable to be sampled for a benthic macroinvertebrate survey (Application Appendices E and F). BPSFL surface water flow conditions were monitored with similar methods as for SW-301 described above since October 1986 (manual monthly) and since December 1994 (automated daily) and generally reflect persistent dry conditions with ephemeral flow events that reached up to 2,525 gpm in June 2018 (Application Appendices B and O).

BRTFL is located where Lee Coulee crosses the eastern edge of the AM5 permit boundary, within the Big Sky Mine permit boundary; and BMMFL is located downgradient of the AM5 permit boundary within the Big Sky Mine permit boundary (Application Appendix O, Figure 13). BRTFL and BMMFL baseline field parameter data from the past 10 years are not available due to persistent dry conditions through their monitoring periods since October 2014. Baseline data records intermittent flow (average 9 gpm, maximum 1,397 gpm) at BRTFL from 1984 through the mid-1990s when Big Sky mining occurred near this site. Postmining continuous recorder data reflect no flow at BRTFL from 2014 through 2017 and two ephemeral flow events from 95 gpm in April 2018 to 285 gpm in June 2018. At BMMFL, pre-mining flows were less common and declined in frequency from the mid- to late-1980s, before mining occurred near this site. Flows at BMMFL were influenced by near continuous MPDES discharges upstream from

the site in the mid-1990s. Postmining, only 11 flow events were recorded at BMMFL from 2012 through 2018, which registered a maximum flow of 180 gpm on May 30, 2013 (Application Appendix B). Long-term ground water monitoring of alluvial wells near BRTFL and BMMFL reflect decreasing ground water levels from the mid-1990s to the mid-2000s when the Big Sky Mine was dewatering the mine, followed by increasing water levels since 2004, consistent with observed wetter than average conditions over the last decade. (Application Appendix O). BRTFL is located a couple hundred feet from wetland G-019, a series of shallow depressions adjacent to Lee Coulee. In September 2015, G-019 was dry and in July 2016, G-019a was too shallow to sample for a benthic macroinvertebrate survey; however, the aquatic life survey identified 20 species at G-019b (Application Appendix F).

Rape Coulee

The minor portion of the Rape Coulee drainage basin located within the analysis area has not been monitored for surface water flow conditions. Spring SP-310 and pond PO-303 are located along a tributary of Rape Coulee. Flow was not measurable at SP-310, but the spring was consistently ponded through its monitoring period (see the **Springs** section for more detail). Water levels in PO-303 vary seasonally from dry conditions each year to peaks in the spring (see the **Ponds** section for more detail).

Rosebud Creek

Rosebud Creek includes two surface water monitoring sites (SW-304 and SW-305) that were installed in November 2017 and recorded flows up to a maximum of 24,512 at SW-305 in May 2018 and up to a maximum of 27,538 gpm at SW-304 in June 2018. Flows averaged approximately 14,000 gpm at the two monitoring sites through the monitoring period. Rosebud Creek was monitored for the Big Sky Mine from 1974 to 1997.

East Fork Armells Creek

East Fork Armells Creek includes ephemeral flow characteristics in its headwaters reaches that transition to limited intermittent flow characteristics along the northern edge of Area B near surface water monitoring site SW-77 (**Figure 33**).

East Fork Armells Creek includes five surface water monitoring sites (SW-75, SW-60, SW-77, SW-76, and SW-55) along the northern edge of the Area B permit boundary. Sites SW-60, SW-76, and SW-77 were installed in 2016 and have been monitored since March 2016 with flow depths ranging from 0 feet up to 1.16 feet at SW-76 in January 2020. SW-75 (west/upgradient of Area B) and SW-55 (east/downgradient of Area B) include trapezoidal flumes and continuous data recorders that were installed in late 2011. SW-75 is normally dry, with six automated flow recordings through its monitoring period up to a maximum observed flow rate of 4,062 gpm in March 2014. SW-55 normally has flow that varies seasonally from lows in late summer to highs during spring runoff periods, with a maximum observed flow rate of 521 gpm in July 2019, and an average daily flow rate of 59 gpm (AM5 Application Appendices B and O).

Ponds

More than three dozen ponds are located within or near the Project area (Application Appendix O, Table 29 and Figure 59). Eight of the inventoried ponds (PO-137, PO-046, PO-026, PO-21C, PO-19A, PO-019, PO-011, and PO-013) are permanent sedimentation ponds located within the existing Area B disturbance area. Twelve of the inventoried ponds (PO-300, PO-301, PO-302, PO-303, PO-304, PO-305, PO-307, PO-308, PO-309, BBIO1, BBIO2, and PO-937) are in or near the analysis area on (stream-fed) or adjacent to (spring-fed) Rape, Richard, and Lee Coulees and East Fork Armells Creek (**Figure 33**) and

were monitored for water level beginning as early as 2005. One of the inventoried ponds (BST13) is a historical sediment trap that was eliminated during Big Sky reclamation.

The 12 existing ponds are used as livestock water impoundments, and all except two of the ponds (PO-304 and PO-937) have year-round water rights with allowable diversion volumes of 30 gallons per day per animal (Montana Department of Natural Resources & Conservation 2018; Application Appendix O, Attachment G). During the past decade of monthly monitoring, pond depths generally ranged from 0 to 5.8 feet deep (PO-301). PO-305/BLCPI is a permanent impoundment in a partially backfilled final pit and is approximately 25 feet deep.

Rape Coulee – Pond PO-303

Pond PO-303, located behind an instream dam on a tributary of Rape Coulee, was monitored monthly since October 2013. The pond contained water for 53 percent of the monitoring events with depths ranging from a few inches to 4.4 feet in April 2019. Surface runoff appears to be the primary source of water for this pond.

Richard Coulee *– Ponds PO-301, PO-302, PO-307, and PO-309*

Ponds PO-301, PO-302, and PO-307, each located behind instream dams on tributaries of Richard Coulee, were monitored monthly since October 2013 (PO-301 and PO-302) and since June 2016 (PO-307). Surface runoff appears to be the primary source of water for PO-301, which contained water for 65 percent of monitoring events with depths ranging from a few inches to 5.8 feet in May 2019, and is associated with wetland G047 (see **Section 3.9, Wetlands**). PO-302, located downstream from spring SP-307 and associated with wetland G044 (see **Section 3.9, Wetlands**), contained water for 69 percent of monitoring events with depths ranging from a few inches to 5 feet in April 2018. Surface runoff appears to be the primary source of water for PO-307, which was dry for all but two monitoring events: in February 2017 with a depth of 1.8 feet and in April 2019 with a depth of 1 foot. PO-309, located outside and downgradient from the AM5 permit boundary, was monitored 18 times since December 2017, all of which showed no water in the pond.

Lee Coulee – Ponds PO-300, PO-304, PO-305, PO-308, BBIO1, BBIO2, and BST13

Ponds PO-300, PO-304, and PO-308, each located behind instream dams within the Lee Coulee watershed, were monitored monthly since October 2013 (PO-300), May 2015 (PO-304), and August 2016 (PO-308). PO-300, located on the headwaters mainstem of Lee Coulee and fed by two seeps associated with wetland 4-2/2 (see **Section 3.9, Wetlands**), contained water for 90 percent of monitoring events with depths ranging from a few inches to 4.3 feet in July 2016. PO-304 and PO-308 are both located on tributaries of Lee Coulee that were both primarily dry during their monitoring periods, with PO-304 registering only 5 days with water (up to 1 foot deep in April 2019) and PO-308 registering only 3 days with water (up to 2.4 feet deep in April 2019).

Pond PO-305 (same as Big Sky Mine Lee Coulee Permanent Impoundment – BLCPI), located along the mainstem of Lee Coulee, was monitored monthly since April 2005 by the Big Sky Mine and since September 2015 by Westmoreland Rosebud. PO-305, associated with wetland G020 (see **Section 3.9, Wetlands**), contains year-round water with seasonal fluctuations of a couple feet that peak each spring.

Ponds BBIO1, BBIO2, and BST13 were historically monitored by Big Sky Mine. BBIO1 and BBIO2 are both located along Lee Coulee outside and downgradient from the AM5 boundary. BBIO1 was monitored 6 times since February 2016, with one recorded water depth of 0.5 feet (August 2017). BBIO2 was monitored 7 times since February 2016, with four recorded water depths of up to 3.95 feet (February

2016). BST13 was located near where the eastern AM5 permit boundary crosses Lee Coulee and was not monitored for depth.

East Fork Armells Creek – Pond PO-937

PO-937, located behind an instream dam on East Fork Armells Creek, was monitored monthly since March 2016 and was primarily dry through the monitoring period with 12 individual days of ponded conditions (up to 9.5 feet in depth).

3.5.2.5 Surface Water Quality

The sections below describe the water quality of surface water resources in the analysis area. Water quality data were collected by Western Energy (predecessor to Westmoreland Rosebud) and the Big Sky Mine. The water quality of surface water resources in the analysis area that coincides with the AM5 expansion area represents non-mining-related conditions that have been minimally affected by manmade disturbances within or upstream of the Project area. The water quality of surface water resources in the analysis area that coincides with the Area B permit boundary represents conditions that have been affected by manmade mining disturbances. The water quality of surface water in the analysis area downstream of the Big Sky Mine represents reclaimed conditions within areas that were previously mined at the Big Sky Mine and natural conditions within areas that were not historically impacted by mining activities. Water quality is variable in the Project area primarily due to the dominance of either direct runoff from snowmelt or rainfall or ground water discharge to surface water during various times of the year. Direct runoff has much lower dissolved solids concentrations (such as calcium, magnesium, sodium, bicarbonate, sulfate, and chloride) than ground water. Differences in surface water quality between drainages are subtler than the impact of seasonal flow variability and are due to the presence or absence of baseflow from ground water discharges, lithology, soil types, and land use practices (Slagle et al. 1983). Other factors affecting surface water quality are evaporation and transpiration, reactions of water with sediment, aquatic biota, impoundments and diversions for agricultural purposes, and stock watering.

Springs

Water quality monitoring results are available for 11 springs within or near the Project area including 1 spring in the Rape Coulee drainage (SP-310); 8 springs in the Richard Coulee drainage (SP-300, SP-301, SP-302, SP-304, SP-305, SP-307, SP-308, and SP-309); and 2 springs in the Lee Coulee drainage (SP-306 and BGDSG). **Table 27** through **Table 37** summarize the spring data collected. Monitoring results include minimum, median, and maximum values for all monitoring sites. Monitoring periods for the monitoring sites are listed below.

- SP-300 (September 2013 through January 2020)
- SP-301 (March 2014 through December 2019)
- SP-302 (September 2013 through January 2020)
- SP-304 (May 2015 through December 2019)
- SP-305 (June 2016 through January 2020)
- SP-306 (June 2016 through January 2020)
- SP-307 (August 2016 through December 2019)
- SP-308 (June 2016 through December 2019)
- SP-309 (February 2017 through March 2020)
- SP-310 (June 2016 through December 2019)
- BGDSG (August 2016 through August 2019)

Sporadic exceedances of Montana numeric water quality standards (Circular DEQ-7 Human Health Standards) include arsenic (SP-300, SP-302, SP-305, SP-306) and fluoride (SP-302 and SP-305).

Table 27. Water Quality of Spring SP-300 (Richard Coulee Mainstem).

Parameter	Unit	Number Samples	Number Detects	Minimum	Median	Maximum	Human Health Standard
Acidity	mg/L	37	0	1	1	5	NS
Aluminum, diss	mg/L	37	36	0.004	0.0303	0.0763	NS
Ammonia, as N	mg/L	37	30	0.0073	0.383	1.4	NS
Arsenic, diss	mg/L	37	36	0.0005	0.00225	**0.0253**	0.01
Bicarbonate alkalinity	mg/L	37	37	427	549	779	NS
Boron, diss	mg/L	37	37	0.177	0.275	1	NS
Cadmium, diss	mg/L	37	26	0.00004	0.0005	0.0005	0.005
Calcium, diss	mg/L	37	37	189	214	254	NS
Carbonate alkalinity	mg/L	37	4	1	1	32	NS
Chloride	mg/L	37	37	5.8	17	25.3	NS
Copper, diss	mg/L	37	22	0.000018	0.002	0.00402	1.3
Fluoride	mg/L	37	30	0.004	0.585	1.79	4
Hydroxide alkalinity	mg/L	37	0	1	1	5	NS
Iron, diss	mg/L	37	36	0.02	1.64	14.8	NS
Laboratory conductivity	µS/cm	37	37	2680	4260	4870	NS
Laboratory pH	s.u.	37	37	7.5	8.15	8.4	NS
Lead, diss	mg/L	37	15	0.0000023	0.0000365	0.0005	0.015
Magnesium, diss	mg/L	37	37	212	244	279	NS
Manganese, diss	mg/L	37	37	0.058	2.06	5.06	NS
Nickel, diss	mg/L	37	30	0.000605	0.003	0.00812	0.1
Nitrate+nitrite	mg/L	37	15	0.003	0.0066	1.1	10
Potassium, diss	mg/L	37	37	8	13.3	27	NS
Selenium, diss	mg/L	37	27	0.000182	0.001	0.0025	0.05
Sodium, diss	mg/L	37	37	40.6	616	683	NS
Sulfate	mg/L	37	37	1290	2220	2570	NS
Total alkalinity	mg/L	37	37	427	551	779	NS
Total dissolved solids	mg/L	37	37	2370	4040	4530	NS
Total hardness	mg/L	37	37	1340	1540	1770	NS
Vanadium, diss	mg/L	37	32	0.000043	0.01	0.01	NS
Zinc, diss	mg/L	37	4	0.000855	0.00146	0.025	2

NS = no numeric standard. µS/cm = micro Siemens/centimeter; s.u. = standard units.
All metals are dissolved.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed the Human Health Standard for ground water.

Table 28. Water Quality of Spring SP-301 (Richard Coulee Mainstem).

Parameter	Unit	Number Samples	Number Detects	Minimum	Median	Maximum	Human Health Standard
Acidity	mg/L	20	0	1	1	1	NS
Aluminum, diss	mg/L	20	20	0.009	0.012	0.03	NS
Ammonia, as N	mg/L	20	7	0.005	0.031	0.148	NS
Arsenic, diss	mg/L	20	7	0.000035	0.000314	0.001	0.01
Bicarbonate alkalinity	mg/L	20	20	371	399.5	555	NS
Boron, diss	mg/L	20	20	0.0745	0.08845	0.321	NS
Cadmium, diss	mg/L	20	14	0.00004	0.0005	0.0005	0.005
Calcium, diss	mg/L	20	20	72	77.4	253	NS
Carbonate alkalinity	mg/L	20	15	1	13.3	31	NS
Chloride	mg/L	20	20	4.94	5.395	23.2	NS
Copper, diss	mg/L	20	11	0.000018	0.002	0.00202	1.3
Fluoride	mg/L	20	18	0.004	0.248	0.456	4
Hydroxide alkalinity	mg/L	20	0	1	1	1	NS
Iron, diss	mg/L	20	5	0.0005	0.00265	0.0806	NS
Laboratory conductivity	µS/cm	20	20	1160	1275	5330	NS
Laboratory pH	s.u.	20	20	8.2	8.345	8.5	NS
Lead, diss	mg/L	20	8	0.0000023	0.0000365	0.0003	0.015
Magnesium, diss	mg/L	20	20	95	103.5	224	NS
Manganese, diss	mg/L	20	15	0.000173	0.005	0.205	NS
Nickel, diss	mg/L	20	8	0.000605	0.000995	0.002	0.1
Nitrate+nitrite	mg/L	20	19	0.0046	0.3835	0.461	10
Potassium, diss	mg/L	20	20	3.96	4.12	11.1	NS
Selenium, diss	mg/L	20	20	0.001	0.001305	0.00219	0.05
Sodium, diss	mg/L	20	20	64.6	70.1	822	NS
Sulfate	mg/L	20	20	330	353.5	2630	NS
Total alkalinity	mg/L	20	20	394	410.5	555	NS
Total dissolved solids	mg/L	20	20	886	927	4790	NS
Total hardness	mg/L	20	20	573	618	1550	NS
Vanadium, diss	mg/L	20	15	0.0000136	0.01	0.01	NS
Zinc, diss	mg/L	20	0	0.000855	0.00146	0.00547	2

NS = no numeric standard. µS/cm = micro Siemens/centimeter; s.u. = standard units.
All metals are dissolved.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed the Human Health Standard for ground water.

Table 29. Water Quality of Spring SP-302 (Richard Coulee Mainstem).

Parameter	Unit	Number Samples	Number Detects	Minimum	Median	Maximum	Human Health Standard
Acidity	mg/L	26	0	1	1	5	NS
Aluminum, diss	mg/L	26	26	0.009	0.046	0.144	NS
Ammonia, as N	mg/L	26	19	0.005	0.0572	2.93	NS
Arsenic, diss	mg/L	26	24	0.000314	0.00113	**0.044**	0.01
Bicarbonate alkalinity	mg/L	26	26	209	520	948	NS
Boron, diss	mg/L	26	26	0.247	0.469	1.76	NS
Cadmium, diss	mg/L	26	16	0.00004	0.0005	0.00322	0.005
Calcium, diss	mg/L	26	26	172	284	568	NS
Carbonate alkalinity	mg/L	26	13	1	5	161	NS
Chloride	mg/L	26	26	12.9	19.85	194	NS
Copper, diss	mg/L	26	20	0.0000224	0.002	0.0131	1.3
Fluoride	mg/L	26	11	0.004	0.00834	**4.02**	4
Hydroxide alkalinity	mg/L	26	0	1	1	5	NS
Iron, diss	mg/L	26	24	0.0005	0.0378	1.83	NS
Laboratory conductivity	µS/cm	26	26	4720	5830	26400	NS
Laboratory pH	s.u.	26	26	7.4	8.305	9.1	NS
Lead, diss	mg/L	26	14	0.000004	0.0003	0.00201	0.015
Magnesium, diss	mg/L	26	26	157	311	2870	NS
Manganese, diss	mg/L	26	26	0.031	0.13	6.29	NS
Nickel, diss	mg/L	26	14	0.000605	0.002	0.0281	0.1
Nitrate+nitrite	mg/L	26	5	0.003	0.0056	0.03	10
Potassium, diss	mg/L	26	26	10.5	15	132	NS
Selenium, diss	mg/L	26	22	0.000394	0.001	0.00603	0.05
Sodium, diss	mg/L	26	26	582	1010	8510	NS
Sulfate	mg/L	26	26	2150	3590	28100	NS
Total alkalinity	mg/L	26	26	355	550	948	NS
Total dissolved solids	mg/L	26	26	3650	6170	37400	NS
Total hardness	mg/L	26	26	1080	1970	13200	NS
Vanadium, diss	mg/L	26	23	0.000043	0.01	0.0111	NS
Zinc, diss	mg/L	26	1	0.000855	0.00146	0.025	2

NS = no numeric standard. µS/cm = micro Siemens/centimeter; s.u. = standard units.
All metals are dissolved.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed the Human Health Standard for ground water.

Table 30. Water Quality of Spring SP-304 (Richard Coulee Tributary).

Parameter	Unit	Number Samples	Number Detects	Minimum	Median	Maximum	Human Health Standard
Acidity	mg/L	12	0	1	1	1	NS
Aluminum, diss	mg/L	12	12	0.0121	0.02725	0.0761	NS
Ammonia, as N	mg/L	12	10	0.005	0.05	0.217	NS
Arsenic, diss	mg/L	12	11	0.000314	0.001	0.00232	0.01
Bicarbonate alkalinity	mg/L	12	12	245	514.5	577	NS
Boron, diss	mg/L	12	12	0.0912	0.1115	0.169	NS
Cadmium, diss	mg/L	12	8	0.00004	0.0005	0.0005	0.005
Calcium, diss	mg/L	12	12	81.1	132.5	173	NS
Carbonate alkalinity	mg/L	12	3	1	1	19.5	NS
Chloride	mg/L	12	12	4.43	7.975	27.2	NS
Copper, diss	mg/L	12	8	0.0000224	0.002	0.00466	1.3
Fluoride	mg/L	12	12	0.3	0.4245	1	4
Hydroxide alkalinity	mg/L	12	0	1	1	1	NS
Iron, diss	mg/L	12	12	0.02	0.05205	0.821	NS
Laboratory conductivity	µS/cm	12	12	1140	1655	2090	NS
Laboratory pH	s.u.	12	12	7.93	8.235	8.5	NS
Lead, diss	mg/L	12	6	0.000004	0.00016825	0.0003	0.015
Magnesium, diss	mg/L	12	12	51.4	95.6	130	NS
Manganese, diss	mg/L	12	12	0.052	0.545	1.09	NS
Nickel, diss	mg/L	12	12	0.002	0.002885	0.0056	0.1
Nitrate+nitrite	mg/L	12	2	0.003	0.0066	0.033	10
Potassium, diss	mg/L	12	12	5	7.96	20.4	NS
Selenium, diss	mg/L	12	4	0.000135	0.00076	0.001	0.05
Sodium, diss	mg/L	12	12	61.9	154	219	NS
Sulfate	mg/L	12	12	307	528.5	760	NS
Total alkalinity	mg/L	12	12	245	516.5	577	NS
Total dissolved solids	mg/L	12	12	682	1260	1680	NS
Total hardness	mg/L	12	12	450	726	950	NS
Vanadium, diss	mg/L	12	9	0.0000136	0.01	0.01	NS
Zinc, diss	mg/L	12	1	0.00108	0.00146	0.008	2

NS = no numeric standard. µS/cm = micro Siemens/centimeter; s.u. = standard units.
All metals are dissolved.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed the Human Health Standard for ground water.

Table 31. Water Quality of Spring SP-305 (Richard Coulee Mainstem).

Parameter	Unit	Number Samples	Number Detects	Minimum	Median	Maximum	Human Health Standard
Acidity	mg/L	16	0	1	1	1	NS
Aluminum, diss	mg/L	16	16	0.019	0.05725	0.104	NS
Ammonia, as N	mg/L	16	12	0.005	0.05	0.33	NS
Arsenic, diss	mg/L	16	16	0.001	0.001115	**0.239**	0.01
Bicarbonate alkalinity	mg/L	16	16	293	621.5	841	NS
Boron, diss	mg/L	16	16	0.36	0.5235	2.16	NS
Cadmium, diss	mg/L	16	11	0.00004	0.0005	0.00238	0.005
Calcium, diss	mg/L	16	16	235	369	491	NS
Carbonate alkalinity	mg/L	16	4	1	1	51.7	NS
Chloride	mg/L	16	16	13.5	19.1	131	NS
Copper, diss	mg/L	16	9	0.000018	0.002	0.0024	1.3
Fluoride	mg/L	16	11	0.0054	0.3	**4.05**	4
Hydroxide alkalinity	mg/L	16	0	1	1	1	NS
Iron, diss	mg/L	16	16	0.0382	0.425	2.2	NS
Laboratory conductivity	µS/cm	16	16	5430	6545	18700	NS
Laboratory pH	s.u.	16	16	7.9	8.16	8.52	NS
Lead, diss	mg/L	16	7	0.0000023	0.0000365	0.0016	0.015
Magnesium, diss	mg/L	16	16	256	317	1410	NS
Manganese, diss	mg/L	16	16	1.13	1.975	5.58	NS
Nickel, diss	mg/L	16	10	0.000764	0.005	0.0275	0.1
Nitrate+nitrite	mg/L	16	4	0.003	0.0066	4.17	10
Potassium, diss	mg/L	16	16	7.86	11.45	111	NS
Selenium, diss	mg/L	16	12	0.00028	0.001	0.00803	0.05
Sodium, diss	mg/L	16	16	894	1135	5480	NS
Sulfate	mg/L	16	16	3080	3725	14800	NS
Total alkalinity	mg/L	16	16	329	642	841	NS
Total dissolved solids	mg/L	16	16	5660	6505	21800	NS
Total hardness	mg/L	16	16	1820	2245	6970	NS
Vanadium, diss	mg/L	16	13	0.000048	0.01	0.01	NS
Zinc, diss	mg/L	16	1	0.00146	0.00307	0.008	2

NS = no numeric standard. µS/cm = micro Siemens/centimeter; s.u. = standard units.
All metals are dissolved.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed the Human Health Standard for ground water.

Table 32. Water Quality of Spring SP-306 (Lee Coulee Tributary).

Parameter	Unit	Number Samples	Number Detects	Minimum	Median	Maximum	Human Health Standard
Acidity	mg/L	15	0	1	1	1	NS
Aluminum, diss	mg/L	15	15	0.009	0.018	0.287	NS
Ammonia, as N	mg/L	15	11	0.005	0.05	11.6	NS
Arsenic, diss	mg/L	15	15	0.001	0.003	**0.0337**	0.01
Bicarbonate alkalinity	mg/L	15	15	41.2	195	1190	NS
Boron, diss	mg/L	15	15	0.0434	0.13	0.51	NS
Cadmium, diss	mg/L	15	9	0.00004	0.0005	0.000672	0.005
Calcium, diss	mg/L	15	15	22	47.7	102	NS
Carbonate alkalinity	mg/L	15	14	1	79	237	NS
Chloride	mg/L	15	15	5.31	27.2	88.6	NS
Copper, diss	mg/L	15	13	0.000358	0.002	0.004	1.3
Fluoride	mg/L	15	15	0.1	0.435	1.37	4
Hydroxide alkalinity	mg/L	15	0	1	1	1	NS
Iron, diss	mg/L	15	14	0.00177	0.0367	0.358	NS
Laboratory conductivity	µS/cm	15	15	613	1550	4070	NS
Laboratory pH	s.u.	15	15	8.1	8.8	9.88	NS
Lead, diss	mg/L	15	9	0.0000023	0.0003	0.00047	0.015
Magnesium, diss	mg/L	15	15	47	136	436	NS
Manganese, diss	mg/L	15	15	0.005	0.00956	0.178	NS
Nickel, diss	mg/L	15	14	0.000764	0.003	0.015	0.1
Nitrate+nitrite	mg/L	15	0	0.003	0.0066	0.0066	10
Potassium, diss	mg/L	15	15	8.76	21.9	105	NS
Selenium, diss	mg/L	15	13	0.00076	0.001	0.002	0.05
Sodium, diss	mg/L	15	15	37	114	411	NS
Sulfate	mg/L	15	15	177	435	1750	NS
Total alkalinity	mg/L	15	15	141	213	1430	NS
Total dissolved solids	mg/L	15	15	500	1220	3480	NS
Total hardness	mg/L	15	15	271	706	1890	NS
Vanadium, diss	mg/L	15	13	0.0000136	0.01	0.01	NS
Zinc, diss	mg/L	15	0	0.00146	0.00307	0.00547	2

NS = no numeric standard. µS/cm = micro Siemens/centimeter; s.u. = standard units.
All metals are dissolved.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed the Human Health Standard for ground water.

Table 33. Water Quality of Spring SP-307 (Richard Coulee Tributary).

Parameter	Unit	Number Samples	Number Detects	Minimum	Median	Maximum	Human Health Standard
Acidity	mg/L	13	0	1	1	1	NS
Aluminum, diss	mg/L	13	13	0.013	0.017	0.049	NS
Ammonia, as N	mg/L	13	12	0.005	0.05	0.146	NS
Arsenic, diss	mg/L	13	12	0.000314	0.001	0.00151	0.01
Bicarbonate alkalinity	mg/L	13	13	409	452	1350	NS
Boron, diss	mg/L	13	13	0.23	0.266	0.435	NS
Cadmium, diss	mg/L	13	7	0.00004	0.0005	0.000804	0.005
Calcium, diss	mg/L	13	13	86	109	119	NS
Carbonate alkalinity	mg/L	13	5	1	1	61.8	NS
Chloride	mg/L	13	13	5	6	141	NS
Copper, diss	mg/L	13	7	0.000018	0.002	0.002	1.3
Fluoride	mg/L	13	12	0.00834	0.516	0.823	4
Hydroxide alkalinity	mg/L	13	0	1	1	1	NS
Iron, diss	mg/L	13	13	0.02	0.17	0.27	NS
Laboratory conductivity	µS/cm	13	13	1700	1870	4490	NS
Laboratory pH	s.u.	13	13	8.06	8.27	8.58	NS
Lead, diss	mg/L	13	6	0.0000023	0.0000365	0.0009	0.015
Magnesium, diss	mg/L	13	13	107	118	172	NS
Manganese, diss	mg/L	13	13	0.0177	0.105	0.389	NS
Nickel, diss	mg/L	13	6	0.000764	0.000995	0.002	0.1
Nitrate+nitrite	mg/L	13	4	0.003	0.0066	0.035	10
Potassium, diss	mg/L	13	13	7.49	9	351	NS
Selenium, diss	mg/L	13	1	0.000135	0.000394	0.001	0.05
Sodium, diss	mg/L	13	13	150	169	321	NS
Sulfate	mg/L	13	13	600	651	866	NS
Total alkalinity	mg/L	13	13	431	457	1350	NS
Total dissolved solids	mg/L	13	13	1320	1410	3310	NS
Total hardness	mg/L	13	13	696	752	1000	NS
Vanadium, diss	mg/L	13	10	0.000828	0.01	0.01	NS
Zinc, diss	mg/L	13	0	0.00146	0.00146	0.00547	2

NS = no numeric standard. µS/cm = micro Siemens/centimeter; s.u. = standard units.
All metals are dissolved.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed the Human Health Standard for ground water.

Table 34. Water Quality of Spring SP-308 (Richard Coulee Tributary).

Parameter	Unit	Number Samples	Number Detects	Minimum	Median	Maximum	Human Health Standard
Acidity	mg/L	11	0	1	1	1	NS
Aluminum, diss	mg/L	11	11	0.0127	0.0213	0.176	NS
Ammonia, as N	mg/L	11	6	0.005	0.05	0.09	NS
Arsenic, diss	mg/L	11	11	0.001	0.001	0.004	0.01
Bicarbonate alkalinity	mg/L	11	11	381	538	674	NS
Boron, diss	mg/L	11	11	0.11	0.17	0.31	NS
Cadmium, diss	mg/L	11	7	0.00004	0.0005	0.000636	0.005
Calcium, diss	mg/L	11	11	93	105	205	NS
Carbonate alkalinity	mg/L	11	8	1	22.7	54.8	NS
Chloride	mg/L	11	11	5.74	9	15	NS
Copper, diss	mg/L	11	8	0.000358	0.002	0.002	1.3
Fluoride	mg/L	11	11	0.3	0.5	1.08	4
Hydroxide alkalinity	mg/L	11	0	1	1	1	NS
Iron, diss	mg/L	11	11	0.02	0.0641	1.66	NS
Laboratory conductivity	µS/cm	11	11	1270	1790	2670	NS
Laboratory pH	s.u.	11	11	8.2	8.4	8.5	NS
Lead, diss	mg/L	11	4	0.0000023	0.0000365	0.0003	0.015
Magnesium, diss	mg/L	11	11	106	151	231	NS
Manganese, diss	mg/L	11	11	0.044	0.798	1.75	NS
Nickel, diss	mg/L	11	11	0.002	0.002	0.00457	0.1
Nitrate+nitrite	mg/L	11	2	0.003	0.0066	0.04	10
Potassium, diss	mg/L	11	11	4.18	7.29	11.2	NS
Selenium, diss	mg/L	11	4	0.000171	0.00076	0.00332	0.05
Sodium, diss	mg/L	11	11	62.8	101	154	NS
Sulfate	mg/L	11	11	370	489	1340	NS
Total alkalinity	mg/L	11	11	409	550	727	NS
Total dissolved solids	mg/L	11	11	1020	1270	2400	NS
Total hardness	mg/L	11	11	689	953	1410	NS
Vanadium, diss	mg/L	11	9	0.0000136	0.01	0.01	NS
Zinc, diss	mg/L	11	0	0.00146	0.00146	0.00547	2

NS = no numeric standard. µS/cm = micro Siemens/centimeter; s.u. = standard units.
All metals are dissolved.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed the Human Health Standard for ground water.

Table 35. Water Quality of Spring SP-309 (Richard Coulee Tributary).

Parameter	Unit	Number Samples	Number Detects	Minimum	Median	Maximum	Human Health Standard
Acidity	mg/L	9	0	1	1	1	NS
Aluminum, diss	mg/L	9	9	0.016	0.024	0.586	NS
Ammonia, as N	mg/L	9	6	0.0073	0.05	0.1	NS
Arsenic, diss	mg/L	9	8	0.000299	0.001	0.00204	0.01
Bicarbonate alkalinity	mg/L	9	9	382	596	814	NS
Boron, diss	mg/L	9	9	0.18	0.23	0.39	NS
Cadmium, diss	mg/L	9	4	0.00004	0.000294	0.0007	0.005
Calcium, diss	mg/L	9	9	119	186	244	NS
Carbonate alkalinity	mg/L	9	8	1	17	66	NS
Chloride	mg/L	9	9	11	18.4	31	NS
Copper, diss	mg/L	9	7	0.000358	0.002	0.00432	1.3
Fluoride	mg/L	9	9	0.3	0.788	1.5	4
Hydroxide alkalinity	mg/L	9	0	1	1	1	NS
Iron, diss	mg/L	9	9	0.02	0.02	0.647	NS
Laboratory conductivity	µS/cm	9	9	2740	3340	4920	NS
Laboratory pH	s.u.	9	9	8.3	8.32	8.6	NS
Lead, diss	mg/L	9	5	0.0000023	0.0003	0.0013	0.015
Magnesium, diss	mg/L	9	9	218	291	421	NS
Manganese, diss	mg/L	9	9	0.005	0.038	0.375	NS
Nickel, diss	mg/L	9	7	0.000995	0.00298	0.00786	0.1
Nitrate+nitrite	mg/L	9	0	0.003	0.0066	0.0066	10
Potassium, diss	mg/L	9	9	6	10.4	24	NS
Selenium, diss	mg/L	9	3	0.000171	0.00076	0.001	0.05
Sodium, diss	mg/L	9	9	308	388	514	NS
Sulfate	mg/L	9	9	1330	1750	2570	NS
Total alkalinity	mg/L	9	9	426	611	824	NS
Total dissolved solids	mg/L	9	9	2480	3530	4620	NS
Total hardness	mg/L	9	9	1190	1660	2340	NS
Vanadium, diss	mg/L	9	7	0.000828	0.01	0.01	NS
Zinc, diss	mg/L	9	2	0.00146	0.00307	0.008	2

NS = no numeric standard. µS/cm = micro Siemens/centimeter; s.u. = standard units.
All metals are dissolved.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed the Human Health Standard for ground water.

Table 36. Water Quality of Spring SP-310 (Rape Coulee Tributary).

Parameter	Unit	Number Samples	Number Detects	Minimum	Median	Maximum	Human Health Standard
Acidity	mg/L	20	0	1	1	1	NS
Aluminum, diss	mg/L	20	20	0.0199	0.07745	1.13	NS
Ammonia, as N	mg/L	20	12	0.005	0.05	0.0618	NS
Arsenic, diss	mg/L	20	19	0.000314	0.001	0.00373	0.01
Bicarbonate alkalinity	mg/L	20	20	386	661.5	796	NS
Boron, diss	mg/L	20	20	0.77	1.105	1.74	NS
Cadmium, diss	mg/L	20	19	0.0000658	0.00055	0.00207	0.005
Calcium, diss	mg/L	20	20	320	429	478	NS
Carbonate alkalinity	mg/L	20	4	1	1	50.7	NS
Chloride	mg/L	20	20	9.73	18.7	28	NS
Copper, diss	mg/L	20	16	0.0000224	0.002	0.00261	1.3
Fluoride	mg/L	20	13	0.0054	0.3	1.71	4
Hydroxide alkalinity	mg/L	20	0	1	1	1	NS
Iron, diss	mg/L	20	16	0.000688	0.02	0.5	NS
Laboratory conductivity	µS/cm	20	20	5630	7690	9490	NS
Laboratory pH	s.u.	20	20	7.8	8.2	8.42	NS
Lead, diss	mg/L	20	10	0.0000023	0.00018575	0.0009	0.015
Magnesium, diss	mg/L	20	20	374	534	673	NS
Manganese, diss	mg/L	20	20	0.0103	0.182	1.09	NS
Nickel, diss	mg/L	20	14	0.000764	0.003435	0.00737	0.1
Nitrate+nitrite	mg/L	20	3	0.003	0.0066	0.701	10
Potassium, diss	mg/L	20	20	9.73	15	19.4	NS
Selenium, diss	mg/L	20	18	0.000171	0.001	0.00329	0.05
Sodium, diss	mg/L	20	20	690	1135	1590	NS
Sulfate	mg/L	20	20	3320	4885	5870	NS
Total alkalinity	mg/L	20	20	415	661.5	796	NS
Total dissolved solids	mg/L	20	20	5980	8355	10400	NS
Total hardness	mg/L	20	20	2340	3280	3920	NS
Vanadium, diss	mg/L	20	16	0.0000136	0.01	0.01	NS
Zinc, diss	mg/L	20	0	0.00146	0.00146	0.00547	2

NS = no numeric standard. µS/cm = micro Siemens/centimeter; s.u. = standard units.
All metals are dissolved.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed the Human Health Standard for ground water.

Table 37. Water Quality of Spring BGDSG (Lee Coulee Tributary).

Parameter	Unit	Number Samples	Number Detects	Minimum	Median	Maximum	Human Health Standard
Acidity	mg/L	7	4	1	6	10	NS
Aluminum, diss	mg/L	7	2	0.012	0.03	0.03	NS
Ammonia, as N	mg/L	7	0	0.0073	0.05	0.05	NS
Arsenic, diss	mg/L	7	0	0.000314	0.001	0.001	0.01
Bicarbonate alkalinity	mg/L	7	7	333	394	423	NS
Boron, diss	mg/L	7	7	0.09	0.12	0.13	NS
Cadmium, diss	mg/L	7	0	0.0000658	0.001	0.001	0.005
Calcium, diss	mg/L	7	7	88	90	105	NS
Carbonate alkalinity	mg/L	7	3	6.7	6.7	36	NS
Chloride	mg/L	7	7	10	10	13	NS
Copper, diss	mg/L	7	0	0.000358	0.005	0.005	1.3
Fluoride	mg/L	7	7	0.4	0.5	0.6	4
Hydroxide alkalinity	mg/L	2	0	1	1	1	NS
Iron, diss	mg/L	7	0	0.00265	0.02	0.02	NS
Laboratory conductivity	µS/cm	7	7	1190	1200	1400	NS
Laboratory pH	s.u.	7	7	7.6	7.7	8.6	NS
Lead, diss	mg/L	7	0	0.0000365	0.001	0.001	0.015
Magnesium, diss	mg/L	7	7	92	96	105	NS
Manganese, diss	mg/L	7	1	0.000214	0.001	0.005	NS
Nickel, diss	mg/L	7	0	0.000995	0.005	0.005	0.1
Nitrate+nitrite	mg/L	7	5	0.0066	0.02	0.09	10
Potassium, diss	mg/L	7	7	3	3	3	NS
Selenium, diss	mg/L	7	7	0.004	0.006	0.006	0.05
Sodium, diss	mg/L	7	7	52	55	64	NS
Sulfate	mg/L	7	7	295	313	421	NS
Total alkalinity	mg/L	7	7	363	395	424	NS
Total dissolved solids	mg/L	7	7	819	877	1030	NS
Total hardness	mg/L	7	7	596	623	693	NS
Vanadium, diss	mg/L	7	2	0.01	0.01	0.01	NS
Zinc, diss	mg/L	7	0	0.00307	0.01	0.01	2

NS = no numeric standard. µS/cm = micro Siemens/centimeter; s.u. = standard units.
All metals are dissolved.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed the Human Health Standard for ground water.

Streams

Water quality results from the past 10 years are available for one nonephemeral surface water monitoring site located in Richard Coulee (SW-302) and two nonephemeral surface water monitoring sites located in Rosebud Creek (SW-304 and SW-305). **Table 38** through **Table 40** summarize these results. Monitoring results include minimum, median, and maximum values for all monitoring sites. Monitoring periods for the monitoring sites are listed below.

- SW-302 (August 2013 through March 2020)
- SW-304 (November 2017 through February 2020)
- SW-305 (November 2017 through February 2020)

The quality of surface water was highly variable during the monitoring period due to the ephemeral nature of flow in tributary drainages. Measured pH was basic with values ranging from 8 to nearly 9. Both Rosebud Creek surface water monitoring sites (SW-304 and SW-305) had exceedances of Montana numeric water quality standards (Circular DEQ-7) for dissolved aluminum and total iron and exceedances of laboratory conductivity (ARM 17.30.670). SW-302 had DEQ-7 water quality exceedances for total iron and exceedances of laboratory conductivity and sodium absorption rate (ARM 17.30.670).

Five surface water monitoring sites are located in East Fork Armells Creek (SW-55, SW-60, SW-75, SW-76, and SW-77) and are not included in this characterization due to ephemeral flow conditions (SW-60 and SW-75) and due to distance from the disturbance area of more than 5 miles (SW-55, SW-76, and SW-77).

Table 38. Water Quality of Surface Water at SW-302.

Parameter	Unit	Number Samples	Number Detects	Minimum	Median	Maximum	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Acidity	mg/L	26	0	1	1	5	NS	NS	NS
Aluminum, diss	mg/L	26	25	0.00316	0.035	0.0775	NS	0.75	0.087
Aluminum, total	mg/L	26	26	0.009	0.221	1.7	NS	NS	NS
Ammonia, as N[1]	mg/L	26	18	0.005	0.05	0.884	NS	T/pH dependent	
Arsenic, diss	mg/L	26	23	0.000082	0.001	0.00313	NS	NS	NS
Arsenic, total	mg/L	26	26	0.00054	0.00154	0.00754	0.01	0.34	0.15
Bicarbonate alkalinity	mg/L	26	26	298	509	710	NS	NS	NS
Boron, diss	mg/L	26	26	0.241	0.4545	0.647	NS	NS	NS
Boron, total	mg/L	26	26	0.279	0.589	4.26	NS	NS	NS
Cadmium, diss	mg/L	26	13	0.000005	0.000397	0.0005	NS	NS	NS
Cadmium, total[2]	mg/L	26	10	0.0000514	0.0001135	0.000592	0.005	Hardness dependent	
Calcium, diss	mg/L	26	26	101	300.5	396	NS	NS	NS
Carbonate alkalinity	mg/L	26	18	1	23.2	50	NS	NS	NS
Chloride	mg/L	26	26	7.24	19	33.3	NS	NS	NS
Chromium, diss	mg/L	12	4	0.000253	0.0003205	0.00369	NS	NS	NS
Chromium, total[2]	mg/L	12	8	0.000222	0.001435	0.0147	0.1	Hardness dependent	
Copper, diss	mg/L	26	17	0.000041	0.002	0.00794	NS	NS	NS
Copper, total[2]	mg/L	26	24	0.000319	0.002225	0.022	1.3	Hardness dependent	
Fluoride	mg/L	26	20	0.004	0.2	1.22	4	NS	NS
Hydroxide alkalinity	mg/L	26	0	1	1	5	NS	NS	NS
Iron, diss	mg/L	26	21	0.0005	0.02	0.0557	NS	NS	NS
Iron, total	mg/L	26	25	0.05	0.305	**3**	NS	NS	1.0
Laboratory conductivity[3]	µS/cm	26	26	**2070**	**5985**	**7740**	500		
Laboratory pH	s.u.	28	28	8.04	8.345	8.66	NS	NS	NS
Lead, diss	mg/L	26	7	0.000004	0.0000216	0.001	NS	NS	NS
Lead, total[2]	mg/L	26	15	0.000003	0.0003	0.0022	0.015	Hardness dependent	
Magnesium, diss	mg/L	26	26	119	295	404	NS	NS	NS
Manganese, diss	mg/L	26	26	0.0033	0.0541	1.03	NS	NS	NS
Manganese, total	mg/L	26	26	0.002	0.0905	1.48	NS	NS	NS
Mercury, diss	mg/L	12	0	0.000008	0.0000265	0.00003	NS	NS	NS
Mercury, total	mg/L	12	0	0.000014	0.00003	0.00003	0.00005	0.0017	0.0009
Nickel, diss	mg/L	26	14	0.000605	0.002	0.00413	NS	NS	NS
Nickel, total[2]	mg/L	26	23	0.000757	0.00323	0.03	0.1	Hardness dependent	
Nitrate+nitrite	mg/L	26	5	0.003	0.0066	0.071	10	NS	NS
Orthophosphate as P	mg/L	11	0	0.00616	0.007	0.022	NS	NS	NS
Potassium, diss	mg/L	26	26	8.87	15.05	30.8	NS	NS	NS
Selenium, diss	mg/L	26	14	0.00028	0.00088	0.00139	NS	NS	NS
Selenium, total	mg/L	26	19	0.000378	0.001	0.00417	0.05	0.02	0.005

Table 38. Water Quality of Surface Water at SW-302.

Parameter	Unit	Number Samples	Number Detects	Minimum	Median	Maximum	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Sodium, diss	mg/L	26	26	199	1015	1400	NS	NS	NS
Sodium Absorption Rate[3]		26	26	3.17	**9.895**	**12.2**	4.5-7.5 (seasonal)		
Sulfate	mg/L	26	26	852	3500	4600	NS	NS	NS
Total alkalinity	mg/L	26	26	342	546	710	NS	NS	NS
Total dissolved solids	mg/L	28	28	594	6030	7610	NS	NS	NS
Total hardness	mg/L	26	26	743	1955	2590	NS	NS	NS
Total nitrogen	mg/L	24	24	0.45	0.8875	1.71	NS	NS	NS
Total phosphate	mg/L	26	24	0.00354	0.04125	0.22	NS	NS	NS
Total suspended sediments	mg/L	52	51	1	12.15	3660	NS	NS	NS
Turbidity	NTU	12	12	0.822	6.295	33.9	NS	NS	NS
Vanadium, diss	mg/L	26	23	0.00033	0.01	0.01	NS	NS	NS
Vanadium, total	mg/L	26	19	0.000332	0.01	0.01	NS	NS	NS
Zinc, diss	mg/L	26	1	0.000855	0.00146	0.008	NS	NS	NS
Zinc, total[2]	mg/L	26	14	0.00119	0.008	0.133	7.4	Hardness dependent	

NS = no numeric standard.
diss = dissolved; μS/cm = micro Siemens/centimeter; s.u. = standard units; NTU = nephelometric turbidity units.
[1] Aquatic Life Standards for Ammonia are temperature and pH dependent. No exceedances occurred during the monitoring period.
[2] Aquatic Life Standards for specific parameters are hardness dependent. No exceedances occurred during the monitoring period.
[3] Standards for Laboratory Conductivity and Sodium Absorption Rate are referenced from ARM 17.30.670.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed noted standards.

Table 39. Water Quality of Surface Water at SW-304.

Parameter	Unit	Number Samples	Number Detects	Minimum	Median	Maximum	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Acidity	mg/L	11	0	1	1	1	NS	NS	NS
Aluminum, diss	mg/L	11	11	0.013	0.022	**0.281**	NS	0.75	0.087
Aluminum, total	mg/L	11	11	0.094	0.55	4.03	NS	NS	NS
Ammonia, as N[1]	mg/L	11	4	0.005	0.0073	0.1	NS	T/pH dependent	
Arsenic, diss	mg/L	11	11	0.001	0.001	0.002	NS	NS	NS
Arsenic, total	mg/L	11	11	0.001	0.002	0.00515	0.01	0.34	0.15
Bicarbonate alkalinity	mg/L	11	11	365	372	523	NS	NS	NS
Boron, diss	mg/L	11	11	0.136	0.177	0.22	NS	NS	NS
Boron, total	mg/L	11	11	0.14	0.194	0.26	NS	NS	NS
Cadmium, diss	mg/L	11	5	0.000048	0.000294	0.0005	NS	NS	NS
Cadmium, total[2]	mg/L	11	7	0.0000923	0.0005	0.00112	0.005	Hardness dependent	
Calcium, diss	mg/L	11	11	75	83	106	NS	NS	NS
Carbonate alkalinity	mg/L	11	11	11	48.8	91	NS	NS	NS
Chloride	mg/L	11	11	5.45	7	8	NS	NS	NS
Chromium, diss	mg/L	0	0	---	---	---	NS	NS	NS
Chromium, total[2]	mg/L	0	0	---	---	---	0.1	Hardness dependent	
Copper, diss	mg/L	11	9	0.000358	0.002	0.00272	NS	NS	NS
Copper, total[2]	mg/L	11	9	0.000319	0.002	0.0129	1.3	Hardness dependent	
Fluoride	mg/L	11	11	0.4	0.6	0.7	4	NS	NS
Hydroxide alkalinity	mg/L	11	0	1	1	1	NS	NS	NS
Iron, diss	mg/L	11	11	0.02	0.02	0.43	NS	NS	NS
Iron, total	mg/L	11	11	0.21	**1.22**	**8.73**	NS	NS	1.0
Laboratory conductivity[3]	µS/cm	11	11	1200	1400	**1650**	1500-2500 (seasonal)		
Laboratory pH	s.u.	11	11	8.4	8.59	8.7	NS	NS	NS
Lead, diss	mg/L	11	4	0.00000507	0.0000365	0.000728	NS	NS	NS
Lead, total[2]	mg/L	11	10	0.0000627	0.0007	0.00666	0.015	Hardness dependent	
Magnesium, diss	mg/L	11	11	92.8	112	138	NS	NS	NS
Manganese, diss	mg/L	11	11	0.005	0.0255	0.096	NS	NS	NS
Manganese, total	mg/L	11	11	0.0388	0.078	0.341	NS	NS	NS
Mercury, diss	mg/L	0	0	---	---	---	NS	NS	NS
Mercury, total	mg/L	0	0	---	---	---	0.00005	0.0017	0.0009
Nickel, diss	mg/L	11	11	0.002	0.002	0.00299	NS	NS	NS
Nickel, total[2]	mg/L	11	11	0.002	0.003	0.0114	0.1	Hardness dependent	
Nitrate+nitrite	mg/L	11	3	0.003	0.0066	0.089	10	NS	NS
Orthophosphate as P	mg/L	0	0	---	---	---	NS	NS	NS
Potassium, diss	mg/L	11	11	10	12.9	14	NS	NS	NS
Selenium, diss	mg/L	11	7	0.00076	0.001	0.001	NS	NS	NS

Table 39. Water Quality of Surface Water at SW-304.

Parameter	Unit	Number Samples	Number Detects	Minimum	Median	Maximum	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Selenium, total	mg/L	11	7	0.000521	0.001	0.00103	0.05	0.02	0.005
Sodium, diss	mg/L	11	11	63.6	95	138	NS	NS	NS
Sodium Absorption Rate[3]		11	11	1.14	1.61	2.19	4.5-7.5 (seasonal)		
Sulfate	mg/L	11	11	312	419	609	NS	NS	NS
Total alkalinity	mg/L	11	11	379	433	550	NS	NS	NS
Total dissolved solids	mg/L	11	11	876	1100	1420	NS	NS	NS
Total hardness	mg/L	11	11	587	648	834	NS	NS	NS
Total nitrogen	mg/L	11	11	0.33	0.553	3.8	NS	NS	NS
Total phosphate	mg/L	11	11	0.02	0.07	0.3	NS	NS	NS
Total suspended sediments	mg/L	11	11	6	49	390	NS	NS	NS
Turbidity	NTU	0	0	---	---	---	NS	NS	NS
Vanadium, diss	mg/L	11	11	0.01	0.01	0.01	NS	NS	NS
Vanadium, total	mg/L	11	10	0.00323	0.01	0.0149	NS	NS	NS
Zinc, diss	mg/L	11	0	0.00146	0.00146	0.00307	NS	NS	NS
Zinc, total[2]	mg/L	11	8	0.00143	0.01	0.0408	7.4	Hardness dependent	

NS = no numeric standard.
diss = dissolved; µS/cm = micro Siemens/centimeter; s.u. = standard units; NTU = nephelometric turbidity units.
[1] Aquatic Life Standards for Ammonia are temperature and pH dependent. No exceedances occurred during the monitoring period.
[2] Aquatic Life Standards for specific parameters are hardness dependent. No exceedances occurred during the monitoring period.
[3] Standards for Laboratory Conductivity and Sodium Absorption Rate are referenced from ARM 17.30.670.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed noted standards.

Table 40. Water Quality of Surface Water at SW-305.

Parameter	Unit	Number Samples	Number Detects	Minimum	Median	Maximum	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Acidity	mg/L	19	0	1	1	1	NS	NS	NS
Aluminum, diss	mg/L	19	19	0.011	0.0176	**0.268**	NS	0.75	0.087
Aluminum, total	mg/L	19	19	0.077	0.425	5.65	NS	NS	NS
Ammonia, as N[1]	mg/L	19	10	0.005	0.05	0.12	NS	T/pH dependent	
Arsenic, diss	mg/L	19	19	0.001	0.001	0.00224	NS	NS	NS
Arsenic, total	mg/L	19	19	0.001	0.002	0.00531	0.01	0.34	0.15
Bicarbonate alkalinity	mg/L	19	19	321	366	479	NS	NS	NS
Boron, diss	mg/L	19	19	0.1	0.17	0.22	NS	NS	NS
Boron, total	mg/L	19	19	0.11	0.2	0.26	NS	NS	NS
Cadmium, diss	mg/L	19	8	0.000048	0.0000658	0.0005	NS	NS	NS
Cadmium, total[2]	mg/L	19	9	0.0000514	0.000183	0.00106	0.005	Hardness dependent	
Calcium, diss	mg/L	19	19	64	80.7	100	NS	NS	NS
Carbonate alkalinity	mg/L	19	19	9	56	77	NS	NS	NS
Chloride	mg/L	19	19	5.28	7	8	NS	NS	NS
Chromium, diss	mg/L	0	0	---	---	---	NS	NS	NS
Chromium, total[2]	mg/L	0	0	---	---	---	0.1	Hardness dependent	
Copper, diss	mg/L	19	13	0.000358	0.002	0.00281	NS	NS	NS
Copper, total[2]	mg/L	19	15	0.000319	0.002	0.0149	1.3	Hardness dependent	
Fluoride	mg/L	19	19	0.4	0.6	0.6	4	NS	NS
Hydroxide alkalinity	mg/L	19	0	1	1	1	NS	NS	NS
Iron, diss	mg/L	19	19	0.02	0.02	0.683	NS	NS	NS
Iron, total	mg/L	19	19	0.19	0.9	**11**	NS	NS	1.0
Laboratory conductivity[3]	µS/cm	19	19	991	1320	**1570**	1500-2500 (seasonal)		
Laboratory pH	s.u.	19	19	8.4	8.6	8.8	NS	NS	NS
Lead, diss	mg/L	19	6	0.00000507	0.0000365	0.00105	NS	NS	NS
Lead, total[2]	mg/L	19	17	0.0000627	0.0006	0.00781	0.015	Hardness dependent	
Magnesium, diss	mg/L	19	19	79	106	128	NS	NS	NS
Manganese, diss	mg/L	19	19	0.00602	0.032	0.074	NS	NS	NS
Manganese, total	mg/L	19	19	0.0363	0.071	0.429	NS	NS	NS
Mercury, diss	mg/L	0	0	---	---	---	NS	NS	NS
Mercury, total	mg/L	0	0	---	---	---	0.00005	0.0017	0.0009
Nickel, diss	mg/L	19	16	0.000995	0.002	0.003	NS	NS	NS
Nickel, total[2]	mg/L	19	18	0.000574	0.00263	0.013	0.1	Hardness dependent	
Nitrate+nitrite	mg/L	19	6	0.003	0.0066	0.074	10	NS	NS
Orthophosphate as P	mg/L	0	0	---	---	---	NS	NS	NS
Potassium, diss	mg/L	19	19	9.64	13	14	NS	NS	NS
Selenium, diss	mg/L	19	11	0.00076	0.001	0.001	NS	NS	NS

Table 40. Water Quality of Surface Water at SW-305.

Parameter	Unit	Number Samples	Number Detects	Minimum	Median	Maximum	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Selenium, total	mg/L	19	11	0.000521	0.001	0.001	0.05	0.02	0.005
Sodium, diss	mg/L	19	19	56	85	119	NS	NS	NS
Sodium Absorption Rate[3]		19	19	1.06	1.4	1.96	4.5-7.5 (seasonal)		
Sulfate	mg/L	19	19	237	397	525	NS	NS	NS
Total alkalinity	mg/L	19	19	330	426	553	NS	NS	NS
Total dissolved solids	mg/L	19	19	760	1000	1290	NS	NS	NS
Total hardness	mg/L	19	19	487	630	775	NS	NS	NS
Total nitrogen	mg/L	19	18	0.0081	0.63	3.49	NS	NS	NS
Total phosphate	mg/L	19	19	0.02	0.06	0.415	NS	NS	NS
Total suspended sediments	mg/L	19	19	6	35	437	NS	NS	NS
Turbidity	NTU	0	0	---	---	---	NS	NS	NS
Vanadium, diss	mg/L	19	19	0.01	0.01	0.01	NS	NS	NS
Vanadium, total	mg/L	19	16	0.00155	0.01	0.0165	NS	NS	NS
Zinc, diss	mg/L	19	0	0.00146	0.00307	0.00307	NS	NS	NS
Zinc, total[2]	mg/L	19	14	0.00143	0.009	0.0389	7.4	Hardness dependent	

NS = no numeric standard.
diss = dissolved; μS/cm = micro Siemens/centimeter; s.u. = standard units; NTU = nephelometric turbidity units.
[1] Aquatic Life Standards for Ammonia are temperature and pH dependent. No exceedances occurred during the monitoring period.
[2] Aquatic Life Standards for specific parameters are hardness dependent. No exceedances occurred during the monitoring period.
[3] Standards for Laboratory Conductivity and Sodium Absorption Rate are referenced from ARM 17.30.670.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed noted standards.

Ponds

Water quality monitoring results within the past 10 years are available for 11 ponds within or near the Project area including along Rape Coulee (PO-303); Richard Coulee (PO-301, PO-302, and PO-307); Lee Coulee (PO-300, PO-304, PO-305, PO-308, BBIO1, and BBIO2); and East Fork Armells Creek (PO-937). **Table 41** through **Table 51** summarize these results. Monitoring results include minimum, median, and maximum values for all monitoring sites. Monitoring periods for the monitoring sites are listed below.

- PO-300 (September 2013 through January 2020)
- PO-301 (September 2013 through January 2020)
- PO-302 (September 2013 through January 2020)
- PO-303 (September 2013 through March 2020)
- PO-304 (June 2018 through January 2020)
- PO-305 (April 2016 through January 2020)
- PO-307 (February 2017)
- PO-308 (May 2019 through January 2020)
- PO-937 (March 2016 through October 2016)
- BBIO1 (February 2016 through August 2018)
- BBIO2 (February 2016 through August 2018)

The quality of pond water was variable during the monitoring periods. The pH of pond water is basic with values ranging from 7.2 to 10.6. As shown in **Table 41** through **Table 51**, parameters with exceedances of Montana Numeric Water Quality Standards (Circular DEQ-7) in the monitored ponds include:

- Dissolved aluminum (PO-300, PO-301, PO-302, PO-303, PO-304, PO-308, BBIO2)
- Total arsenic (PO-300, PO-301, PO-302, PO-937, BBIO2)
- Total iron (PO-300, PO-301, PO-302, PO-303, PO-304, PO-305, PO-308, BBIO1, BBIO2)
- Total lead (PO-301, PO-302, BBIO1)
- Total mercury (PO-300)
- Total nickel (BBIO1)
- Total selenium (PO-302)

Parameters with exceedances of DEQ-7 aquatic life standards that are hardness dependent (exceedances not reflected in the following tables) include:

- Total cadmium (PO-307)
- Total copper (PO-300, PO-301, PO-302, BBIO1)
- Total lead (PO-300, PO-301, PO-302, BBIO1)
- Total zinc (BBIO1)

The DEQ-7 ammonia standard for aquatic life, which is temperature and pH dependent (exceedances not reflected in the following tables), was exceeded in PO-300 and in PO-302. Exceedances of laboratory conductivity (ARM 17.30.670) occurred in all except three of the monitoring sites. Exceedances of sodium absorption rate (ARM 17.30.670) occurred in four of the monitoring sites.

Table 41. Water Quality of Pond PO-300.

Parameter	Unit	Number Samples	Number Detects	Min	Median	Max	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Acidity	mg/L	38	0	1	1	5	NS	NS	NS
Aluminum, diss	mg/L	38	36	0.004	**0.1565**	**2.55**	NS	0.75	0.087
Aluminum, total	mg/L	38	38	0.1	0.5815	4.83	NS	NS	NS
Ammonia, as N[1]	mg/L	38	24	0.005	0.06345	1.8	NS	T/pH dependent	
Arsenic, diss	mg/L	38	38	0.001	0.00949	0.0379	NS	NS	NS
Arsenic, total	mg/L	38	38	0.001	**0.0139**	**0.0402**	0.01	0.34	0.15
Bicarbonate alkalinity	mg/L	38	38	5	249	421	NS	NS	NS
Boron, diss	mg/L	38	38	0.03	0.13	0.251	NS	NS	NS
Boron, total	mg/L	38	38	0.0307	0.14	0.473	NS	NS	NS
Cadmium, diss	mg/L	38	18	0.000005	0.00018755	0.0005	NS	NS	NS
Cadmium, total[2]	mg/L	38	15	0.000032	0.000129	0.0005	0.005	Hardness dependent	
Calcium, diss	mg/L	38	38	15.8	33.95	170	NS	NS	NS
Carbonate alkalinity	mg/L	38	34	1	41.9	279	NS	NS	NS
Chloride	mg/L	38	38	1.92	11.85	25.9	NS	NS	NS
Chromium, diss	mg/L	20	5	0.000253	0.000388	0.000793	NS	NS	NS
Chromium, total[2]	mg/L	20	14	0.000222	0.00134	0.00401	0.1	Hardness dependent	
Copper, diss	mg/L	38	34	0.000358	0.002	0.00492	NS	NS	NS
Copper, total[2]	mg/L	38	37	0.000488	0.00395	0.0132	1.3	Hardness dependent	
Fluoride	mg/L	38	35	0.004	0.5125	1.34	4	NS	NS
Hydroxide alkalinity	mg/L	38	0	1	1	5	NS	NS	NS
Iron, diss	mg/L	38	36	0.02	0.155	1.52	NS	NS	NS
Iron, total	mg/L	38	38	0.145	**1.135**	**8.78**	NS	NS	1.0
Laboratory conductivity[3]	µS/cm	38	38	273	**2390**	**3670**	500		
Laboratory pH	s.u.	38	38	8.03	8.81	10.4	NS	NS	NS
Lead, diss	mg/L	38	31	0.000004	0.0003	0.00136	NS	NS	NS
Lead, total[2]	mg/L	38	37	0.000088	0.001485	0.00881	0.015	Hardness dependent	
Magnesium, diss	mg/L	38	38	8.25	16.7	102	NS	NS	NS
Manganese, diss	mg/L	38	38	0.005	0.02975	0.45	NS	NS	NS
Manganese, total	mg/L	38	38	0.0161	0.0964	0.496	NS	NS	NS
Mercury, diss	mg/L	20	0	0.000008	0.000008	0.00003	NS	NS	NS
Mercury, total	mg/L	20	1	0.000008	0.00003	**0.0002**	0.00005	0.0017	0.0009
Nickel, diss	mg/L	38	27	0.000605	0.002	0.00502	NS	NS	NS
Nickel, total[2]	mg/L	38	34	0.000717	0.00281	0.01	0.1	Hardness dependent	
Nitrate+nitrite	mg/L	38	7	0.003	0.0046	0.349	10	NS	NS
Orthophosphate as P	mg/L	20	5	0.00616	0.022	0.221	NS	NS	NS
Potassium, diss	mg/L	38	38	7.22	15.35	27.8	NS	NS	NS
Selenium, diss	mg/L	38	24	0.000182	0.001	0.001	NS	NS	NS
Selenium, total	mg/L	38	19	0.000378	0.000785	0.00111	0.05	0.02	0.005

Table 41. Water Quality of Pond PO-300.

Parameter	Unit	Number Samples	Number Detects	Min	Median	Max	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Sodium, diss	mg/L	38	38	3.49	514.5	868	NS	NS	NS
Sodium Absorption Rate[3]		38	38	0.1	**19**	**37.7**	4.5-7.5 (seasonal)		
Sulfate	mg/L	38	38	61	827.5	1370	NS	NS	NS
Total alkalinity	mg/L	38	38	63.8	354.5	549	NS	NS	NS
Total dissolved solids	mg/L	38	38	192	1710	2690	NS	NS	NS
Total hardness	mg/L	38	38	85.7	146.5	840	NS	NS	NS
Total nitrogen	mg/L	36	35	0.0081	2.38	4.81	NS	NS	NS
Total phosphate	mg/L	38	38	0.0156	0.2415	0.959	NS	NS	NS
Total suspended sediments	mg/L	38	38	2	24.25	84.4	NS	NS	NS
Turbidity	NTU	20	20	2.47	21.35	114	NS	NS	NS
Vanadium, diss	mg/L	38	34	0.000043	0.01	0.01	NS	NS	NS
Vanadium, total	mg/L	38	34	0.000332	0.01	0.0114	NS	NS	NS
Zinc, diss	mg/L	38	2	0.000855	0.00146	0.008	NS	NS	NS
Zinc, total[2]	mg/L	38	24	0.00119	0.008	0.0355	7.4	Hardness dependent	

NS = no numeric standard.
diss = dissolved; μS/cm = micro Siemens/centimeter; s.u. = standard units; NTU = nephelometric turbidity units.
[1] Aquatic Life Standards for Ammonia are temperature and pH dependent. Any exceedances are noted in text narrative.
[2] Aquatic Life Standards for specific parameters are hardness dependent. Any exceedances are noted in text narrative.
[3] Standards for Laboratory Conductivity and Sodium Absorption Rate are referenced from ARM 17.30.670.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed the Human Health Standard or Aquatic Life Standards.

Table 42. Water Quality of Pond PO-301.

Parameter	Unit	Number Samples	Number Detects	Min	Median	Max	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Acidity	mg/L	22	0	1	1	5	NS	NS	NS
Aluminum, diss	mg/L	22	22	0.011	0.03	**0.302**	NS	0.75	0.087
Aluminum, total	mg/L	22	22	0.056	0.3205	13.8	NS	NS	NS
Ammonia, as N[1]	mg/L	22	11	0.0073	0.0474	0.8	NS	T/pH dependent	
Arsenic, diss	mg/L	22	22	0.001	0.002	0.007	NS	NS	NS
Arsenic, total	mg/L	22	22	0.001	0.00285	**0.017**	0.01	0.34	0.15
Bicarbonate alkalinity	mg/L	22	22	26.3	85.15	171	NS	NS	NS
Boron, diss	mg/L	22	21	0.0137	0.031	0.0956	NS	NS	NS
Boron, total	mg/L	22	22	0.03	0.0497	0.108	NS	NS	NS
Cadmium, diss	mg/L	22	9	0.00004	0.0000811	0.0005	NS	NS	NS
Cadmium, total[2]	mg/L	22	8	0.0000514	0.0001135	0.0005	0.005	Hardness dependent	
Calcium, diss	mg/L	22	22	26.5	44.2	88.1	NS	NS	NS
Carbonate alkalinity	mg/L	22	10	1	5	38.6	NS	NS	NS
Chloride	mg/L	22	22	1	2.36	7	NS	NS	NS
Chromium, diss	mg/L	10	3	0.000228	0.000253	0.000878	NS	NS	NS
Chromium, total[2]	mg/L	10	8	0.000222	0.0009195	0.021	0.1	Hardness dependent	
Copper, diss	mg/L	22	19	0.000358	0.002	0.00453	NS	NS	NS
Copper, total[2]	mg/L	22	22	0.002	0.00236	0.0409	1.3	Hardness dependent	
Fluoride	mg/L	22	21	0.008	0.1715	0.385	4	NS	NS
Hydroxide alkalinity	mg/L	22	0	1	1	5	NS	NS	NS
Iron, diss	mg/L	22	21	0.02	0.045	0.21	NS	NS	NS
Iron, total	mg/L	22	22	0.117	0.539	**24.1**	NS	NS	1.0
Laboratory conductivity[3]	µS/cm	22	22	333	**557.5**	**1040**	500		
Laboratory pH	s.u.	22	22	7.6	8.35	9.82	NS	NS	NS
Lead, diss	mg/L	22	13	0.0000023	0.0003	0.00951	NS	NS	NS
Lead, total[2]	mg/L	22	19	0.0000627	0.0004695	**0.0249**	0.015	Hardness dependent	
Magnesium, diss	mg/L	22	22	15	27.75	66	NS	NS	NS
Manganese, diss	mg/L	22	22	0.005	0.0102	0.798	NS	NS	NS
Manganese, total	mg/L	22	22	0.00868	0.0347	0.841	NS	NS	NS
Mercury, diss	mg/L	10	0	0.000008	0.00003	0.00003	NS	NS	NS
Mercury, total	mg/L	10	0	0.000008	0.00003	0.00003	0.00005	0.0017	0.0009
Nickel, diss	mg/L	22	12	0.000605	0.002	0.0032	NS	NS	NS
Nickel, total[2]	mg/L	22	19	0.000574	0.002	0.0265	0.1	Hardness dependent	
Nitrate+nitrite	mg/L	22	6	0.003	0.0066	0.37	10	NS	NS
Orthophosphate as P	mg/L	9	1	0.00616	0.007	0.022	NS	NS	NS
Potassium, diss	mg/L	22	22	5.3	12	19.3	NS	NS	NS
Selenium, diss	mg/L	22	9	0.000171	0.00076	0.00142	NS	NS	NS

Table 42. Water Quality of Pond PO-301.

Parameter	Unit	Number Samples	Number Detects	Min	Median	Max	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Selenium, total	mg/L	22	10	0.000378	0.00057	0.00177	0.05	0.02	0.005
Sodium, diss	mg/L	22	22	10.4	29	58	NS	NS	NS
Sodium Absorption Rate[3]		22	22	0.29	0.845	1.3	4.5-7.5 (seasonal)		
Sulfate	mg/L	22	22	82.5	185.5	433	NS	NS	NS
Total alkalinity	mg/L	22	22	40	98.2	171	NS	NS	NS
Total dissolved solids	mg/L	22	22	232	391	740	NS	NS	NS
Total hardness	mg/L	22	22	132	205.5	398	NS	NS	NS
Total nitrogen	mg/L	20	20	0.517	1.07	2.54	NS	NS	NS
Total phosphate	mg/L	22	22	0.0251	0.08405	0.929	NS	NS	NS
Total suspended sediments	mg/L	22	22	1	12.55	477	NS	NS	NS
Turbidity	NTU	10	10	4.86	21.3	341	NS	NS	NS
Vanadium, diss	mg/L	22	17	0.0000136	0.01	0.01	NS	NS	NS
Vanadium, total	mg/L	22	16	0.000164	0.01	0.0332	NS	NS	NS
Zinc, diss	mg/L	22	0	0.000855	0.00146	0.00547	NS	NS	NS
Zinc, total[2]	mg/L	22	12	0.0011	0.008	0.0896	7.4	Hardness dependent	

NS = no numeric standard.
diss = dissolved; μS/cm = micro Siemens/centimeter; s.u. = standard units; NTU = nephelometric turbidity units.
[1] Aquatic Life Standards for Ammonia are temperature and pH dependent. Any exceedances are noted in text narrative.
[2] Aquatic Life Standards for specific parameters are hardness dependent. Any exceedances are noted in text narrative.
[3] Standards for Laboratory Conductivity and Sodium Absorption Rate are referenced from ARM 17.30.670.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed the Human Health Standard or Aquatic Life Standards.

Table 43. Water Quality of Pond PO-302.

Parameter	Unit	Number Samples	Number Detects	Min	Median	Max	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Acidity	mg/L	27	0	1	1	5	NS	NS	NS
Aluminum, diss	mg/L	27	27	0.0083	0.03	**0.416**	NS	0.75	0.087
Aluminum, total	mg/L	27	27	0.0554	0.256	18.8	NS	NS	NS
Ammonia, as N[1]	mg/L	27	14	0.005	0.05	3.08	NS	T/pH dependent	
Arsenic, diss	mg/L	27	27	0.001	0.00344	0.016	NS	NS	NS
Arsenic, total	mg/L	27	27	0.001	0.00463	**0.018**	0.01	0.34	0.15
Bicarbonate alkalinity	mg/L	27	26	1	188	608	NS	NS	NS
Boron, diss	mg/L	27	27	0.0979	0.32	1.17	NS	NS	NS
Boron, total	mg/L	27	27	0.111	0.32	1.74	NS	NS	NS
Cadmium, diss	mg/L	27	11	0.00004	0.0000811	0.0005	NS	NS	NS
Cadmium, total[2]	mg/L	27	9	0.000032	0.000129	0.000958	0.005	Hardness dependent	
Calcium, diss	mg/L	27	27	19.1	59	319	NS	NS	NS
Carbonate alkalinity	mg/L	27	27	5	96	273	NS	NS	NS
Chloride	mg/L	27	27	2.95	10	52.5	NS	NS	NS
Chromium, diss	mg/L	12	4	0.000253	0.000388	0.000793	NS	NS	NS
Chromium, total[2]	mg/L	12	10	0.0005	0.001225	0.00354	0.1	Hardness dependent	
Copper, diss	mg/L	27	24	0.000358	0.002	0.0167	NS	NS	NS
Copper, total[2]	mg/L	27	27	0.002	0.00304	0.034	1.3	Hardness dependent	
Fluoride	mg/L	27	24	0.004	0.2	2.03	4	NS	NS
Hydroxide alkalinity	mg/L	27	0	1	1	5	NS	NS	NS
Iron, diss	mg/L	27	24	0.00265	0.02	0.457	NS	NS	NS
Iron, total	mg/L	27	27	0.0503	0.452	**31.9**	NS	NS	1.0
Laboratory conductivity[3]	µS/cm	27	27	**802**	**2320**	**6380**	500		
Laboratory pH	s.u.	27	27	8.29	9.2	10.6	NS	NS	NS
Lead, diss	mg/L	27	17	0.000004	0.0003	0.000506	NS	NS	NS
Lead, total[2]	mg/L	27	22	0.0000122	0.000411	**0.021**	0.015	Hardness dependent	
Magnesium, diss	mg/L	27	27	45.7	167	425	NS	NS	NS
Manganese, diss	mg/L	27	27	0.005	0.0104	0.624	NS	NS	NS
Manganese, total	mg/L	27	27	0.00602	0.0254	1.03	NS	NS	NS
Mercury, diss	mg/L	12	0	0.000008	0.000014	0.00003	NS	NS	NS
Mercury, total	mg/L	12	0	0.000008	0.00003	0.00003	0.00005	0.0017	0.0009
Nickel, diss	mg/L	27	19	0.000605	0.002	0.00545	NS	NS	NS
Nickel, total[2]	mg/L	27	26	0.000898	0.0027	0.032	0.1	Hardness dependent	
Nitrate+nitrite	mg/L	27	4	0.003	0.0066	2.32	10	NS	NS
Orthophosphate as P	mg/L	10	0	0.00616	0.007	0.022	NS	NS	NS
Potassium, diss	mg/L	27	27	6.71	16	93.7	NS	NS	NS
Selenium, diss	mg/L	27	17	0.000178	0.001	0.00723	NS	NS	NS

Table 43. Water Quality of Pond PO-302.

Parameter	Unit	Number Samples	Number Detects	Min	Median	Max	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Selenium, total	mg/L	27	14	0.000236	0.00066	**0.00775**	0.05	0.02	0.005
Sodium, diss	mg/L	27	27	70.9	304	855	NS	NS	NS
Sodium Absorption Rate[3]		27	27	1.88	**4.7**	**8.95**	4.5-7.5 (seasonal)		
Sulfate	mg/L	27	27	204	1190	3740	NS	NS	NS
Total alkalinity	mg/L	27	27	126	273	674	NS	NS	NS
Total dissolved solids	mg/L	27	27	510	1940	6290	NS	NS	NS
Total hardness	mg/L	27	27	236	777	2390	NS	NS	NS
Total nitrogen	mg/L	25	25	0.529	1.29	10.1	NS	NS	NS
Total phosphate	mg/L	27	27	0.024	0.08	0.777	NS	NS	NS
Total suspended sediments	mg/L	27	26	1	13.3	1720	NS	NS	NS
Turbidity	NTU	12	12	1.71	10.195	89.7	NS	NS	NS
Vanadium, diss	mg/L	27	26	0.000828	0.01	0.01	NS	NS	NS
Vanadium, total	mg/L	27	24	0.000332	0.01	0.038	NS	NS	NS
Zinc, diss	mg/L	27	1	0.000855	0.00146	0.008	NS	NS	NS
Zinc, total[2]	mg/L	27	16	0.0011	0.008	0.097	7.4	Hardness dependent	

NS = no numeric standard.
diss = dissolved; μS/cm = micro Siemens/centimeter; s.u. = standard units; NTU = nephelometric turbidity units.
[1] Aquatic Life Standards for Ammonia are temperature and pH dependent. Any exceedances are noted in text narrative.
[2] Aquatic Life Standards for specific parameters are hardness dependent. Any exceedances are noted in text narrative.
[3] Standards for Laboratory Conductivity and Sodium Absorption Rate are referenced from ARM 17.30.670.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed the Human Health Standard or Aquatic Life Standards.

Table 44. Water Quality of Pond PO-303.

Parameter	Unit	Number Samples	Number Detects	Min	Median	Max	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Acidity	mg/L	18	0	1	1	5	NS	NS	NS
Aluminum, diss	mg/L	18	17	0.00316	0.032	**0.75**	NS	0.75	0.087
Aluminum, total	mg/L	18	17	0.0051	0.2475	9.3	NS	NS	NS
Ammonia, as N[1]	mg/L	18	11	0.0073	0.0535	0.311	NS	T/pH dependent	
Arsenic, diss	mg/L	18	18	0.001	0.001105	0.00515	NS	NS	NS
Arsenic, total	mg/L	18	18	0.001	0.001285	0.0095	0.01	0.34	0.15
Bicarbonate alkalinity	mg/L	18	18	88.6	212	623	NS	NS	NS
Boron, diss	mg/L	18	18	0.0786	0.365	0.754	NS	NS	NS
Boron, total	mg/L	18	18	0.08	0.407	1.18	NS	NS	NS
Cadmium, diss	mg/L	18	7	0.00004	0.0000811	0.0005	NS	NS	NS
Cadmium, total[2]	mg/L	18	7	0.0000514	0.0001135	0.0005	0.005	Hardness dependent	
Calcium, diss	mg/L	18	18	51.3	160	304	NS	NS	NS
Carbonate alkalinity	mg/L	18	8	1	3	40	NS	NS	NS
Chloride	mg/L	18	18	2.45	9.09	28	NS	NS	NS
Chromium, diss	mg/L	6	2	0.000228	0.000253	0.00062	NS	NS	NS
Chromium, total[2]	mg/L	6	6	0.0005	0.00145	0.00408	0.1	Hardness dependent	
Copper, diss	mg/L	18	17	0.000358	0.002	0.0041	NS	NS	NS
Copper, total[2]	mg/L	18	16	0.0000476	0.004935	0.023	1.3	Hardness dependent	
Fluoride	mg/L	18	15	0.004	0.2	0.302	4	NS	NS
Hydroxide alkalinity	mg/L	18	0	1	1	5	NS	NS	NS
Iron, diss	mg/L	18	17	0.000688	0.03265	1.3	NS	NS	NS
Iron, total	mg/L	18	18	0.0526	0.423	**16.7**	NS	NS	1.0
Laboratory conductivity[3]	µS/cm	18	18	**1070**	**3115**	**6680**	500		
Laboratory pH	s.u.	18	18	7.4	8.295	8.42	NS	NS	NS
Lead, diss	mg/L	18	7	0.0000023	0.00003485	0.0011	NS	NS	NS
Lead, total[2]	mg/L	18	15	0.0000122	0.000348	0.012	0.015	Hardness dependent	
Magnesium, diss	mg/L	18	18	55.2	198	429	NS	NS	NS
Manganese, diss	mg/L	18	18	0.005	0.0433	0.559	NS	NS	NS
Manganese, total	mg/L	18	18	0.0143	0.08305	0.671	NS	NS	NS
Mercury, diss	mg/L	6	0	0.000008	0.00003	0.00003	NS	NS	NS
Mercury, total	mg/L	6	0	0.000008	0.00003	0.00003	0.00005	0.0017	0.0009
Nickel, diss	mg/L	18	15	0.000605	0.002	0.00751	NS	NS	NS
Nickel, total[2]	mg/L	18	16	0.000574	0.0045	0.0195	0.1	Hardness dependent	
Nitrate+nitrite	mg/L	18	4	0.003	0.0066	0.312	10	NS	NS
Orthophosphate as P	mg/L	6	0	0.00616	0.007	0.022	NS	NS	NS
Potassium, diss	mg/L	18	18	6.33	16.4	34	NS	NS	NS
Selenium, diss	mg/L	18	10	0.00028	0.001	0.00121	NS	NS	NS

Table 44. Water Quality of Pond PO-303.

Parameter	Unit	Number Samples	Number Detects	Min	Median	Max	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Selenium, total	mg/L	18	11	0.000521	0.001	0.00185	0.05	0.02	0.005
Sodium, diss	mg/L	18	18	77.7	386	846	NS	NS	NS
Sodium Absorption Rate[3]		18	18	1.8	**4.83**	**7.38**	4.5-7.5 (seasonal)		
Sulfate	mg/L	18	18	458	1770	4100	NS	NS	NS
Total alkalinity	mg/L	18	18	88.6	214.5	663	NS	NS	NS
Total dissolved solids	mg/L	18	18	812	2950	6950	NS	NS	NS
Total hardness	mg/L	18	18	355	1235	2530	NS	NS	NS
Total nitrogen	mg/L	17	17	0.57	1.41	3.44	NS	NS	NS
Total phosphate	mg/L	18	18	0.0261	0.0905	1.2	NS	NS	NS
Total suspended sediments	mg/L	18	18	2	11	666	NS	NS	NS
Turbidity	NTU	6	6	2.12	18.9	133	NS	NS	NS
Vanadium, diss	mg/L	18	14	0.0000136	0.01	0.01	NS	NS	NS
Vanadium, total	mg/L	18	13	0.000332	0.01	0.021	NS	NS	NS
Zinc, diss	mg/L	18	2	0.000855	0.00146	0.008	NS	NS	NS
Zinc, total[2]	mg/L	18	12	0.00143	0.008	0.061	7.4	Hardness dependent	

NS = no numeric standard.
diss = dissolved; μS/cm = micro Siemens/centimeter; s.u. = standard units; NTU = nephelometric turbidity units.
[1] Aquatic Life Standards for Ammonia are temperature and pH dependent. Any exceedances are noted in text narrative.
[2] Aquatic Life Standards for specific parameters are hardness dependent. Any exceedances are noted in text narrative.
[3] Standards for Laboratory Conductivity and Sodium Absorption Rate are referenced from ARM 17.30.670.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed the Human Health Standard or Aquatic Life Standards.

Table 45. Water Quality of Pond PO-304.

Parameter	Unit	Number Samples	Number Detects	Min	Median	Max	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Acidity	mg/L	2	0	1	1	1	NS	NS	NS
Aluminum, diss	mg/L	2	2	0.054	**0.1035**	**0.153**	NS	0.75	0.087
Aluminum, total	mg/L	2	2	0.187	0.5255	0.864	NS	NS	NS
Ammonia, as N[1]	mg/L	2	1	0.0073	0.04365	0.08	NS	T/pH dependent	
Arsenic, diss	mg/L	2	2	0.001	0.001	0.001	NS	NS	NS
Arsenic, total	mg/L	2	2	0.001	0.00135	0.0017	0.01	0.34	0.15
Bicarbonate alkalinity	mg/L	2	2	70.6	75.3	80	NS	NS	NS
Boron, diss	mg/L	2	2	0.03	0.03	0.03	NS	NS	NS
Boron, total	mg/L	2	2	0.03	0.03	0.03	NS	NS	NS
Cadmium, diss	mg/L	2	1	0.000294	0.000397	0.0005	NS	NS	NS
Cadmium, total[2]	mg/L	2	1	0.000183	0.0003415	0.0005	0.005	Hardness dependent	
Calcium, diss	mg/L	2	2	21.3	21.65	22	NS	NS	NS
Carbonate alkalinity	mg/L	2	0	1	1	1	NS	NS	NS
Chloride	mg/L	2	2	1.67	4.835	8	NS	NS	NS
Chromium, diss	mg/L	0	0	---	---	---	NS	NS	NS
Chromium, total[2]	mg/L	0	0	---	---	---	0.1	Hardness dependent	
Copper, diss	mg/L	2	2	0.002	0.002	0.002	NS	NS	NS
Copper, total[2]	mg/L	2	2	0.003	0.00307	0.00314	1.3	Hardness dependent	
Fluoride	mg/L	2	1	0.0292	0.0646	0.1	4	NS	NS
Hydroxide alkalinity	mg/L	2	0	1	1	1	NS	NS	NS
Iron, diss	mg/L	2	2	0.07	0.099	0.128	NS	NS	NS
Iron, total	mg/L	2	2	0.2	0.675	**1.15**	NS	NS	1.0
Laboratory conductivity[3]	µS/cm	2	2	198	199	200	500		
Laboratory pH	s.u.	2	2	7.7	7.73	7.76	NS	NS	NS
Lead, diss	mg/L	2	2	0.0003	0.0003	0.0003	NS	NS	NS
Lead, total[2]	mg/L	2	2	0.0003	0.000835	0.00137	0.015	Hardness dependent	
Magnesium, diss	mg/L	2	2	5.11	5.555	6	NS	NS	NS
Manganese, diss	mg/L	2	2	0.005	0.079	0.153	NS	NS	NS
Manganese, total	mg/L	2	2	0.007	0.09	0.173	NS	NS	NS
Mercury, diss	mg/L	0	0	---	---	---	NS	NS	NS
Mercury, total	mg/L	0	0	---	---	---	0.00005	0.0017	0.0009
Nickel, diss	mg/L	2	1	0.000764	0.001382	0.002	NS	NS	NS
Nickel, total[2]	mg/L	2	2	0.002	0.0025	0.003	0.1	Hardness dependent	
Nitrate+nitrite	mg/L	2	1	0.0066	0.3233	0.64	10	NS	NS
Orthophosphate as P	mg/L	0	0	---	---	---	NS	NS	NS
Potassium, diss	mg/L	2	2	11.5	13.75	16	NS	NS	NS
Selenium, diss	mg/L	2	1	0.00028	0.00064	0.001	NS	NS	NS

Table 45. Water Quality of Pond PO-304.

Parameter	Unit	Number Samples	Number Detects	Min	Median	Max	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Selenium, total	mg/L	2	1	0.00057	0.000785	0.001	0.05	0.02	0.005
Sodium, diss	mg/L	2	2	1	1.415	1.83	NS	NS	NS
Sodium Absorption Rate[3]		2	2	0.05	0.07	0.09	4.5-7.5 (seasonal)		
Sulfate	mg/L	2	2	9	15.4	21.8	NS	NS	NS
Total alkalinity	mg/L	2	2	70.6	75.3	80	NS	NS	NS
Total dissolved solids	mg/L	2	2	120	133	146	NS	NS	NS
Total hardness	mg/L	2	2	74.1	78.05	82	NS	NS	NS
Total nitrogen	mg/L	2	2	1.57	2.685	3.8	NS	NS	NS
Total phosphate	mg/L	2	2	0.7	0.725	0.75	NS	NS	NS
Total suspended sediments	mg/L	2	2	15	31	47	NS	NS	NS
Turbidity	NTU	0	0	---	---	---	NS	NS	NS
Vanadium, diss	mg/L	2	2	0.01	0.01	0.01	NS	NS	NS
Vanadium, total	mg/L	2	1	0.00323	0.006615	0.01	NS	NS	NS
Zinc, diss	mg/L	2	0	0.00146	0.002265	0.00307	NS	NS	NS
Zinc, total[2]	mg/L	2	2	0.008	0.008	0.008	7.4	Hardness dependent	

NS = no numeric standard.
diss = dissolved; µS/cm = micro Siemens/centimeter; s.u. = standard units; NTU = nephelometric turbidity units.
[1] Aquatic Life Standards for Ammonia are temperature and pH dependent. Any exceedances are noted in text narrative.
[2] Aquatic Life Standards for specific parameters are hardness dependent. Any exceedances are noted in text narrative.
[3] Standards for Laboratory Conductivity and Sodium Absorption Rate are referenced from ARM 17.30.670.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed the Human Health Standard or Aquatic Life Standards.

Table 46. Water Quality of Pond PO-305.

Parameter	Unit	Number Samples	Number Detects	Min	Median	Max	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Acidity	mg/L	19	0	1	1	1	NS	NS	NS
Aluminum, diss	mg/L	19	19	0.009	0.0129	0.0306	NS	0.75	0.087
Aluminum, total	mg/L	19	19	0.0113	0.0277	0.998	NS	NS	NS
Ammonia, as N[1]	mg/L	19	10	0.005	0.05	0.336	NS	T/pH dependent	
Arsenic, diss	mg/L	19	17	0.000035	0.00101	0.00231	NS	NS	NS
Arsenic, total	mg/L	19	17	0.000246	0.00197	0.00316	0.01	0.34	0.15
Bicarbonate alkalinity	mg/L	19	19	43.5	274	324	NS	NS	NS
Boron, diss	mg/L	19	19	0.03	0.17	0.202	NS	NS	NS
Boron, total	mg/L	19	19	0.03	0.19	0.246	NS	NS	NS
Cadmium, diss	mg/L	19	12	0.000005	0.0005	0.0005	NS	NS	NS
Cadmium, total[2]	mg/L	19	11	0.0000514	0.0005	0.0005	0.005	Hardness dependent	
Calcium, diss	mg/L	19	19	12	62.7	86	NS	NS	NS
Carbonate alkalinity	mg/L	19	17	1	22	45.4	NS	NS	NS
Chloride	mg/L	19	19	1	6	7.2	NS	NS	NS
Chromium, diss	mg/L	6	3	0.000228	0.000444	0.000677	NS	NS	NS
Chromium, total[2]	mg/L	6	5	0.00035	0.0005	0.00108	0.1	Hardness dependent	
Copper, diss	mg/L	19	10	0.0000224	0.002	0.00501	NS	NS	NS
Copper, total[2]	mg/L	19	11	0.0000476	0.002	0.00587	1.3	Hardness dependent	
Fluoride	mg/L	19	19	0.1	0.1	0.406	4	NS	NS
Hydroxide alkalinity	mg/L	19	0	1	1	1	NS	NS	NS
Iron, diss	mg/L	19	13	0.00177	0.02	0.0419	NS	NS	NS
Iron, total	mg/L	19	19	0.02	0.049	**1.65**	NS	NS	1.0
Laboratory conductivity[3]	μS/cm	19	19	238	**1960**	**2240**	500		
Laboratory pH	s.u.	19	19	8.03	8.5	8.77	NS	NS	NS
Lead, diss	mg/L	19	9	0.0000023	0.0000715	0.0003	NS	NS	NS
Lead, total[2]	mg/L	19	9	0.000003	0.0000627	0.00134	0.015	Hardness dependent	
Magnesium, diss	mg/L	19	19	15.6	217	252	NS	NS	NS
Manganese, diss	mg/L	19	19	0.005	0.011	0.0271	NS	NS	NS
Manganese, total	mg/L	19	19	0.005	0.0199	0.0666	NS	NS	NS
Mercury, diss	mg/L	6	0	0.000008	0.000011	0.000023	NS	NS	NS
Mercury, total	mg/L	6	0	0.000008	0.0000185	0.00003	0.00005	0.0017	0.0009
Nickel, diss	mg/L	19	7	0.000661	0.000995	0.002	NS	NS	NS
Nickel, total[2]	mg/L	19	13	0.000574	0.002	0.004	0.1	Hardness dependent	
Nitrate+nitrite	mg/L	19	0	0.003	0.0066	0.0075	10	NS	NS
Orthophosphate as P	mg/L	5	0	0.00616	0.00616	0.022	NS	NS	NS
Potassium, diss	mg/L	19	19	1.31	10	12.3	NS	NS	NS
Selenium, diss	mg/L	19	6	0.000135	0.00076	0.001	NS	NS	NS

Table 46. Water Quality of Pond PO-305.

Parameter	Unit	Number Samples	Number Detects	Min	Median	Max	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Selenium, total	mg/L	19	1	0.000192	0.00057	0.001	0.05	0.02	0.005
Sodium, diss	mg/L	19	19	9.91	103	123	NS	NS	NS
Sodium Absorption Rate[3]		19	19	0.44	1.39	1.65	4.5-7.5 (seasonal)		
Sulfate	mg/L	19	19	70.3	968	1110	NS	NS	NS
Total alkalinity	mg/L	19	19	43.5	296	359	NS	NS	NS
Total dissolved solids	mg/L	19	19	132	1720	1860	NS	NS	NS
Total hardness	mg/L	19	19	93.9	1050	1240	NS	NS	NS
Total nitrogen	mg/L	19	18	0.05	0.38	1.4	NS	NS	NS
Total phosphate	mg/L	19	19	0.00784	0.0131	0.0853	NS	NS	NS
Total suspended sediments	mg/L	19	18	1	2.4	47	NS	NS	NS
Turbidity	NTU	6	6	0.426	1.1835	3.31	NS	NS	NS
Vanadium, diss	mg/L	19	14	0.0000136	0.01	0.01	NS	NS	NS
Vanadium, total	mg/L	19	12	0.000182	0.01	0.01	NS	NS	NS
Zinc, diss	mg/L	19	1	0.00108	0.00146	0.008	NS	NS	NS
Zinc, total[2]	mg/L	19	7	0.0011	0.00143	0.014	7.4	Hardness dependent	

NS = no numeric standard.
diss = dissolved; μS/cm = micro Siemens/centimeter; s.u. = standard units; NTU = nephelometric turbidity units.
[1] Aquatic Life Standards for Ammonia are temperature and pH dependent. Any exceedances are noted in text narrative.
[2] Aquatic Life Standards for specific parameters are hardness dependent. Any exceedances are noted in text narrative.
[3] Standards for Laboratory Conductivity and Sodium Absorption Rate are referenced from ARM 17.30.670.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed the Human Health Standard or Aquatic Life Standards.

Table 47. Water Quality of Pond PO-307.

Parameter	Unit	Number Samples	Number Detects	Min	Median	Max	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Acidity	mg/L	1	0	1	1	1	NS	NS	NS
Aluminum, diss	mg/L	1	1	0.042	0.042	0.042	NS	0.75	0.087
Aluminum, total	mg/L	1	1	0.221	0.221	0.221	NS	NS	NS
Ammonia, as N[1]	mg/L	1	1	0.05	0.05	0.05	NS	T/pH dependent	
Arsenic, diss	mg/L	1	1	0.001	0.001	0.001	NS	NS	NS
Arsenic, total	mg/L	1	1	0.001	0.001	0.001	0.01	0.34	0.15
Bicarbonate alkalinity	mg/L	1	1	30.1	30.1	30.1	NS	NS	NS
Boron, diss	mg/L	1	1	0.03	0.03	0.03	NS	NS	NS
Boron, total	mg/L	1	1	0.03	0.03	0.03	NS	NS	NS
Cadmium, diss	mg/L	1	0	0.00004	0.00004	0.00004	NS	NS	NS
Cadmium, total[2]	mg/L	1	1	0.0005	0.0005	0.0005	0.005	Hardness dependent	
Calcium, diss	mg/L	1	1	7.12	7.12	7.12	NS	NS	NS
Carbonate alkalinity	mg/L	1	0	1	1	1	NS	NS	NS
Chloride	mg/L	1	1	1.34	1.34	1.34	NS	NS	NS
Chromium, diss	mg/L	1	1	0.000624	0.000624	0.000624	NS	NS	NS
Chromium, total[2]	mg/L	1	1	0.000636	0.000636	0.000636	0.1	Hardness dependent	
Copper, diss	mg/L	1	1	0.002	0.002	0.002	NS	NS	NS
Copper, total[2]	mg/L	1	1	0.00248	0.00248	0.00248	1.3	Hardness dependent	
Fluoride	mg/L	1	1	0.1	0.1	0.1	4	NS	NS
Hydroxide alkalinity	mg/L	1	0	1	1	1	NS	NS	NS
Iron, diss	mg/L	1	1	0.0379	0.0379	0.0379	NS	NS	NS
Iron, total	mg/L	1	1	0.212	0.212	0.212	NS	NS	1.0
Laboratory conductivity[3]	µS/cm	1	1	69	69	69	500		
Laboratory pH	s.u.	1	1	7.83	7.83	7.83	NS	NS	NS
Lead, diss	mg/L	1	1	0.0003	0.0003	0.0003	NS	NS	NS
Lead, total[2]	mg/L	1	1	0.0003	0.0003	0.0003	0.015	Hardness dependent	
Magnesium, diss	mg/L	1	1	1.84	1.84	1.84	NS	NS	NS
Manganese, diss	mg/L	1	1	0.005	0.005	0.005	NS	NS	NS
Manganese, total	mg/L	1	1	0.0067	0.0067	0.0067	NS	NS	NS
Mercury, diss	mg/L	1	0	0.000023	0.000023	0.000023	NS	NS	NS
Mercury, total	mg/L	1	0	0.000023	0.000023	0.000023	0.00005	0.0017	0.0009
Nickel, diss	mg/L	1	1	0.002	0.002	0.002	NS	NS	NS
Nickel, total[2]	mg/L	1	1	0.002	0.002	0.002	0.1	Hardness dependent	
Nitrate+nitrite	mg/L	1	1	0.05	0.05	0.05	10	NS	NS
Orthophosphate as P	mg/L	1	1	0.179	0.179	0.179	NS	NS	NS
Potassium, diss	mg/L	1	1	6.42	6.42	6.42	NS	NS	NS
Selenium, diss	mg/L	1	0	0.000171	0.000171	0.000171	NS	NS	NS

Table 47. Water Quality of Pond PO-307.

Parameter	Unit	Number Samples	Number Detects	Min	Median	Max	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Selenium, total	mg/L	1	0	0.00057	0.00057	0.00057	0.05	0.02	0.005
Sodium, diss	mg/L	1	1	1	1	1	NS	NS	NS
Sodium Absorption Rate[3]		1	0	0.1	0.1	0.1	4.5-7.5 (seasonal)		
Sulfate	mg/L	1	1	1.84	1.84	1.84	NS	NS	NS
Total alkalinity	mg/L	1	1	30.1	30.1	30.1	NS	NS	NS
Total dissolved solids	mg/L	1	1	66	66	66	NS	NS	NS
Total hardness	mg/L	1	1	25.3	25.3	25.3	NS	NS	NS
Total nitrogen	mg/L	1	1	0.978	0.978	0.978	NS	NS	NS
Total phosphate	mg/L	1	1	0.276	0.276	0.276	NS	NS	NS
Total suspended sediments	mg/L	1	1	9.2	9.2	9.2	NS	NS	NS
Turbidity	NTU	1	1	12.6	12.6	12.6	NS	NS	NS
Vanadium, diss	mg/L	1	1	0.01	0.01	0.01	NS	NS	NS
Vanadium, total	mg/L	1	1	0.01	0.01	0.01	NS	NS	NS
Zinc, diss	mg/L	1	0	0.00146	0.00146	0.00146	NS	NS	NS
Zinc, total[2]	mg/L	1	1	0.008	0.008	0.008	7.4	Hardness dependent	

NS = no numeric standard.
diss = dissolved; μS/cm = micro Siemens/centimeter; s.u. = standard units; NTU = nephelometric turbidity units.
[1] Aquatic Life Standards for Ammonia are temperature and pH dependent. Any exceedances are noted in text narrative.
[2] Aquatic Life Standards for specific parameters are hardness dependent. Any exceedances are noted in text narrative.
[3] Standards for Laboratory Conductivity and Sodium Absorption Rate are referenced from ARM 17.30.670.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed the Human Health Standard or Aquatic Life Standards.

Table 48. Water Quality of Pond PO-308.

Parameter	Unit	Number Samples	Number Detects	Min	Median	Max	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Acidity	mg/L	2	0	1	1	1	NS	NS	NS
Aluminum, diss	mg/L	2	2	0.017	0.052	**0.087**	NS	0.75	0.087
Aluminum, total	mg/L	2	2	0.199	0.306	0.413	NS	NS	NS
Ammonia, as N[1]	mg/L	2	1	0.0073	0.02865	0.05	NS	T/pH dependent	
Arsenic, diss	mg/L	2	2	0.001	0.0025	0.004	NS	NS	NS
Arsenic, total	mg/L	2	2	0.001	0.0025	0.004	0.01	0.34	0.15
Bicarbonate alkalinity	mg/L	2	2	46	148	250	NS	NS	NS
Boron, diss	mg/L	2	2	0.03	0.04	0.05	NS	NS	NS
Boron, total	mg/L	2	2	0.04	0.04	0.04	NS	NS	NS
Cadmium, diss	mg/L	2	0	0.0000658	0.0001799	0.000294	NS	NS	NS
Cadmium, total[2]	mg/L	2	0	0.0000923	0.00013765	0.000183	0.005	Hardness dependent	
Calcium, diss	mg/L	2	2	12	39.5	67	NS	NS	NS
Carbonate alkalinity	mg/L	2	1	1	3	5	NS	NS	NS
Chloride	mg/L	2	2	3	3.5	4	NS	NS	NS
Chromium, diss	mg/L	0	0	---	---	---	NS	NS	NS
Chromium, total[2]	mg/L	0	0	---	---	---	0.1	Hardness dependent	
Copper, diss	mg/L	2	1	0.000358	0.001179	0.002	NS	NS	NS
Copper, total[2]	mg/L	2	2	0.002	0.002	0.002	1.3	Hardness dependent	
Fluoride	mg/L	2	1	0.0292	0.0646	0.1	4	NS	NS
Hydroxide alkalinity	mg/L	2	0	1	1	1	NS	NS	NS
Iron, diss	mg/L	2	2	0.07	0.115	0.16	NS	NS	NS
Iron, total	mg/L	2	2	0.18	0.975	**1.77**	NS	NS	1.0
Laboratory conductivity[3]	µS/cm	2	2	123	291	459	500		
Laboratory pH	s.u.	2	2	7.2	7.75	8.3	NS	NS	NS
Lead, diss	mg/L	2	1	0.0000365	0.00016825	0.0003	NS	NS	NS
Lead, total[2]	mg/L	2	2	0.0003	0.0005	0.0007	0.015	Hardness dependent	
Magnesium, diss	mg/L	2	2	4	10.5	17	NS	NS	NS
Manganese, diss	mg/L	2	2	0.01	0.131	0.252	NS	NS	NS
Manganese, total	mg/L	2	2	0.015	0.2485	0.482	NS	NS	NS
Mercury, diss	mg/L	0	0	---	---	---	NS	NS	NS
Mercury, total	mg/L	0	0	---	---	---	0.00005	0.0017	0.0009
Nickel, diss	mg/L	2	1	0.000995	0.0014975	0.002	NS	NS	NS
Nickel, total[2]	mg/L	2	2	0.002	0.0025	0.003	0.1	Hardness dependent	
Nitrate+nitrite	mg/L	2	0	0.0066	0.0066	0.0066	10	NS	NS
Orthophosphate as P	mg/L	0	0	---	---	---	NS	NS	NS
Potassium, diss	mg/L	2	2	14	14.5	15	NS	NS	NS
Selenium, diss	mg/L	2	1	0.00076	0.00088	0.001	NS	NS	NS

Table 48. Water Quality of Pond PO-308.

Parameter	Unit	Number Samples	Number Detects	Min	Median	Max	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Selenium, total	mg/L	2	1	0.000521	0.0007605	0.001	0.05	0.02	0.005
Sodium, diss	mg/L	2	2	1	1.5	2	NS	NS	NS
Sodium Absorption Rate[3]		2	1	0.01	0.03	0.05	4.5-7.5 (seasonal)		
Sulfate	mg/L	2	2	3	8.5	14	NS	NS	NS
Total alkalinity	mg/L	2	2	46	149	252	NS	NS	NS
Total dissolved solids	mg/L	2	2	190	325	460	NS	NS	NS
Total hardness	mg/L	2	2	44	139.5	235	NS	NS	NS
Total nitrogen	mg/L	2	2	3.5	4.05	4.6	NS	NS	NS
Total phosphate	mg/L	2	2	0.64	0.705	0.77	NS	NS	NS
Total suspended sediments	mg/L	2	2	16	40	64	NS	NS	NS
Turbidity	NTU	0	0	---	---	---	NS	NS	NS
Vanadium, diss	mg/L	2	0	0.000828	0.000828	0.000828	NS	NS	NS
Vanadium, total	mg/L	2	0	0.000914	0.002072	0.00323	NS	NS	NS
Zinc, diss	mg/L	2	1	0.00307	0.005535	0.008	NS	NS	NS
Zinc, total[2]	mg/L	2	1	0.00225	0.005125	0.008	7.4	Hardness dependent	

NS = no numeric standard.
diss = dissolved; µS/cm = micro Siemens/centimeter; s.u. = standard units; NTU = nephelometric turbidity units.
[1] Aquatic Life Standards for Ammonia are temperature and pH dependent. Any exceedances are noted in text narrative.
[2] Aquatic Life Standards for specific parameters are hardness dependent. Any exceedances are noted in text narrative.
[3] Standards for Laboratory Conductivity and Sodium Absorption Rate are referenced from ARM 17.30.670.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed the Human Health Standard or Aquatic Life Standards.

Table 49. Water Quality of Pond PO-937.

Parameter	Unit	Number Samples	Number Detects	Min	Median	Max	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Acidity	mg/L	3	0	1	1	1	NS	NS	NS
Aluminum, diss	mg/L	3	3	0.0245	0.0263	0.0377	NS	0.75	0.087
Aluminum, total	mg/L	3	3	0.0443	0.206	0.227	NS	NS	NS
Ammonia, as N[1]	mg/L	3	3	0.0711	0.613	0.902	NS	T/pH dependent	
Arsenic, diss	mg/L	3	3	0.00106	0.00148	0.00308	NS	NS	NS
Arsenic, total	mg/L	3	3	0.00134	0.00161	**0.0118**	0.01	0.34	0.15
Bicarbonate alkalinity	mg/L	3	3	69	345	434	NS	NS	NS
Boron, diss	mg/L	3	3	0.293	0.355	0.402	NS	NS	NS
Boron, total	mg/L	3	3	0.397	0.5	0.524	NS	NS	NS
Cadmium, diss	mg/L	3	2	0.00004	0.0005	0.0005	NS	NS	NS
Cadmium, total[2]	mg/L	3	2	0.000113	0.0005	0.0005	0.005	Hardness dependent	
Calcium, diss	mg/L	3	3	140	169	276	NS	NS	NS
Carbonate alkalinity	mg/L	3	3	19.6	21.3	29.2	NS	NS	NS
Chloride	mg/L	3	3	14.1	15.9	59.5	NS	NS	NS
Chromium, diss	mg/L	3	2	0.000388	0.0005	0.0005	NS	NS	NS
Chromium, total[2]	mg/L	3	3	0.000512	0.00181	0.00353	0.1	Hardness dependent	
Copper, diss	mg/L	3	3	0.002	0.002	0.002	NS	NS	NS
Copper, total[2]	mg/L	3	3	0.002	0.002	0.00914	1.3	Hardness dependent	
Fluoride	mg/L	3	2	0.00834	0.399	0.44	4	NS	NS
Hydroxide alkalinity	mg/L	3	0	1	1	1	NS	NS	NS
Iron, diss	mg/L	3	3	0.02	0.02	0.0464	NS	NS	NS
Iron, total	mg/L	3	3	0.303	0.334	0.384	NS	NS	1.0
Laboratory conductivity[3]	µS/cm	3	3	**2810**	**3160**	**4950**	500		
Laboratory pH	s.u.	3	3	8.43	8.43	8.84	NS	NS	NS
Lead, diss	mg/L	3	1	0.0000023	0.000004	0.0003	NS	NS	NS
Lead, total[2]	mg/L	3	3	0.0003	0.00038	0.000385	0.015	Hardness dependent	
Magnesium, diss	mg/L	3	3	329	348	508	NS	NS	NS
Manganese, diss	mg/L	3	3	0.062	0.102	0.121	NS	NS	NS
Manganese, total	mg/L	3	3	0.0686	0.142	0.193	NS	NS	NS
Mercury, diss	mg/L	3	0	0.000008	0.000008	0.000008	NS	NS	NS
Mercury, total	mg/L	3	0	0.000008	0.00003	0.00003	0.00005	0.0017	0.0009
Nickel, diss	mg/L	3	3	0.002	0.002	0.002	NS	NS	NS
Nickel, total[2]	mg/L	3	2	0.000898	0.002	0.00512	0.1	Hardness dependent	
Nitrate+nitrite	mg/L	3	1	0.003	0.003	0.029	10	NS	NS
Orthophosphate as P	mg/L	3	0	0.00616	0.022	0.022	NS	NS	NS
Potassium, diss	mg/L	3	3	17.2	18.5	54.3	NS	NS	NS
Selenium, diss	mg/L	3	2	0.000394	0.001	0.001	NS	NS	NS

Table 49. Water Quality of Pond PO-937.

Parameter	Unit	Number Samples	Number Detects	Min	Median	Max	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Selenium, total	mg/L	3	2	0.000462	0.001	0.00218	0.05	0.02	0.005
Sodium, diss	mg/L	3	3	222	232	317	NS	NS	NS
Sodium Absorption Rate[3]		3	3	2.33	2.34	2.61	4.5-7.5 (seasonal)		
Sulfate	mg/L	3	3	1630	1680	3470	NS	NS	NS
Total alkalinity	mg/L	3	3	90.3	364	463	NS	NS	NS
Total dissolved solids	mg/L	3	3	2920	3160	4950	NS	NS	NS
Total hardness	mg/L	3	3	1700	1850	2780	NS	NS	NS
Total nitrogen	mg/L	3	3	0.725	0.908	4.13	NS	NS	NS
Total phosphate	mg/L	3	3	0.0432	0.048	0.159	NS	NS	NS
Total suspended sediments	mg/L	3	3	7.6	9.87	11.5	NS	NS	NS
Turbidity	NTU	3	3	4.13	6.59	10.3	NS	NS	NS
Vanadium, diss	mg/L	3	3	0.01	0.01	0.01	NS	NS	NS
Vanadium, total	mg/L	3	2	0.000289	0.01	0.01	NS	NS	NS
Zinc, diss	mg/L	3	0	0.00108	0.00108	0.00547	NS	NS	NS
Zinc, total[2]	mg/L	3	1	0.0012	0.0012	0.008	7.4	Hardness dependent	

NS = no numeric standard.
diss = dissolved; µS/cm = micro Siemens/centimeter; s.u. = standard units; NTU = nephelometric turbidity units.
[1] Aquatic Life Standards for Ammonia are temperature and pH dependent. Any exceedances are noted in text narrative.
[2] Aquatic Life Standards for specific parameters are hardness dependent. Any exceedances are noted in text narrative.
[3] Standards for Laboratory Conductivity and Sodium Absorption Rate are referenced from ARM 17.30.670.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed the Human Health Standard or Aquatic Life Standards.

Table 50. Water Quality of Pond BBIO1.

Parameter	Unit	Number Samples	Number Detects	Min	Median	Max	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Acidity	mg/L	6	6	12	26.5	46	NS	NS	NS
Aluminum, diss	mg/L	6	0	0.03	0.03	0.03	NS	0.75	0.087
Aluminum, total	mg/L	6	5	0.03	0.07	48.8	NS	NS	NS
Ammonia, as N[1]	mg/L	6	3	0.05	0.21	0.41	NS	T/pH dependent	
Arsenic, diss	mg/L	6	6	0.002	0.004	0.025	NS	NS	NS
Arsenic, total	mg/L	6	6	0.002	0.007	0.056	0.01	0.34	0.15
Bicarbonate alkalinity	mg/L	6	6	470	734.5	1196	NS	NS	NS
Boron, diss	mg/L	6	6	0.17	0.29	0.45	NS	NS	NS
Boron, total	mg/L	6	6	0.19	0.3	0.69	NS	NS	NS
Cadmium, diss	mg/L	6	0	0.001	0.001	0.001	NS	NS	NS
Cadmium, total[2]	mg/L	6	1	0.001	0.001	0.001	0.005	Hardness dependent	
Calcium, diss	mg/L	6	6	169	227.5	258	NS	NS	NS
Carbonate alkalinity	mg/L	6	1	6	6	6.7	NS	NS	NS
Chloride	mg/L	6	6	11	16	27	NS	NS	NS
Chromium, diss	mg/L	0	0	---	---	---	NS	NS	NS
Chromium, total[2]	mg/L	0	0	---	---	---	0.1	Hardness dependent	
Copper, diss	mg/L	6	0	0.005	0.005	0.005	NS	NS	NS
Copper, total[2]	mg/L	6	1	0.005	0.005	0.105	1.3	Hardness dependent	
Fluoride	mg/L	6	6	0.1	0.15	0.2	4	NS	NS
Hydroxide alkalinity	mg/L	0	0	---	---	---	NS	NS	NS
Iron, diss	mg/L	6	6	0.05	0.23	4.23	NS	NS	NS
Iron, total	mg/L	6	6	0.36	**5.825**	**153**	NS	NS	1.0
Laboratory conductivity[3]	µS/cm	6	6	**3060**	**4130**	**4850**	500		
Laboratory pH	s.u.	6	6	7.5	7.8	8	NS	NS	NS
Lead, diss	mg/L	6	0	0.001	0.001	0.001	NS	NS	NS
Lead, total[2]	mg/L	6	2	0.001	0.001	**0.071**	0.015	Hardness dependent	
Magnesium, diss	mg/L	6	6	280	404	563	NS	NS	NS
Manganese, diss	mg/L	6	6	0.055	1.555	4.01	NS	NS	NS
Manganese, total	mg/L	6	6	0.169	2.725	43.2	NS	NS	NS
Mercury, diss	mg/L	0	0	---	---	---	NS	NS	NS
Mercury, total	mg/L	0	0	---	---	---	0.00005	0.0017	0.0009
Nickel, diss	mg/L	6	0	0.005	0.005	0.005	NS	NS	NS
Nickel, total[2]	mg/L	6	1	0.005	0.005	**0.103**	0.1	Hardness dependent	
Nitrate+nitrite	mg/L	6	4	0.01	0.025	0.04	10	NS	NS
Orthophosphate as P	mg/L	0	0	---	---	---	NS	NS	NS
Potassium, diss	mg/L	6	6	9	14	29	NS	NS	NS
Selenium, diss	mg/L	6	3	0.001	0.005	0.018	NS	NS	NS

Table 50. Water Quality of Pond BBIO1.

Parameter	Unit	Number Samples	Number Detects	Min	Median	Max	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Selenium, total	mg/L	6	1	0.001	0.001	0.002	0.05	0.02	0.005
Sodium, diss	mg/L	6	6	188	261.5	408	NS	NS	NS
Sodium Absorption Rate[3]		6	6	1.76	2.52	3.32	4.5-7.5 (seasonal)		
Sulfate	mg/L	6	6	1580	2335	2790	NS	NS	NS
Total alkalinity	mg/L	6	6	471	735.5	1200	NS	NS	NS
Total dissolved solids	mg/L	6	6	2650	3930	4570	NS	NS	NS
Total hardness	mg/L	6	6	1570	2290	2850	NS	NS	NS
Total nitrogen	mg/L	6	6	0.4	1.35	2	NS	NS	NS
Total phosphate	mg/L	6	6	0.043	0.433	6.16	NS	NS	NS
Total suspended sediments	mg/L	6	6	13	47	3320	NS	NS	NS
Turbidity	NTU	0	0	---	---	---	NS	NS	NS
Vanadium, diss	mg/L	6	0	0.01	0.01	0.01	NS	NS	NS
Vanadium, total	mg/L	6	1	0.01	0.01	0.1	NS	NS	NS
Zinc, diss	mg/L	6	0	0.01	0.01	0.01	NS	NS	NS
Zinc, total[2]	mg/L	6	2	0.01	0.01	0.39	7.4	Hardness dependent	

NS = no numeric standard.
diss = dissolved; µS/cm = micro Siemens/centimeter; s.u. = standard units; NTU = nephelometric turbidity units.
[1] Aquatic Life Standards for Ammonia are temperature and pH dependent. Any exceedances are noted in text narrative.
[2] Aquatic Life Standards for specific parameters are hardness dependent. Any exceedances are noted in text narrative.
[3] Standards for Laboratory Conductivity and Sodium Absorption Rate are referenced from ARM 17.30.670.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed the Human Health Standard or Aquatic Life Standards.

Table 51. Water Quality of Pond BBIO2.

Parameter	Unit	Number Samples	Number Detects	Min	Median	Max	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Acidity	mg/L	6	6	0	6	24	NS	NS	NS
Aluminum, diss	mg/L	6	1	0.03	0.03	**0.13**	NS	0.75	0.087
Aluminum, total	mg/L	6	3	0.03	0.04	1.31	NS	NS	NS
Ammonia, as N[1]	mg/L	6	1	0.05	0.05	0.06	NS	T/pH dependent	
Arsenic, diss	mg/L	6	4	0.001	0.0035	0.011	NS	NS	NS
Arsenic, total	mg/L	6	4	0.001	0.0035	**0.013**	0.01	0.34	0.15
Bicarbonate alkalinity	mg/L	6	6	172	271	543	NS	NS	NS
Boron, diss	mg/L	6	6	0.06	0.29	0.49	NS	NS	NS
Boron, total	mg/L	6	6	0.06	0.29	0.52	NS	NS	NS
Cadmium, diss	mg/L	6	0	0.001	0.001	0.001	NS	NS	NS
Cadmium, total[2]	mg/L	6	0	0.001	0.001	0.001	0.005	Hardness dependent	
Calcium, diss	mg/L	6	6	63	130	192	NS	NS	NS
Carbonate alkalinity	mg/L	6	2	6	6	47	NS	NS	NS
Chloride	mg/L	6	6	6	15.5	34	NS	NS	NS
Chromium, diss	mg/L	0	0	---	---	---	NS	NS	NS
Chromium, total[2]	mg/L	0	0	---	---	---	0.1	Hardness dependent	
Copper, diss	mg/L	6	0	0.005	0.005	0.005	NS	NS	NS
Copper, total[2]	mg/L	6	0	0.005	0.005	0.005	1.3	Hardness dependent	
Fluoride	mg/L	6	1	0.1	0.1	0.4	4	NS	NS
Hydroxide alkalinity	mg/L	0	0	---	---	---	NS	NS	NS
Iron, diss	mg/L	6	6	0.02	0.075	0.08	NS	NS	NS
Iron, total	mg/L	6	6	0.08	0.295	**2.71**	NS	NS	1.0
Laboratory conductivity[3]	µS/cm	6	6	**1050**	**3515**	**5500**	500		
Laboratory pH	s.u.	6	6	7.7	7.8	8.8	NS	NS	NS
Lead, diss	mg/L	6	0	0.001	0.001	0.001	NS	NS	NS
Lead, total[2]	mg/L	6	1	0.001	0.001	0.002	0.015	Hardness dependent	
Magnesium, diss	mg/L	6	6	69	375	589	NS	NS	NS
Manganese, diss	mg/L	6	6	0.392	0.6705	1.13	NS	NS	NS
Manganese, total	mg/L	6	6	0.382	0.4825	1.23	NS	NS	NS
Mercury, diss	mg/L	0	0	---	---	---	NS	NS	NS
Mercury, total	mg/L	0	0	---	---	---	0.00005	0.0017	0.0009
Nickel, diss	mg/L	6	0	0.005	0.005	0.005	NS	NS	NS
Nickel, total[2]	mg/L	6	0	0.005	0.005	0.005	0.1	Hardness dependent	
Nitrate+nitrite	mg/L	6	2	0.01	0.01	0.01	10	NS	NS
Orthophosphate as P	mg/L	0	0	---	---	---	NS	NS	NS
Potassium, diss	mg/L	6	6	6	20.5	31	NS	NS	NS
Selenium, diss	mg/L	6	3	0.001	0.0015	0.159	NS	NS	NS

Table 51. Water Quality of Pond BBIO2.

Parameter	Unit	Number Samples	Number Detects	Min	Median	Max	Human Health Standard	Aquatic Life Std (acute)	Aquatic Life Std (chronic)
Selenium, total	mg/L	6	0	0.001	0.001	0.001	0.05	0.02	0.005
Sodium, diss	mg/L	6	6	67	336.5	549	NS	NS	NS
Sodium Absorption Rate[3]		6	6	1.39	3.28	**4.6**	4.5-7.5 (seasonal)		
Sulfate	mg/L	6	6	396	2095	3850	NS	NS	NS
Total alkalinity	mg/L	6	6	172	294.5	544	NS	NS	NS
Total dissolved solids	mg/L	6	6	718	3205	5490	NS	NS	NS
Total hardness	mg/L	6	6	441	1945	2820	NS	NS	NS
Total nitrogen	mg/L	6	6	0.4	1.1	2.6	NS	NS	NS
Total phosphate	mg/L	6	6	0.048	0.089	0.218	NS	NS	NS
Total suspended sediments	mg/L	6	5	3	11.5	209	NS	NS	NS
Turbidity	NTU	0	0	---	---	---	NS	NS	NS
Vanadium, diss	mg/L	6	0	0.01	0.01	0.01	NS	NS	NS
Vanadium, total	mg/L	6	0	0.01	0.01	0.01	NS	NS	NS
Zinc, diss	mg/L	6	0	0.01	0.01	0.01	NS	NS	NS
Zinc, total[2]	mg/L	6	0	0.01	0.01	0.01	7.4	Hardness dependent	

NS = no numeric standard.
diss = dissolved; μS/cm = micro Siemens/centimeter; s.u. = standard units; NTU = nephelometric turbidity units.
[1] Aquatic Life Standards for Ammonia are temperature and pH dependent. Any exceedances are noted in text narrative.
[2] Aquatic Life Standards for specific parameters are hardness dependent. Any exceedances are noted in text narrative.
[3] Standards for Laboratory Conductivity and Sodium Absorption Rate are referenced from ARM 17.30.670.
For less than detection limit concentrations, detection limit used to calculate summary statistics.
Concentrations in bold exceed the Human Health Standard or Aquatic Life Standards.

3.5.3 Environmental Consequences

This section discloses direct and secondary impacts on surface waters resulting from the No Action Alternative (Alternative 1), Proposed Action (Alternative 2), and Agency Mitigated Alternative (Alternative 3), as well as cumulative impacts, unavoidable adverse impacts, and irreversible and irretrievable impacts. Existing surface water conditions and the analysis area used for this impact analysis are described in **Section 3.5.1.2, Analysis Area and Methods** and **Section 3.5.2, Affected Environment**.

3.5.3.1 Alternative 1 – No Action

Under the No Action Alternative, Westmoreland Rosebud would not develop AM5 within the Rosebud Mine. There would be no impact on the surface water hydrology or water quality in the Project area described in **Section 3.5.1.2, Analysis Area and Methods** because changes associated with development of AM5 would not occur.

The No Action Alternative would not change the status of other permit areas, including Area F, of the Rosebud Mine (see **Section 2.2, Rosebud Mine – Description of Past and Existing Mine Operations and Reclamation**), nor would it affect the federal coal lease MTM 80697 (tracts in Areas B and C) modification application, which is currently being evaluated by the BLM (see **Section 3.1.5, Related Future Actions**). Impacts on surface water hydrology and water quality due to current and future mining and reclamation in the existing Area B permit area and other permit areas of the Rosebud Mine would continue.

3.5.3.2 Alternative 2 – Proposed Action

Summary of Actions

During mining, the same surface mining method currently used in Area B (see **Section 2.2.2.2, General Mining Method** and **Section 2.4.4, Operations Plan**) would continue to be employed throughout the proposed Project area. Features related to surface water management (e.g., sediment impoundments and BTCA) are proposed within the Project area (see **Section 2.4.6.2, Surface Water Management and Sediment-Control Measures**). Existing surface water discharges for Area B (as currently permitted) would continue in accordance with existing MPDES Permit MT-0023965, and new surface water discharges from the Project area would occur in accordance with a new MPDES Permit MT-0032042.

Postmining, the watershed topography and hydrology would be restored to reestablish, to the extent possible, the hydrologic balance in the analysis area (see **Section 2.4.6, Protection of the Hydrologic Balance**). This reclamation would be phased (see **Figure 10, Proposed Project Area Reclamation Plan** for the proposed timing of reclamation), with spoil backfilled, graded, and stabilized in the pit after each subsequent mine pass. During the final phases of spoil grading, surface drainages would be reconstructed to the approved approximate postmine topography, which would approximate original drainage configurations. A tributary system would be designed and constructed to restore the pre-mine incised drainages. The postmine channels and floodplains would be designed to mimic the pre-mine channels' response to rainfall events by providing channel geometry (length, slope, longitudinal profile, cross-section, and bedform) to create velocities, depths, flow areas, and other hydraulic properties similar to pre-mine properties for the same discharge events. New ponds may be constructed, and surface water flow and quality would be monitored to determine if surface water quantity and quality without treatment had stabilized to its previous undisturbed state and achieved postmine land use performance standards for livestock and wildlife use in and downstream of the Project area. At the most downstream ends of the

analysis area, any changes to the relationship between the quality and quantity of water inflow to, water outflow from, and water storage in the impacted drainage basins, including the dynamic relationships among precipitation, runoff, evaporation, and changes in ground water and surface water storage, would be minimized during and following reclamation.

Summary of Impacts

Adverse impacts on surface water include the following:

- The loss of ephemeral streams, such as Richard and Lee Coulees and their tributaries within the mine disturbance boundary;
- The loss of existing springs and stock ponds within the mine disturbance boundary; and
- The reduction or elimination of spring flows to wetlands and stock ponds sourced from overburden or spoil ground water.

Some surface runoff to streams would be captured in sediment ponds and discharged to streams at permitted MPDES outfalls during mining. Westmoreland Rosebud must obtain MPDES permit coverage for all discharges from the Project area to surface waters and has submitted an Application to DEQ, which is currently under review.

Changes to site hydrology in the analysis area would continue throughout the Project area during mining and reclamation until sedimentation ponds are removed during the reclamation process and the watershed topography and hydrology are reclaimed to conditions similar to pre-mine conditions. Based on Westmoreland Rosebud's ground water model, it would take more than 50 years for the water table to be reestablished after site reclamation (AM5 Application Appendix I). Forty years of spoil water level monitoring in other previously mined areas at the Rosebud Mine show that ground water levels are still recovering in most locations. In many locations, recovery of ground water levels in spoil are influenced by ongoing nearby mining. Any ground water discharge to downgradient stream reaches near mining similar to existing conditions is not expected to return for more than 50 years, and it may take hundreds of years (Nicklin 2017) until the ground water table returns to near pre-mine conditions. Other impacts would be changes to in-stream and spring-fed pond water quality during mining and after mining and reclamation is completed due to the discharge of ground water from the spoil to undisturbed strata downgradient of the mine and from those undisturbed strata to streams and ponds downslope of the mine. Westmoreland Rosebud would be required to meet postmine land use performance standards and protect pre-mine and beneficial uses of the water.

To mitigate the general lack of water near the Project area (due to climate and not primarily because of mining), Westmoreland Rosebud proposes enhancement features within the postmine topography to capture water when available and use it to enhance habitat for wildlife and livestock and to establish wetlands. These features would be in the form of small depressions that would store water after runoff events, thereby providing water sources, promoting establishment of wetland species, and diversifying the postmine habitat types within the Project area. These small depressions would also help retain sediment within the Project area.

Direct and Secondary Impacts

Surface Water Quantity Impacts

Springs – Mining Period (Direct Impacts)

Potential impacts on the 11 monitored springs in the Project area during and after mining are summarized in **Section 3.6, Water Resources – Ground Water**. Overburden springs located outside of the

disturbance area (including monitored springs SP-310 and BGDSG) would not be affected by mining if their overburden source of water is not removed. Springs located within the mining footprint (including monitored springs SP-300, SP-301, SP-302, SP-304, SP-305, SP-307, SP-308, and SP-309) would be eliminated, thereby affecting downstream stream and alluvial flows. The flows of springs near the mining footprint (including monitored spring SP-306) are likely to be reduced or eliminated by mining if the source water is reduced or eliminated by mining activities. The timing of impacts on spring flow would be related to the mining sequence (see AM5 Application, Operations Plan). Spring flows would not be reduced or eliminated until the source material near the spring is mined out.

Springs – Postmining Period (Secondary Impacts)

After mining ceases, pre-mine flow conditions would not return to springs in which source material was removed. As described in **Section 3.6, Water Resources – Ground Water**, it is possible that springs from backfilled spoil may develop within or downslope of the disturbance area. For example, in Area C of the Rosebud Mine, two springs have developed in drainage bottoms during reclamation that appear to be a result of preferential subsurface flow paths in the spoil (DEQ 2015a).

Overall impacts from the Proposed Action on spring flows and the beneficial uses of spring water in the analysis area would continue until reclamation activities and recovery of the ground water table are complete. The impact of the removal of springs on the analysis area would be reduced because of wetland mitigation, postmine reclamation to reestablish the hydrologic balance to the extent possible, and water supply replacement as described in the AM5 Application.

Streams – Mining Period (Direct Impacts) – Ephemeral Flow

Flows in the analysis area streams are dominated by ephemeral conditions and occur as a result of runoff from storm events or snowmelt. During mining, portions of the Richard and Lee Coulee drainages would be mined out, and runoff from undisturbed lands upstream of the active pit would be captured in the pit or sediment ponds. Surface runoff from disturbed areas would be impounded in the mine pits or sediment ponds, resulting in reduced ephemeral and alluvial flows during precipitation or snowmelt runoff events and altering surface water storage and recharge to ground water. Disturbing the soil surface, altering topography, and removing vegetation would also affect the interception, infiltration, evaporation, sublimation, and transpiration of water at the land surface, thereby affecting stream and alluvial flows. Based on the expected mining sequence (see **Section 2.2.2.2, General Mining Method**), both Richard and Lee Coulee drainages would be affected simultaneously.

Estimated mean annual runoff and peak flows for analysis area streams and other ungaged streams in southeastern Montana were determined using multiple regression equations developed by the USGS (Sando et al. 2018) based on basin characteristics such as drainage area, percentage of basin covered by forest, precipitation, basin elevation, basin slope, and evapotranspiration. During mining, the Richard and Lee Coulee watershed areas contributing to storm water flow would effectively be reduced as each watershed is mined due to peak storm runoff being directed to mining pits and sediment ponds; thus, it is expected that peak runoff to streams would decrease. Using the USGS equations (Sando et al. 2018) to estimate peak flows on these streams, percent flow reductions at full mine development are provided in **Table 52**. To show the impact of a reduction in watershed area, the calculations assume that the percent forest cover in each basin would not change as a result of mining; however, if the percent forest cover decreases, peak flows would increase, and if the percent forest cover increases, peak flows would decrease. The flows provided in **Table 52** are for each stream from the top of each watershed to the downstream, southeastern Project area boundary. Before all mine passes are excavated in each watershed, impacts on stream flows would be less and would progressively increase to those shown in **Table 52**. Impacts on Rape Coulee and in East Fork Armells Creek from AM5 are limited to minor surface runoff

flows from disturbed areas (haul road and soil stockpiles) that would be temporarily impounded in and discharged from sediment ponds or traps through permitted MPDES discharges, resulting in reduced ephemeral flows during precipitation or snowmelt runoff events. Within each analysis area watershed (**Figure 34**), when all the mine passes are being or had been mined, and until the watersheds are fully reclaimed, estimated 2-year, 10-year, and 100-year peak flows would be reduced by up to 69 percent in Richard Coulee and up to 52 percent in Lee Coulee.

Table 52. Estimated Peak Flows for Streams in the Project Area before Mining and at Full Mine Development.

Drainage Basin	Watershed Area in Project Area (acres)	Pre-Mine Peak Flow (cfs)			Peak Flow at Full Mine Development (cfs)			Percent Reduction in Peak Flow (cfs)		
		2-yr	10-yr	100-yr	2-yr	10-yr	100-yr	2-yr	10-yr	100-yr
Richard Coulee	5,380	26	196	883	8	64	314	69	67	64
Lee Coulee (Mainstem)	2,430	27	201	905	13	99	469	52	51	48
Lee Coulee (Fossil Fork)	1,470	13	113	573	7	66	348	46	42	39

Source for peak flow calculations: Sando et al. 2018.

In addition, disturbed area runoff would be controlled by a network of roadside ditches, sediment-control ponds, and sediment traps. Surface runoff from disturbed areas would be impounded in the mine pits or sediment-control structures in accordance with the Hydrologic Control Plan (**Figure 35**). Some of the water stored in the sediment ponds or mine pits would be used (such as for dust control), some would evaporate, and some would infiltrate to the subsurface; this is water that would be lost as surface or subsurface flow in the stream channels. Loss of runoff water due to storage of runoff in the sediment ponds or mine pits, evaporation, or infiltration could affect the local hydrologic balance (USEPA 2001). The volume, timing, and frequency of ephemeral flows in analysis area streams would change. The impact of reduced peak flows may include changes to stream morphology and reduced surface and subsurface (via the alluvium) recharge to the streams below the analysis area. Reduced peak flows may result in less sediment transport, channel narrowing, and less water storage within channel banks and floodplains. It may be difficult to separate these impacts from the impacts of variability in runoff-producing storm events.

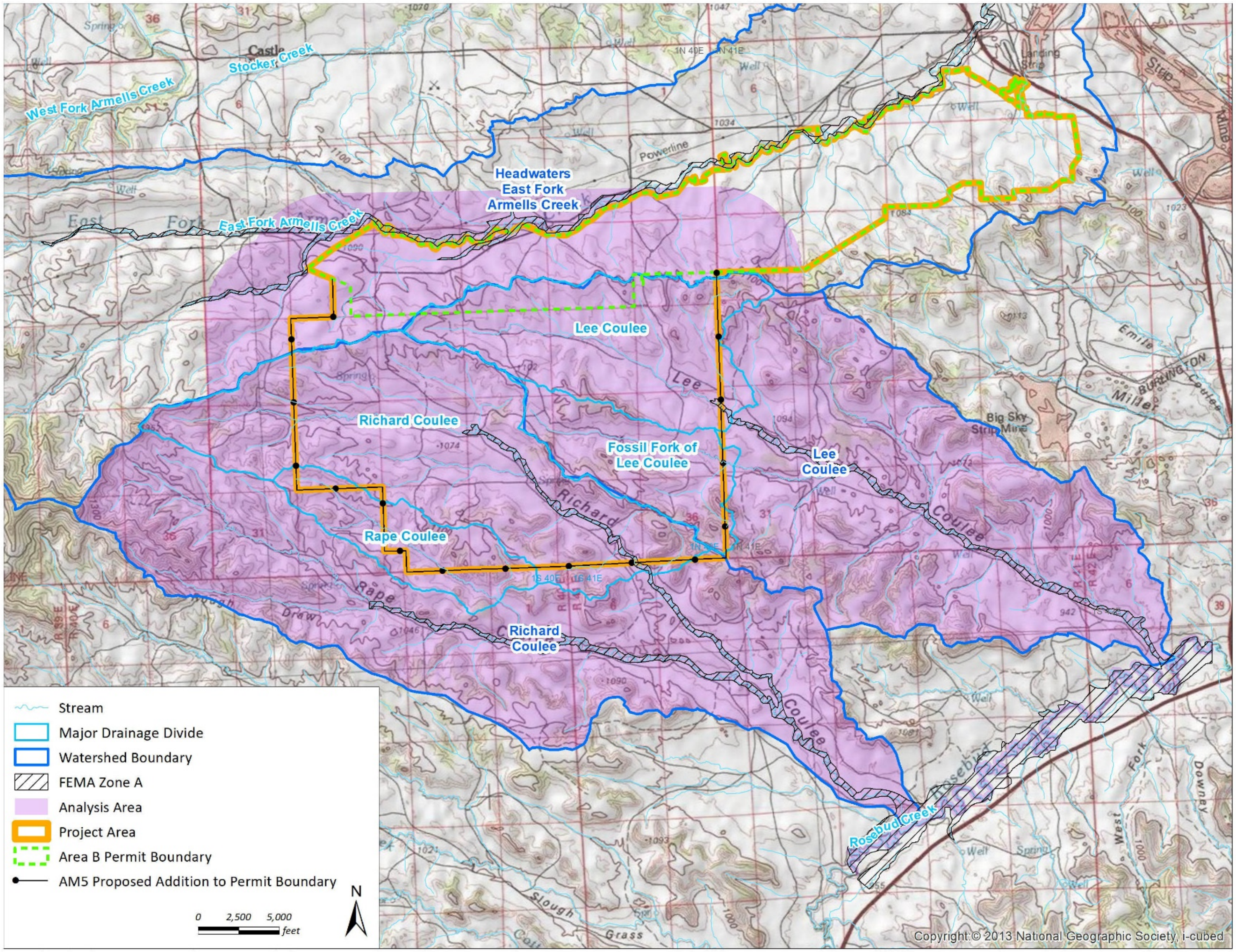

Figure 34. Watershed Areas in the Project Area.

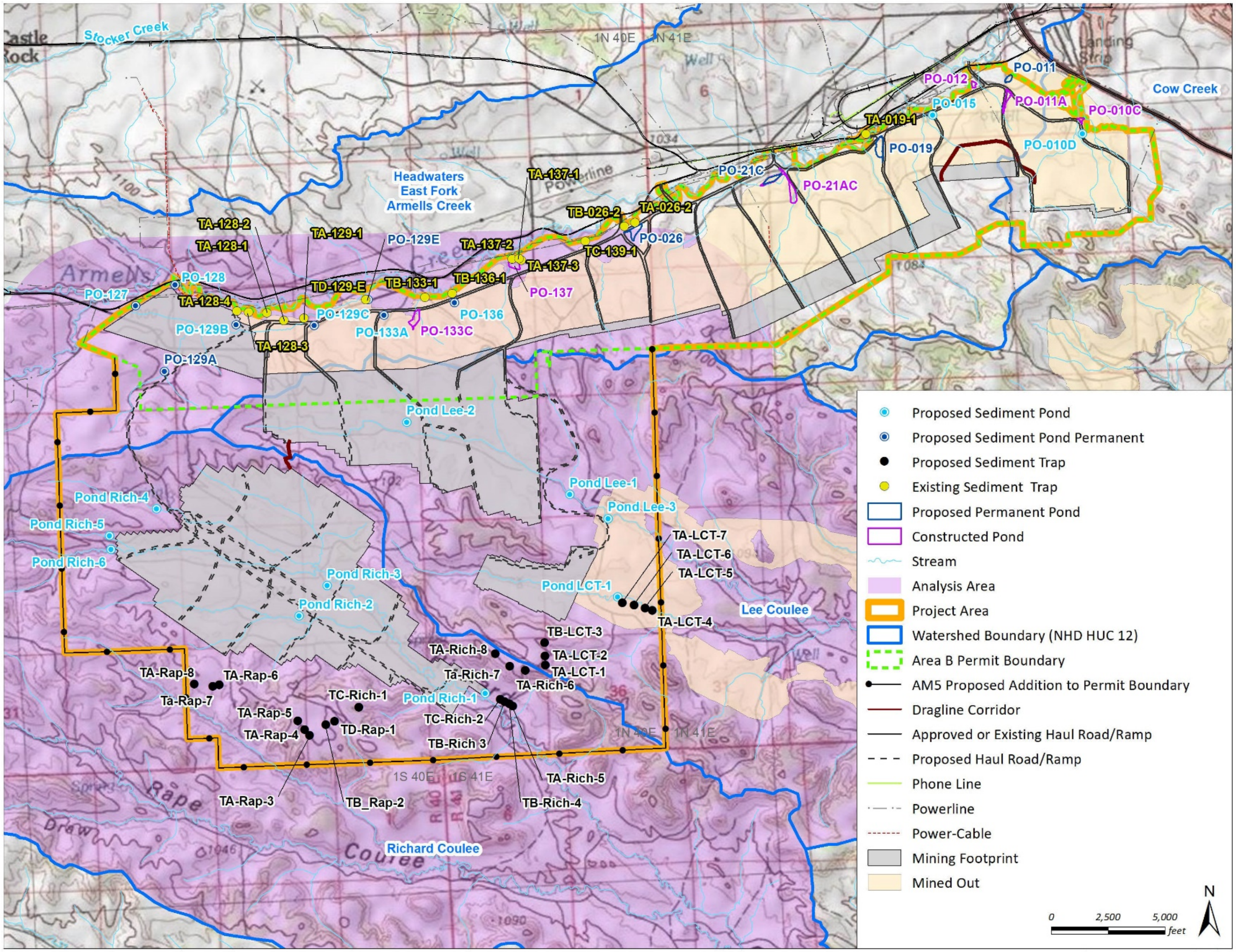

Figure 35. Hydrologic Control Plan.

During mining, water may be discharged from sediment ponds and traps to Richard Coulee (including Rape Coulee) and Lee Coulee via MPDES outfalls. The sedimentation ponds would be minimally designed to retain up to the volume of runoff produced by the theoretical 10-year, 24-hour storm event, although the ponds are generally oversized to allow capacity for successive storms and minimize maintenance. Runoff from larger events may discharge to the main channels (AM5 Application Appendix O). Discharge may also occur when the ponds need to be drained to comply with the minimum 24-hour retention capacity requirement under ARM 17.24.639(2). Stored water would be removed using a nonclogging dewatering device or conduit approved by DEQ. Discharges to mine area streams would replace some of the storm water runoff, but the volume, timing, and frequency of such discharges would not be the same as would occur naturally; therefore, impacts on channel morphology would not be offset by discharges at the MPDES outfalls (**Figure 35**).

Streams – Mining Period (Direct Impacts) – Base Flow

As described above, Lee and Richard Coulee stream flows in the Project area are dominated by ephemeral characteristics where channel thalweg elevations exceed ground water table elevations (AM5 Application Appendix O); therefore, no perennial or intermittent streams with baseflow would be disturbed by the Project activities. However, downstream reaches of Lee Coulee may exhibit limited baseflow conditions. Prior to mining at Big Sky, a “wet reach” existed on Lee Coulee in Sections 24 and 25 in the Project area, and Section 30, just downstream from the Project area. This wet reach was impacted by mining at Big Sky, and reclamation at Big Sky was designed to restore this wet reach when ground water levels recovered postmining. Mining in the Project area would delay this ground water level recovery and reestablishment of the wet reach during the mining period.

As noted in **Section 3.6, Water Resources – Ground Water**, the mine pits would intercept ground water that would otherwise have discharged to alluvium in the Project area drainages. Both Richard and Lee Coulees are ephemeral, indicating that the majority of ground water reaching the alluvium does so without surfacing as stream flow. Removal of the overburden and Rosebud Coal would temporarily reduce the amount of ground water reaching the downstream alluvial deposits. Removing the alluvium, overburden, and Rosebud Coal within the Project area drainages would likely result in reduced baseflow in downstream reaches near mining during and following mining until ground water levels have recovered. Further downstream, outside the permit boundary, no impacts on baseflow are expected.

Streams – Postmining Period (Secondary Impacts) – Ephemeral Flow

As the mine site is reclaimed (see **Section 2.4.5, Reclamation Plan** and **Figure 10. Proposed Project Area Reclamation Plan** for the proposed timing of reclamation), the postmine topography, drainage areas, and geomorphic characteristics would be designed to be similar to pre-mine topography (given the constraints of earthmoving equipment, costs, other ongoing reclamation, and the volume of spoil available to fill the pits and reclaim the site topography) (Application Appendix J, Tables J-1 and J-2). As a result, peak flows would return to near pre-mine peak flows (Application Appendix J, Tables J-3 to J-5). MSUMRA (ARM 17.24.601 *et seq.*) requires that basins be reclaimed to the approximate original stream function. To the extent possible during reclamation, smooth transitions would be constructed between undisturbed and reclaimed land to reestablish surface drainage patterns. The disturbed tributary drainages and stream channels would be reconstructed to the approximate original drainage configurations, with channel geometry similar to pre-mine conditions; however, there would be small differences in watershed areas and shapes postmining that would slightly alter runoff within the watersheds (see **Figure 9, Proposed Postmine Topography**). The disturbed stream channels within the Project area formerly governed by geologic structure and the inherent variability of different strata would no longer exist. Geologic structure within the stream channels would not be disturbed upstream or downstream of the

Project area. Spoil in the designed postmine drainages may either be covered by several feet of topsoil and vegetated to minimize erosion or left uncovered to replicate pre-mine erosional drainage features.

Although overall ephemeral stream flows after reclamation would be similar to pre-mine ephemeral stream flows, ephemeral stream flow may be reduced through portions of the reclaimed area with low slopes because the vertical percolation rate in the spoil may be greater than in the overburden (see **Section 3.6, Water Resources – Ground Water**) and vegetative cover in reclamation may also be greater than in the native condition. Some surface flow may infiltrate into the spoil rather than flowing in surface channels to the lower portion of the watershed, as has been observed at the Big Sky Mine during reclamation (DEQ 2015b). The extent to which surface flow across the spoil would be reduced would depend on topography; where fairly flat, there may be very limited flow after reclamation. Areas with low slopes are limited in the postmine topography, thus overall reductions in flow due to increased infiltration should be minor. Impacts from the Proposed Action on ephemeral stream flows in the analysis area would continue until reclamation activities and removal of sediment ponds are complete.

Streams – Postmining Period (Secondary Impacts) – Base Flow

After mining, as ground water levels recover and the spoil resaturates, ground water would begin to flow from the spoil to alluvium and downslope stream channels. It is not known how much time would be required to resaturate the spoil, but based on Westmoreland Rosebud's ground water model, it would take more than 50 years for the ground water table to reestablish after site reclamation (Application Appendix O) and may take hundreds of years (Nicklin 2017). Forty years of spoil water level monitoring in other previously mined areas at the Rosebud Mine show that ground water levels are still recovering in most locations. Ground water contributions to stream flow from the reclaimed area would eventually return to the downstream wet reach of Lee Coulee. In addition, the location of ground water discharge and base flow in the downstream reach may change due to the change in water source (from Rosebud Coal to spoil).

The impacts of reducing ground water contributions to stream flow in the Lee Coulee wet reach was mitigated by Big Sky Mine during reclamation by construction of permanent impoundments with equal or greater aquatic habitat. Impacts from the Project would be mitigated through wetland mitigation and postmine reclamation to minimize disturbance of hydrologic balance, as described in the AM5 Application. Impacts from the Proposed Action on ground water contributions to stream flows and to the overall beneficial uses of stream flows in the analysis area would continue until reclamation activities and recovery of the ground water table is complete.

Ponds – Mining Period (Direct Impacts)

Ponds with primary water sources that are outside of the disturbance area (including monitored pond PO-303) would not be affected by mining. Ponds located within the mining footprint (including monitored ponds PO-300, PO-301, PO-302, PO-304, PO-307, and PO-308) would be eliminated, thereby reducing surface water storage. The water supply of ponds located within Lee and Richard Coulees and downstream from the disturbance area (including monitored ponds PO-305, PO-309, BBIO1, and BBIO2) may be reduced during mining due to the impoundment of runoff or a reduction in ground water inflow that is a source of supply to the ponds.

Ponds – Postmining Period (Secondary Impacts)

After mining, some ponds would be reestablished, and some sediment ponds would be retained to provide water supplies for wildlife and livestock; thus, overall impacts from the Proposed Action on pond water supply in the analysis area would continue until reclamation activities are complete. As discussed in

Section 3.7, Water Resources – Water Rights, if a pond with a water right for stock watering were to become unusable, a suitable replacement source would be provided by Westmoreland Rosebud.

Floodplains – Mining Period (Direct Impacts)

The 100-year floodplain on Lee Coulee and East Fork Armells Creek in the analysis area would not be mined and would remain intact. Portions of the 100-year floodplain on Richard Coulee within Township 1N, Range 40E, Sections 27, 34, and 35 would be mined out (see **Figure 34**). Haul roads would be located outside of the 100-year floodplains, but where they cross streams, culverts would be installed that were designed for the 10-year, 24-hour storm event (see **Figure 35**). Structural BTCA, described in **Section 2.4.6.2, Surface Water Management and Sediment-Control Measures**, would be used to control sediment movement and erosion and stabilize the haul roads. Other mine facilities that may be installed in the floodplains would be sediment ponds and traps. The disturbance area of the sediment ponds or traps to Project area streams would be very small compared to the area of the 100-year floodplains in the analysis area. Flooding would continue to occur due to large storms. Runoff from storms greater than the 10-year, 24-hour event would flow over any haul roads, and some would flow through the culverts. It is likewise not expected that any other mine structures or mine activities would damage the floodplains or cause an increased hazard to life downstream of the Project area. Impacts on floodplains would continue until reclamation activities are complete.

Surface Water Quality Impacts

Surface water quality data for Areas A, B, C, D, and E were evaluated for changes in water quality that may have occurred before mining and during or after mining. For the most part, there were limited pre-mine data to make such a comparison. In addition, changes in laboratory detection limits since the 1970s and early 1980s (pre-mining), as well as natural water quality variability, made it difficult to analyze changes in stream, spring, and pond water quality due to mining. Another variable for stream water quality was the suspended solids concentration, which is variable during runoff events and can affect metal concentrations in streams. The only documented difference in water quality occurred in Pond 917 in Area D, where nitrate+nitrite and selenium concentrations were sometimes higher during and after mining than when measured before mining began in Area D.

Springs – Mining Period (Direct Impacts)

The water quality of overburden springs located outside or upgradient of the disturbance area (including monitored springs SP-310 and BGDSG) would not be affected by mining. Springs located within the mining footprint (including monitored springs SP-300, SP-301, SP-302, SP-304, SP-305, SP-307, SP-308, and SP-309) would be eliminated. Due to its proximity to the proposed mining footprint (180 feet) and location within a highwall reduction area, spoil spring SP-306 is likely to experience physical disturbance and reduction or cessation of flow, which may alter water quality constituents consistent with physical impacts.

Springs – Postmining Period (Secondary Impacts)

The water quality of spoil would generally have higher dissolved solids concentrations than overburden or the Rosebud Coal (as described in **Section 3.6, Water Resources – Ground Water**); therefore, any springs that develop in or near the mined area from spoil ground water would likely have higher dissolved solids concentrations than pre-mine springs.

Streams – Mining Period (Direct Impacts)

Runoff from disturbed lands would be intercepted and treated by the implementation of sediment-control measures. Sedimentation ponds would be minimally designed for total containment of runoff from the 10-year, 24-hour precipitation event plus storage of 3 years of sediment yield from disturbed areas in the mine area, although they are generally oversized to allow capacity for successive storms and minimize maintenance. Locations of sedimentation ponds and associated ditches are shown on **Figure 35** (see also **Section 2.4.6.2, Surface Water Management and Sediment-Control Measures**). During mining, runoff from undisturbed land above the pit would be intercepted by the pit or by impoundments or traps in the drainages above the pit. Very large runoff events would be intercepted by the pit. A system of ditches and traps proposed for the perimeter haul road is shown in the Approximate Hydrologic Control Plan (Application Exhibit D) and discussed in **Section 2.4.6.2, Surface Water Management and Sediment-Control Measures**. Ditches along the haul road would direct runoff to either sedimentation ponds or sediment traps. In areas where the haul road crosses the ephemeral drainages, runoff from the road embankment would be collected by sediment traps. Ditches would roughly parallel the roads to intercept runoff from disturbed lands. This containment system should prevent any sediment or untreated runoff from leaving the Project area for runoff events from precipitation less than the design 10-year, 24-hour event. All discharges from the proposed mining areas to state surface waters would be required to comply with applicable MPDES permit effluent limits.

Westmoreland Rosebud would also use other sediment-control measures for roads and other disturbed areas as described in **Section 2.4.6.2, Surface Water Management and Sediment-Control Measures**. Erosion-control BTCA listed by DEQ in the MPDES permit for the Project area would be required. Sediment- and erosion-control structures would remain in place after mining for as long as needed until all disturbed areas were fully reclaimed. Structural BTCA that have been proposed for use in the Project area by Westmoreland Rosebud are outlined in **Section 2.4.6.2, Surface Water Management and Sediment-Control Measures**. Assuming all runoff from disturbed lands are effectively captured and treated before release to any of the unmined streams in the analysis area, and all discharges at MPDES permit outfalls meet effluent limits, adverse impacts on stream water quality should be minimal, and beneficial uses should be protected.

If a precipitation event occurred that was greater than the culverts, sediment ponds, ditches, and other erosion-control structures were designed for, they would not be capable of routing, holding, or treating sediment-laden runoff and may themselves cause erosion of roads, upland disturbed and undisturbed areas, and channels and floodplains in and downslope of the analysis area. Some storm water runoff would be captured in the mine pits, but other runoff from disturbed areas in such circumstances may reach streams and ponds in the unmined areas, temporarily increasing suspended sediment, dissolved solids, and total metal concentrations in streams and ponds.

During mining, the quality of storm water flow from undisturbed areas in the Project area would be the same as before mining commenced if no untreated storm water runoff was released from the disturbed areas. The quality of water where it flows ephemerally in nearby downgradient sections of Richard and Lee Coulees, if such flows from ground water remained, would be similar to the existing water quality (see tables in **Section 3.6, Water Resources – Ground Water**).

Streams – Postmining Period (Secondary Impacts)

As noted in the Application Appendix O, probable hydrologic consequences of surface water quality during the postmining period are generally expected to exhibit the following characteristics.

- Postmine surface water quality at the Lee Coulee wet reach would reflect a combination of postmine surface water quality from runoff (similar to pre-mine runoff water quality) and postmine ground water quality from spoil (similar to pre-mine ground water quality from spoil at Big Sky Mine, or baseline conditions).
- Postmine surface water quality in Richard Coulee would reflect a combination of postmine surface water quality from runoff (similar to pre-mine runoff water quality), postmine ground water quality of limited overburden seepage (western portion of disturbed area), and postmine ground water quality from spoil (eastern portion of disturbed area).
- Postmine surface water quality to the east of the permit boundary would reflect pre-mine conditions.

As discussed in **Section 3.6, Water Resources – Ground Water**, after backfilling and once the spoil resaturates, ground water may discharge from the spoil to alluvium along the major drainages, and some of the alluvial water could discharge to streams where the ground water table intersects the stream bottom. The Lee Coulee wet reach is the only location downstream from the mine on Lee Coulee or Richard Coulee where ground water discharged to streams before mining. Ground water discharge or hyporheic exchange (the mixing of surface and shallow subsurface water through porous sediment surrounding a river) from the spoil to streams, if it occurred, could result in changes in water quality in the drainages close to mining compared to pre-mining conditions. Postmining, any ground water discharge or hyporheic exchange to the streams near mining between spoil materials and surface water could have higher dissolved solids and some metal concentrations, compared to pre-mine conditions. As discussed in **Section 3.6, Water Resources – Ground Water**, the quality of spoil ground water in other areas mined by Westmoreland Rosebud is highly variable, so it is difficult to predict to what extent ground water discharge from the spoil in the analysis area would affect surface water quality, and if changes in water quality due to ground water discharge from the spoil would be distinguishable from natural water quality variability.

In addition, an evaluation of several decades of spoil water quality data from Areas A, B, and C of the Rosebud Mine indicate the potential for spoil exceedances of water quality standards would be low, although some spatial and temporal variability would be expected. After nearly 40 years of monitoring, there is no clear indication that TDS concentrations in the spoil have reached equilibrium or have shown decreases. It is not known how long it would take for the quality of water in spoil to improve as soluble salts and metals are flushed from the system. Based on spoil water quality presented in **Section 3.6, Water Resources – Ground Water**, TDS, sulfate, calcium, sodium, magnesium, and manganese concentrations in spoil may exceed recommended limits for livestock, other ruminants, and aquatic life; however, these parameters also exceeded these recommended limits in pre-mining ground water. If ground water discharge from spoil was the major or only source of water to a stream, surface water may also exceed these recommended limits; this scenario was not identified as a probable hydrologic consequence (Application Appendix O). As stated in **Section 3.5.1.1, Regulatory Framework**, cattle and wildlife are understood to adapt to higher TDS concentrations, but there may be chronic adverse health and growth impacts. The overall impacts of the Proposed Action on surface water quality and associated beneficial uses of streams in the analysis area would continue until reclamation activities and flushing of spoil ground water are complete.

MSUMRA requires that permits must be designed to minimize disturbance to the hydrologic balance and to prevent material damage to the prevailing hydrologic balance outside the permit area. In the event that soil would influence surface drainages and streams, the permittee is required under ARM 17.24.631(3) to minimize water pollution and use treatment where necessary to control pollution. Water quality changes caused by mining, making a surface water unfit for a designated beneficial use, are not projected by the Probable Hydrologic Consequences; MSUMRA does not allow for approval of a permit with known material damage. In the event that water quality changes caused by mining render a surface water unfit for

designated beneficial uses, 82-4-253, MCA and ARM 17.24.648 require the permittee to provide replacement water both immediately on a temporary basis and to replace water in like quality, quantity, and duration if the loss is caused by mining.

Ponds – Mining Period (Direct Impacts)

The water quality of ponds with primary water sources that are outside of the disturbance area (including monitored pond PO-303) would not be affected by mining. Ponds located within the mining footprint (including monitored ponds PO-300, PO-301, PO-302, PO-304, PO-307, and PO-308) would be eliminated. During mining, for ponds in which water supply was reduced due to the impoundment of runoff (including monitored ponds PO-305, PO-309, BBIO1, and BBIO2), the quality of the pond water may change due to the reduction in sediment-laden runoff entering the pond and reduced total metals associated with the suspended solids in the water.

Ponds – Postmining Period (Secondary Impacts)

The overall impacts on water quality and associated beneficial uses of ponds in the analysis area would continue until reclamation activities are complete. Postmine ponds would be supplied water from storm water runoff; therefore, the water quality of the ponds would be similar to that of existing ponds in which the source of water is only storm runoff.

Sediment Yield – Postmining Period (Secondary Impacts)

Input parameters for the WEPP model to predict existing sediment yield in the analysis area over 20 years included pre-mine topography and drainage basin boundaries, NRCS soil survey data, a rangeland grass system with sagebrush vegetative cover, and precipitation data from the Colstrip meteorological station (AM5 Application Appendix V). Input parameters for the SEDCAD model included estimated postmine topography and drainage basin boundaries, an assumed 80 percent ground cover after reclamation, postmine soil that would be similar to pre-mine soil, a loam or silt loam soil texture, an erodibility factor with a soil of moderate infiltration rate and runoff potential, and a 10-year, 24-hour storm event of 2.45 inches (AM5 Application Appendix V). **Table 53** provides a summary of results comparing pre-mine and postmine sediment yields for portions of the Project area.

Table 53. Pre-mine and Postmine Sediment Yields for Portions of the Project Area.

Project Area Portion	Range of Sediment Yield (ton/acre/year)		Average Sediment Yield (ton/acre/year)		
	Pre-mine	Postmine	Pre-mine	Postmine	Difference
Area B + AM5	0.000–1.804	0.002–0.188	0.181	0.059	-0.12
Area B Haul Road	0.033–0.138	0.009–0,039	0.086	0.024	-0.06
Richard Coulee	0.001–1.804	0.002–0.188	0.264	0.065	-0.20
Lee Coulee	0.004–0.449	0.004–0.123	0.104	0.055	-0.05

As shown in the last column of **Table 53**, average postmine sediment yields would be less than pre-mine sediment yields in all Project area portions. Because each portion listed in **Table 53** comprises many subareas, information has been provided below to present results for subareas of interest. The largest sediment yield increases were predicted to occur in basin area Rich77 of Richard Coulee (0.148 ton/acre/year increase after disturbance of 7.9 acres) and in basin area LCT2 of Lee Coulee (0.070 ton/acre/year increase after disturbance of 48.8 acres). The largest 10-year, 24-hour sediment yields were predicted to occur in basin area Rich7 of Richard Coulee (55.70 tons) and in basin area Lee4 of Lee Coulee (31.80 tons). The largest sediment yield decreases were predicted to occur in basin area Rich78 of Richard Coulee (1.627 ton/acre/year decrease after disturbance of 18.9 acres) and in basin area LCT32 of Lee Coulee (0.401 ton/acre/year decrease after disturbance of 18.8 acres).

Changes in sediment yield indistinguishable from those caused by fluctuations in natural processes would not have measurable impacts on streams. Increases or decreases in sediment yield in some of the basins may have localized measurable impacts on stream morphology and water quality. Large increases or decreases in sediment yields may result in measurable impacts on stream morphology, stream water quality, and aquatic habitat in parts of the watersheds in the analysis area. Although a few localized watersheds may show increases in sediment yield, the overall impact of the Proposed Action is to reduce sediment yields within the analysis area as shown in **Table 53**. The overall impact on surface water quality due to changes in sediment yield in the analysis area would continue until reclamation activities and removal of sediment ponds are complete.

3.5.3.3 Cumulative Impacts

The surface water cumulative impacts analysis area is the same as the direct and secondary impacts analysis area and includes the East Fork Armells Creek, Richard Coulee, and Lee Coulee watersheds (see **Figure 33**). Past, present, and related future actions under concurrent consideration in the analysis area that have impacted surface water resources or could impact them in the future include:

- Past and present agricultural water use;
- Federal land management (BLM ARMP);
- Discharges to surface water from existing permit areas of the Rosebud Mine;
- Past, present, and future permitted coal mining in other permit areas of the Rosebud Mine;
- Past coal mining by the Big Sky Coal Company at the Big Sky Mine;
- Past and ongoing gravel quarrying; and
- Wildland fires.

The past, present, and related future under concurrent consideration actions that have occurred or may occur in the surface water cumulative impacts analysis area were, for the most part, evaluated qualitatively for impacts on stream flows and surface water quality.

Surface water has been used extensively in the analysis area for stock watering and grazing and, to a limited extent, for irrigation of crops. In some cases, surface water is used at the source, and in others it is diverted for use on nearby land. This alters stream flow and, in some cases, impacts surface water quality. Past and ongoing livestock grazing has destabilized stream channels, disturbed spring areas, and degraded water quality in areas where livestock drink.

The BLM ARMP has a goal of maintaining or enhancing the beneficial uses of surface water by supporting natural surface water flow regimes and protecting water resources from point source and nonpoint source pollution.

Past and current coal mining and reclamation by Western Energy and Westmoreland Rosebud at the Rosebud Mine and by Big Sky Coal Company at the Big Sky Mine affect stream flows, spring flows, and water supply, as well as surface water quality. These mines are in various stages of operation, reclamation, or closure. The impacts on water resources due to mining in Area B at the Rosebud Mine and the Big Sky Mine are described in Appendix I of the Written Findings for Area B AM4 (DEQ 2015c). Impacts on stream and spring flow and quality are described for the following watersheds near the city of Colstrip (see **Figure 33**):

- East Fork Armells Creek watershed due to mining in Area B;
- Lee Coulee watershed due to mining in Area B and the Big Sky Mine;
- Richard Coulee watershed due to mining in Area B AM5; and
- Rosebud Creek watershed due to mining in the Big Sky Mine.

Impacts on surface water quantity and quality would include:

- Alterations in stream and spring flows due to ground water drawdown;
- Alterations in surface flows from disturbance of the watershed and ephemeral stream channels;
- Removal of ephemeral tributaries during mining;
- Surface water quality changes due to changes in ground water quality;
- Changes in storm runoff due to retention of runoff in sediment-control ponds;
- Changes in surface water quality and quantity due to MPDES discharges and mine pit dewatering to streams;
- Changes in surface water quality due to runoff from mine roads and facilities;
- Changes in stream flow due to filling of channels with more permeable unconsolidated materials postmining; and
- Changes in the hydrologic balance due to changes in topography postmining.

One MPDES permit for the Rosebud Mine allows discharges at 151 outfalls to multiple creeks including East Fork Armells Creek and Lee Coulee. Discharges must meet effluent numeric and narrative limits to protect surface water quality and uses. As noted in the Application Appendix O, "From water year 1999 through 2016, there were fewer than 15 permit limitation exceedances during planned discharges."

The Proposed Action would contribute long-term adverse cumulative impacts on surface water hydrology due to changes in stream and spring flows, loss of springs, and loss of ponds or reduction in water supply to ponds. The Proposed Action would contribute short-term and long-term adverse cumulative impacts on surface water quality due to backfilling with spoil and surface disturbances.

3.5.3.4 Unavoidable Adverse Impacts

The following would be unavoidable adverse impacts on surface water resources within the analysis area:

Inside Permit Boundary

- Permanent loss of springs (SP-300, SP-301, SP-302, SP-304, SP-305, SP-307, SP-308, and SP-309); ponds (PO-300, PO-301, PO-302, PO-304, PO-307, and PO-308); and associated wetlands (see **Section 3.9, Wetlands**) that would be removed during mining;
- Temporary loss of surface water channels (Lee Coulee and Richard Coulee and their tributaries) within the mine disturbance area;
- Temporary reduction of ground water contributions to springs (SP-306) that may have their source water reduced during mining, which may also alter ground water quality constituents corresponding with the physical impacts;
- Temporary reduction of surface water or ground water contributions to ponds (PO-305) that may have their source water reduced during mining, which may also reduce sediment-laden runoff entering the ponds and reduce total metals associated with suspended solids;
- Temporary reduction of surface water contributions (volume, timing, and frequency) from upstream and within the mine disturbance area to downstream ephemeral streams and floodplains (Lee Coulee and Richard Coulee);
- Temporary reduction of ground water contributions to Lee Coulee wet reach stream flow; and
- Temporary increase of suspended sediment, dissolved solids, and total metal concentrations in streams (Lee Coulee and Richard Coulee) from runoff of a precipitation event that is greater than erosion-control structures were designed.

Outside Permit Boundary

- Temporary reduction of surface water or ground water contributions to ponds (PO-309, BBIO1, and BBIO2) that may have their source water reduced during mining, which may also reduce sediment-laden runoff entering the ponds and reduce total metals associated with suspended solids; and
- Temporary reduction of surface water contributions (volume, timing, and frequency) from upstream and within the mine disturbance area to downstream ephemeral streams and floodplains (Lee Coulee and Richard Coulee).

3.5.3.5 Irreversible and Irretrievable Impacts

The following would be irreversible and irretrievable impacts on surface water resources within the analysis area:

Inside Permit Boundary

- Permanent loss of springs (SP-300, SP-301, SP-302, SP-304, SP-305, SP-307, SP-308, and SP-309); ponds (PO-300, PO-301, PO-302, PO-304, PO-307, and PO-308); and associated wetlands (see **Section 3.9, Wetlands**) that would be removed during mining;
- Minor reduction in stream flow in reclaimed stream channels within the mine disturbance area because the permeability of the spoil material is higher than that of the undisturbed native material;
- Minor changes in stream flow and sediment yield in channels (Lee Coulee and Richard Coulee) near the mine disturbance area due to changes in postmine watershed characteristics and channel morphology;
- Minor changes in water quality in the Lee Coulee wet reach immediately downslope of the spoil where the ground water table intersects the stream bottom; and
- Minor increase in dissolved solids and some metal concentrations from spoil discharges into streams (Lee Coulee and Richard Coulee) near the mine disturbance area.

The loss of wetlands in the Project area and the hydrologic conditions that support the wetlands is discussed in **Section 3.9, Wetlands**. New springs may appear along Project area drainages after the spoil is resaturated postmining. Based on Westmoreland Rosebud's ground water model, it would take more than 50 years for the ground water table to be reestablished after site reclamation (Application Appendix O) and may take hundreds of years (Nicklin 2017). Forty years of spoil water level monitoring in other previously mined areas at the Rosebud Mine show that ground water levels are still recovering in most locations. After mining, some ponds may be constructed or retained to provide water supplies for wildlife and livestock. Because impacts on the hydrologic balance in the Project area would be minimized, there would be no other irreversible or irretrievable impacts.

3.6 WATER RESOURCES – GROUND WATER

3.6.1 Introduction

This section describes ground water resources that occur within the analysis area; the analysis area is defined below in **Section 3.6.1.2, Analysis Area and Methods**. This section includes regulatory requirements to protect ground water (quantity and quality), a description of areas of ground water in the analysis area, and descriptions of ground water movement, flow direction, depths, and recharge in the analysis area. This section also describes ground water quality in the analysis area.

This section also analyzes the environmental consequences including direct, secondary, and cumulative impacts of the No Action Alternative and the Proposed Action (Alternative 2) with respect to ground water resources.

3.6.1.1 Regulatory Framework

Federal Requirements

There are no applicable federal regulations within or near the analysis area.

State Requirements

DEQ regulates permitting and operation of surface coal mines on lands within Montana under the authority of MSUMRA (82-4-221 *et seq.*, MCA) and its implementing rules (ARM 17.24.301-1309). Subchapter 6, ARM 17.24.605, 631, 632, 635, 641, 643, 644, and 645 provide specific requirements to protect the quantity and quality of ground water. These requirements cover ground water levels, ground water recharge, protection of ground water rights, and ground water quality. The regulations require control of mine drainages to protect ground water and placement of backfill materials to minimize adverse impacts on ground water flow and quantity. The regulations state that disturbed areas must be reclaimed to restore the approximate pre-mine recharge capacity to support the approved postmining land use (ARM 17.24.644), and disturbances to the prevailing hydrologic balance in the mine area and adjacent areas must be minimized (ARM 17.24.605, 631, and 645). ARM 17.24.314 requires submittal of a plan for protection of the hydrologic balance, including water quantity and quality, and water rights. In addition, the regulations describe required ground water monitoring (ARM 17.24.645). State water rights requirements are described in **Section 3.9, Water Rights**.

MSUMRA conditions approval of an application for a coal mine operating permit on demonstration by the applicant that “the assessment of the probable cumulative impact of all anticipated mining in the area on the hydrologic balance has been made by the department [DEQ] and the proposed operation of the mining operation has been designed to prevent material damage to the hydrologic balance outside the permit area” under 82-4-227(3)(a), MCA, ARM 17.24.314(5), and ARM 17.24.405(6)(c). MSUMRA defines “material damage” as follows in 82-4-203(32), MCA: “with respect to protection of the hydrologic balance, degradation or reduction by coal mining and reclamation operations of the quality or quantity of water outside of the permit area in a manner or to an extent that land uses or beneficial uses of water are adversely affected, water quality standards are violated, or water rights are impacted. Violation of a water quality standard, whether or not an existing water use is affected, is material damage.”

The permit application must contain a detailed description of the “measures to be taken during and after mining activities to minimize disturbance to the hydrologic balance on and off the mine permit area, and prevent material damage to the hydrologic balance outside the permit area” under ARM 17.24.314(1).

Material damage criteria are established for the evaluation of both surface and ground water quality and quantity, and are used to determine whether water quality or quantity outside the permit area would be impacted to the extent that land uses or beneficial uses of water were adversely affected, water quality standards outside the permit area would be violated, or water rights outside the permit area would be impacted by the proposed mine operations. This EIS is not the cumulative hydrologic impact assessment required in 82-4-227(3)(a), MCA, ARM 17.24.314(5), and ARM 17.24.405(6)(c) and makes no determinations regarding material damage. The cumulative hydrologic impact assessment and determination whether the permit is designed to prevent material damage is conducted by DEQ as part of its written findings on the permit decision.

Ground Water Quality

State Classification and Standards

DEQ classifies ground water as Class I, II, III, or IV based on natural specific conductance (ARM 17.30.1006). Class I ground water has a specific conductance less than or equal to 1,000 microSiemens/centimeter (µS/cm). The quality of Class I ground water must be maintained for the following beneficial uses with little or no treatment: public and private water supply, culinary and food processing purposes, irrigation, drinking water for livestock and wildlife, and commercial and industrial purposes. Class II ground water has a natural specific conductance greater than 1,000 µS/cm and less than or equal to 2,500 µS/cm. The quality of Class II ground water must be maintained so that such waters are at least marginally suitable for the following beneficial uses: public and private water supplies, culinary and food processing purposes, irrigation of some agricultural crops, drinking water for livestock and wildlife, and most commercial and industrial purposes. Class III ground water has a natural specific conductance greater than 2,500 µS/cm and less than or equal to 15,000 µS/cm. The quality of Class III ground water must be maintained so that such waters are at least marginally suitable for the following beneficial uses: drinking, culinary, and food processing purposes (where the specific conductance is less than 7,000 µS/cm); irrigation of some salt-tolerant crops; some commercial and industrial purposes; and drinking water for some livestock and wildlife. Class IV ground water has a natural specific conductance of greater than 15,000 µS/cm. The quality of Class IV ground waters must be maintained so that they are suitable for some industrial and commercial uses. Class I and II ground water is considered high-quality water in Montana. The Montana Water Quality Act prohibits degradation of high-quality waters unless DEQ issues an authorization to degrade.

Montana numeric ground water quality standards for inorganic pollutants applicable to the Project are shown in **Table 54**. Montana's ground water rules contain narrative standards that cover a number of parameters, such as alkalinity, chloride, hardness, sediment, sulfate, and total dissolved solids (TDS), for which sufficient information does not yet exist to develop specific numeric standards. These narrative standards are designed to protect beneficial uses from adverse impacts and supplement the existing numeric standards. The narrative standards prohibit any increase in a parameter to a level that renders the water harmful, detrimental, or injurious to the beneficial uses listed for the class.

Local Requirements

There are no applicable local regulations within or near the analysis area.

Table 54. Montana Numeric Ground Water Quality Standards.

Parameter	Montana Numeric Ground Water Quality Standard (milligrams per liter [mg/L])
Nitrate+nitrite, as N	10/50[1]
Nitrite, as N	1.0
Antimony	0.006
Arsenic	0.01
Barium	1.0
Beryllium	0.004
Cadmium	0.005
Chromium	0.1
Copper	1.3
Fluoride	4.0
Lead	0.015
Mercury	0.002
Nickel	0.1
Selenium	0.05
Silver	0.1
Zinc	2.0

[1] Nitrate+nitrite as N standard is 10 mg/L for Class I and II ground water, and also for Class III ground water except when specific conductance is equal to or greater than 7,000 µS/cm; then the standard is 50 mg/L (ARM 17.30.1006).

Source: Circular DEQ-7, Montana Numeric Water Quality Standards, DEQ 2019.

There is little scientific consensus on recommended water quality limits for livestock. The state and USEPA have not established ambient water quality criteria for livestock or wildlife. A summary of water quality criteria for livestock from several studies is provided in **Section 3.7, Water Resources – Surface Water**. These criteria are also relevant to well water used for livestock. The criteria are not enforceable standards but are used as guidance in evaluating the suitability of water quality for optimal livestock performance.

3.6.1.2 Analysis Area and Methods

Analysis Area

The analysis area for direct and secondary impacts on ground water quantity and quality is the proposed 15,153-acre Project area and the surrounding area where direct impacts on ground water quantity are predicted to occur as determined by ground water modeling. Within the Project area, the Rosebud Coal would be removed in select areas, resulting in ground water drawdown in the remaining portions of the Rosebud Coal. Outside of the Project area, the analysis area includes areas where ground water drawdown is predicted to be greater than 5 feet as a result of the Proposed Action. Model predicted drawdown at the end of mining is shown on **Figure 43** and **Figure 44**.

Analysis Methods

Available ground water–related data and Application documents for the proposed Project were reviewed. Additional ground water data from other permit areas of the Rosebud Mine were also reviewed. A qualitative analysis of potential impacts on ground water resources in the analysis area was performed.

3.6.2 Affected Environment

This section describes the affected environment for ground water. Because of mining associated with the Big Sky Mine, which is located along the southeast boundary of the proposed Area B permit area, the affected environment described includes existing impacts of previous mining and does not represent baseline conditions for the mine as a whole.

3.6.2.1 Site Hydrogeology

The proposed Project would be within the Tongue River Member of the Fort Union Formation. The Paleocene Tongue River Member consists of massive to cross-bedded sandstone, fine-grained siltstone, light to dark-colored mudstone, claystone, and numerous coal seams, including the economically minable Rosebud Coal seam. Except in the coal seams, individual beds or layers are not typically laterally continuous. In addition to the depositional units, areas of thermally metamorphosed sedimentary rock (clinker) have developed locally next to burned coal seams exposed at or near the surface. The clinker formed due to burning of the coal followed by the collapse into the burned coal void space. As discussed below, the characteristics of the clinker influence local ground water recharge and movement. A low-permeability clay layer immediately underlies many of the coal seams and is typically laterally continuous, unlike most of the other non-coal lithologies.

The Lebo Shale Member underlies the Tongue River Member, ranging in thickness between 95 and 200 feet in the area of the Rosebud Mine (Application Appendix I). The Lebo Shale Member consists of gray smectitic shale and mudstone with lenses of gray and yellow, very fine- to medium-grained sandstone with a few thin coal beds (Vuke et al. 2001).

Unconsolidated Quaternary age alluvium and colluvium, generally less than 15 feet thick to a maximum of 35 feet, overlie the Tongue River Member locally, mostly along major drainageways (Application Appendix I). Within the analysis area, relatively thin deposits of silty clay and gravelly sand comprise the Quaternary alluvial fill occurring within portions of Richard Coulee. Thin unmapped unconsolidated alluvial deposits are also present in the Lee and Rape Coulee drainages and associated tributaries. For additional discussion of geology in the area, see **Section 3.6, Geology**. Wetlands are present to a limited extent in association with drainage bottoms, ponds, and scattered springs (see **Section 3.9, Wetlands**).

Ground Water Conditions

Westmoreland Rosebud combined the various lithologic units into the following hydrostratigraphic units, which were used in the Westmoreland Rosebud numerical model of the Project area (Application Appendix I):

- Alluvium
- Overburden (all lithologies that overlie the Rosebud Coal, including clinker)
- Spoil
- Rosebud Coal
- Interburden (Tongue River Member between the Rosebud and McKay Coals)
- McKay Coal
- Sub-McKay (Tongue River Member below the McKay Coal).

Well locations screened within these various units are presented are presented on **Figure 36**.

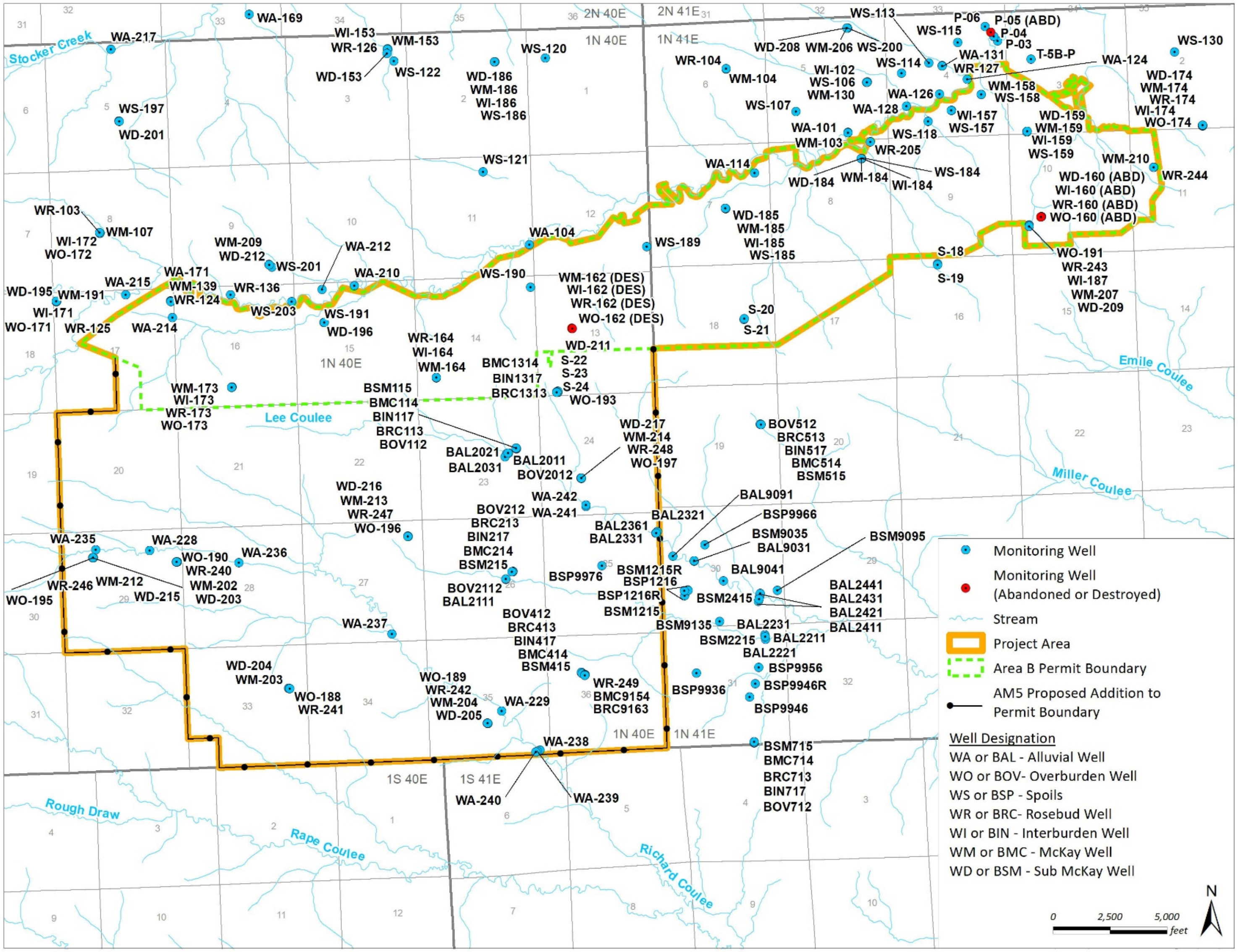

Figure 36. Ground Water Monitoring Well Locations.

Alluvium

Of the depositional units, alluvium represents the most permeable lithology in the Rosebud Mine area with respect to ground water. Alluvium along the main stem of East Fork Armells Creek between Areas A, B, and C has a saturated thickness up to 30 feet (Application Appendix I). Within the AM5 expansion area, Richard Coulee alluvium varies in thickness from 11 feet near the upstream permit boundary to 31 feet at the downstream end (Application Appendix O). In the AM5 expansion area, the saturated thickness in the alluvium associated with Richard Coulee is typically less than that observed along East Fork Armells Creek, and alluvial wells installed within the Lee Coulee are typically dry (Application Appendix O). The median transmissivity of the alluvium across the 108 Rosebud Mine alluvium wells tested is 593 feet squared per day (ft^2/day) (Application Appendix I). Based on testing performed at three alluvial wells in AM5, transmissivity ranges from 335 to 1,940 ft^2/day (Application Appendix I).

Overburden

Ground water occurs in various low to moderately permeable sandstones as perched zones of saturation overlying very low-permeability mudstones/claystones. The areal extent of the saturated sandstones is limited by the discontinuous nature of the general stratigraphy. Depth to water in the overburden can vary locally because of the various lithologies included as overburden and common perched conditions. The horizontal conductivity is dominated by the higher-permeability sandstone units, while the vertical conductivity is controlled by the low-permeability mudstones/claystones. The overburden ground water flow direction in the Project area is largely controlled by local topography and generally flows from recharge areas along drainage divides to discharge areas along the major drainages. Water level elevations in the overburden monitoring wells are shown in **Figure 37**. Because overburden wells are completed in different saturated units, some of which are likely perched, flow paths are likely local in much of the overburden and, therefore, a potentiometric surface map for this unit is not accurate or appropriate. The median transmissivity of the overburden across the 41 Rosebud Mine overburden wells tested is 44 ft^2/day (Application Appendix I). Based on testing performed at two overburden wells in AM5, transmissivity ranges from 21 to 139 ft^2/day (Application Appendix I).

Clinker is included in overburden because of its typical stratigraphic position. Clinker is reported to occur in thicknesses ranging from 10 to 300 feet (Vuke et al. 2001). Because the clinker results from the baking of overlying sedimentary rock and subsequent collapse into the space once occupied by the burned coal, its permeability is generally very high, particularly compared with other water-bearing lithologies in the area. Because clinker is typically exposed at or near the surface and is highly permeable, clinker exposures represent localized areas of high recharge rates from precipitation. At least during periods of high precipitation or snow melt, clinker is a source of water to deeper units and nearby alluvium.

Spoil

Spoil is located in portions of Area B in the Project area as well as in the Big Sky Mine area along the southeast boundary of the permit area. The spoil represents overburden that has been broken into smaller fragments associated with mining activities, representing a relatively homogeneous mixture of the sedimentary lithologies comprising the overburden. In contrast to the overburden, whose vertical conductivity is limited by the low-permeability mudstones/claystones, the lack of lithologic units allows the spoil to have a vertical percolation rate greater than the overburden. However, the higher-permeability sandstone units do not occur in the spoil, resulting in a horizontal conductivity that is less than that of the overburden sandstones. The median transmissivity of the spoil across the 16 Rosebud Mine wells tested is 14.84 ft^2/day (Application Appendix I). The ground water flow direction in the Project area spoil depends on the level of ground water recovery. Once recovered, ground water flow direction in the spoil is presumed to be similar to that in the Rosebud Coal.

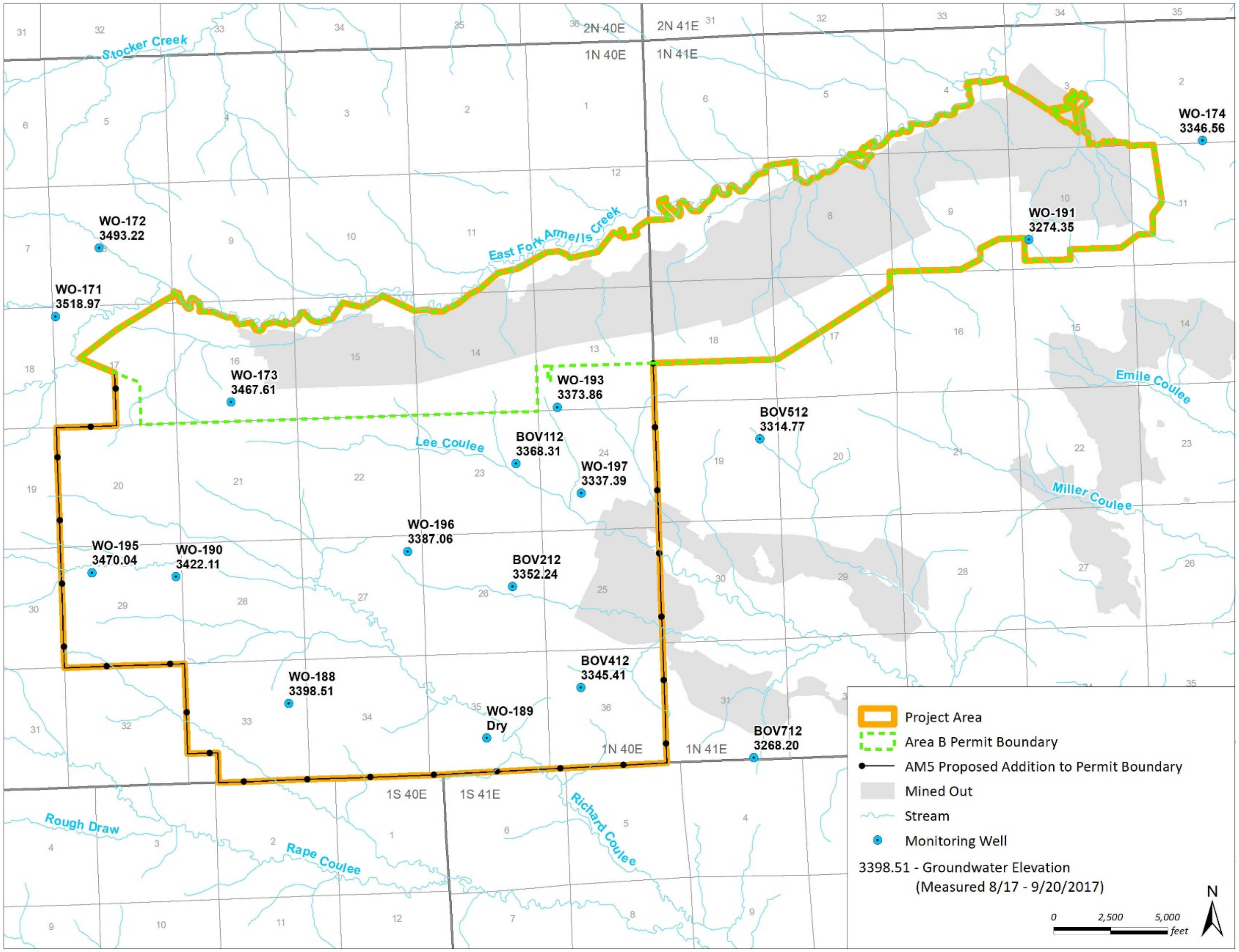

Figure 37. Ground Water Elevations in Overburden.

Rosebud Coal

The Rosebud Coal seam averages 22.6 feet thick over the permit area (Application Appendix D). It is unconfined where it is at or near the surface and confined when overlain by mudstone/claystone. The water-yielding capacity of this coal is limited, owing to the very low hydraulic conductivities and low transmissivities (Application Appendix I). The median transmissivity of the Rosebud Coal across the 45 Rosebud Mine wells tested is 4.81 ft^2/day (Application Appendix I). Based on testing performed at four wells screened in the Rosebud Coal in the AM5 expansion area, transmissivity ranges from 3.21 to 11 ft^2/day (Application Appendix I). Van Voast et al. (1977) report that the higher hydraulic conductivities in the Rosebud Coal are typically associated with fault or fracture zones. The Rosebud Coal ground water flow direction in the permit area is generally from west to east-southeast (**Figure 38**).

Interburden

The interburden is the stratigraphic sequence between the two major coal beds and is composed of similar lithologies to the overburden, except that it does not commonly contain clinker. The thickness of the interburden ranges from a few feet to more than 100 feet (Application Appendix I). Hydrologically, the interburden behaves like the overburden and generally has low permeability. The interburden ground water flow direction in the permit area is generally from west to east-southeast (**Figure 39**). The median transmissivity of the interburden across the 28 Rosebud Mine wells tested is 10.1 ft^2/day (Application Appendix I).

McKay Coal

The McKay Coal is hydrologically similar to the Rosebud Coal. The McKay Coal seam averages 7.9 feet thick in the AM5 expansion area (Application Appendix D). Ground water in the McKay Coal generally flows from west to east-southeast (**Figure 40**). The median transmissivity of the McKay Coal across the 52 Rosebud Mine wells tested is 7.22 ft^2/day (Application Appendix I).

Sub-McKay (or Underburden)

This stratigraphic sequence includes the remainder of the Tongue River Member below the McKay Coal. The lithologies of this group are similar to those of the overburden and interburden. Water level data from the Sub-McKay monitoring wells indicate considerable variability in ground water elevations measured with a ground water high at WD-196. In general, ground water flows from west to east and northwest to southeast (**Figure 41**). Sub-McKay monitoring wells may be completed in different water-bearing units with different water levels, leading to the chaotic appearance of the potentiometric surface depicted in **Figure 41**. The median transmissivity of the Sub-McKay across the 22 Rosebud Mine wells tested is 11.5 ft^2/day (Application Appendix I). Based on testing performed at three wells screened in the Sub-McKay in the AM5 expansion area, transmissivity ranges from 0.563 to 31.3 ft^2/day (Application Appendix I).

Springs

Numerous springs have been identified in the Project area (**Figure 42**). Eleven of the springs are numbered and are actively monitored by Westmoreland Rosebud. Springs are typically located along or near drainages, often daylighting where the ground surface intersects at a sandstone's basal contact with a mudstone/claystone or where a coal seam outcrops. **Table 55** provides a summary of the likely ground water source to each monitored spring.

Table 55. Source of Ground Water to Monitored Springs.

Spring	Ground Water Source
SP-300	Alluvium/Overburden
SP-301	Overburden
SP-302	Alluvium/Overburden
SP-304	Overburden
SP-305	Alluvium/Overburden
SP-306	Spoil
SP-307	Overburden
SP-308	Overburden
SP-309	Overburden
SP-310	Overburden
BGDSG	Overburden

Source: Application Appendix B and Appendix O.

3.6.2.2 Conceptual Hydrogeological Model

The geologic framework, specifically the complex stratigraphy, and the regional climate are key factors in the occurrence and movement of ground water in the region. Most of the Tongue River Member sedimentary units are saturated, but only some of the lithologies have high enough hydraulic conductivity to yield water in sufficient quantities to be considered aquifers. Because of low annual precipitation and high evaporation rates, net infiltration rates to overburden units are generally low in the Project area, except in areas with clinker outcrops. The very permeable nature of the clinker results in much higher rates of infiltration and temporary storage of ground water. Ground water stored in the clinker is available to recharge deeper sandstones or to discharge to shallow alluvium. As ground water percolates downward, the intervening low-permeability mudstone and claystone units perch ground water within the lenticular sandstones. Exposures of sandstones in the overburden may also receive recharge to the west and northwest, but because of the discontinuous nature of the Tongue River Member's stratigraphy, the ground water may discharge to various drainages.

Water level contour maps of the Rosebud and McKay Coals (**Figure 38** and **Figure 40**) show a ground water flow direction from west to east-southeast, indicating that at least the deeper units of the Tongue River Member receive recharge in the upland areas to the west. Water level data collected from Rosebud Coal monitoring wells indicate that the Rosebud Coal may also receive vertical recharge through the overburden along the northwestern corner of the Project area where clinker does not outcrop but alluvium from East Fork Armells Creek overlies bedrock overburden. The ground water levels in the Rosebud Coal monitoring wells in this area responded rapidly with water levels increasing by several feet during the period of high precipitation in the spring of 2011, while other Rosebud Coal monitoring wells to the east displayed minimal water level increases.

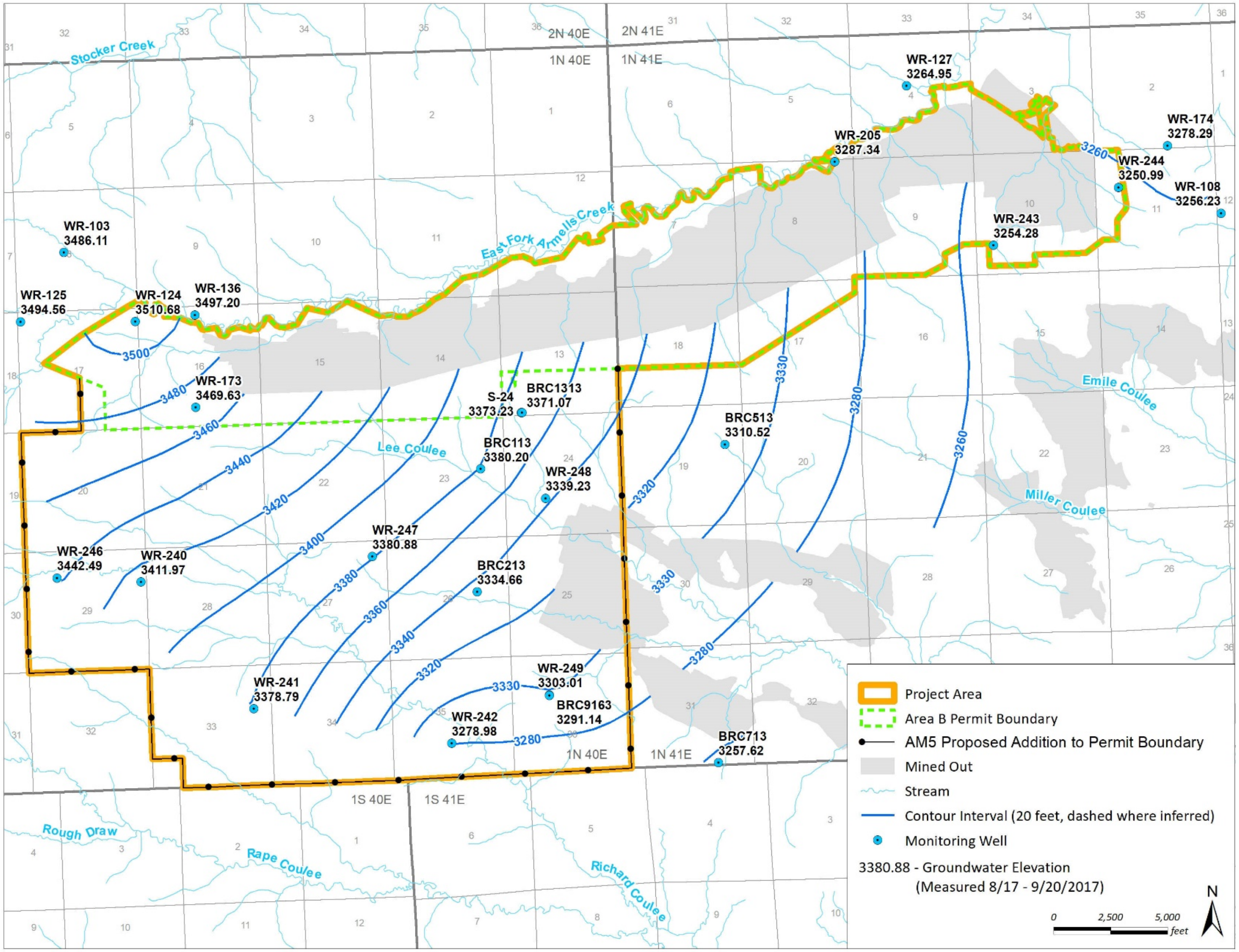

Figure 38. Potentiometric Surface in Rosebud Coal.

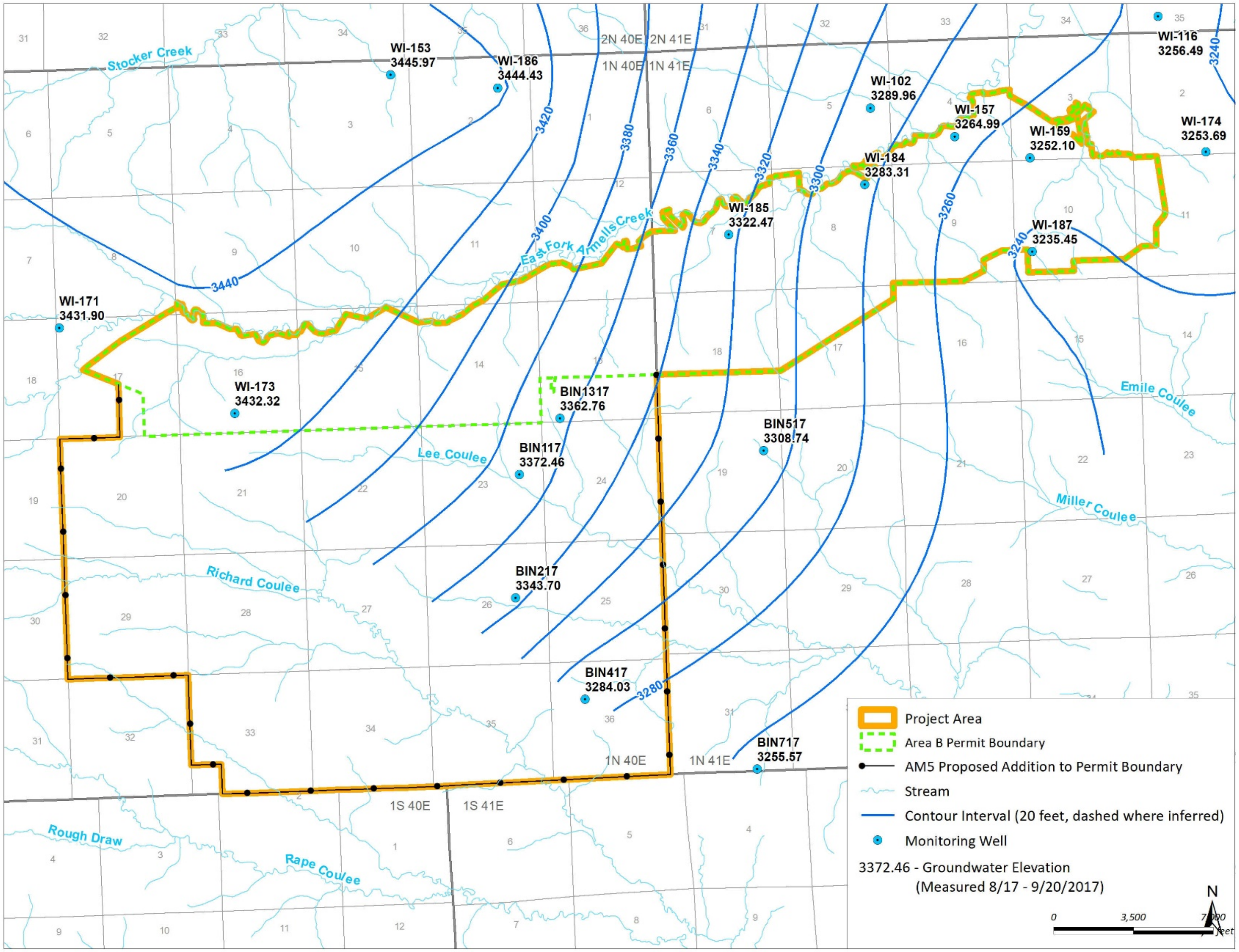

Figure 39. Potentiometric Surface in Interburden.

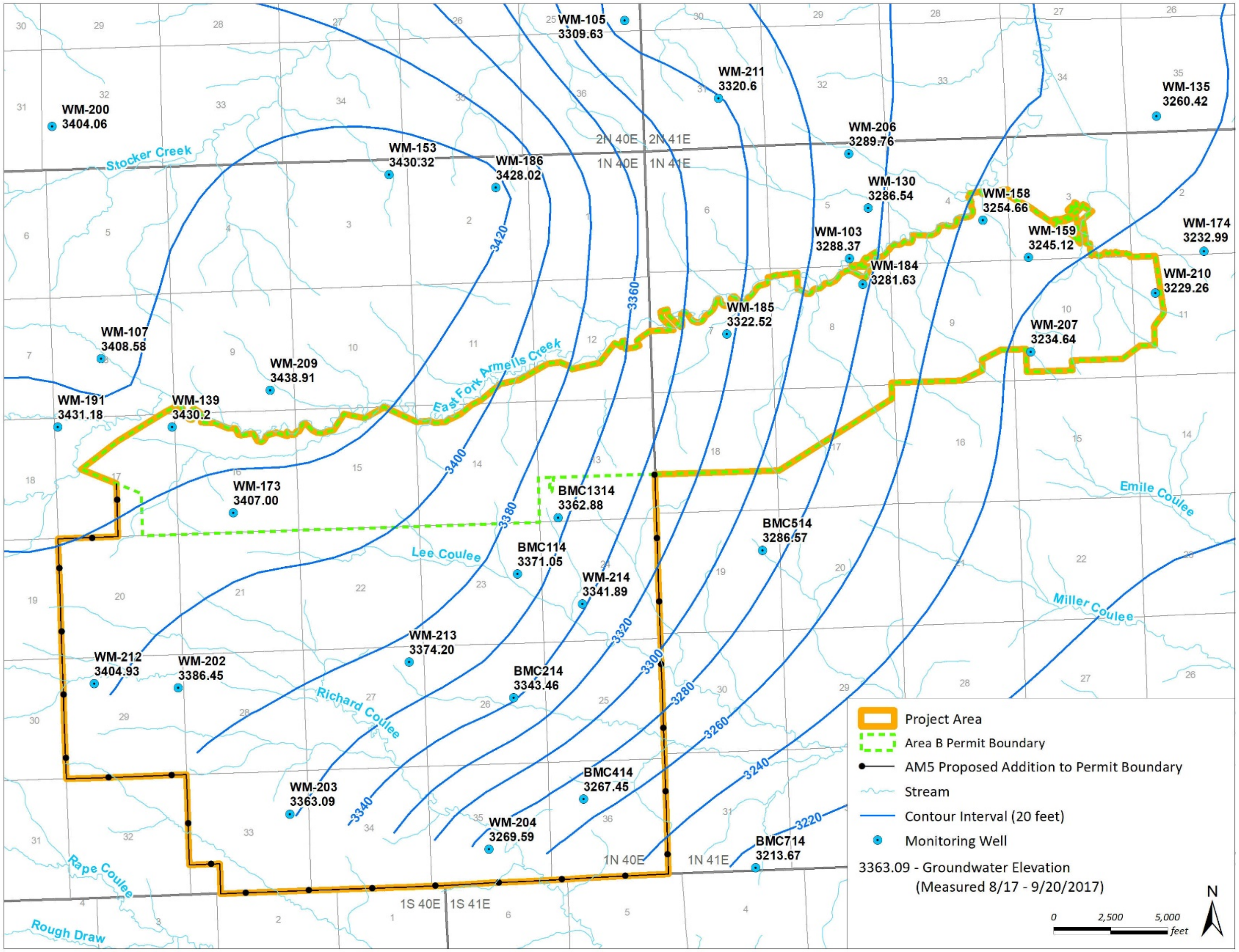

Figure 40. Potentiometric Surface in McKay Coal.

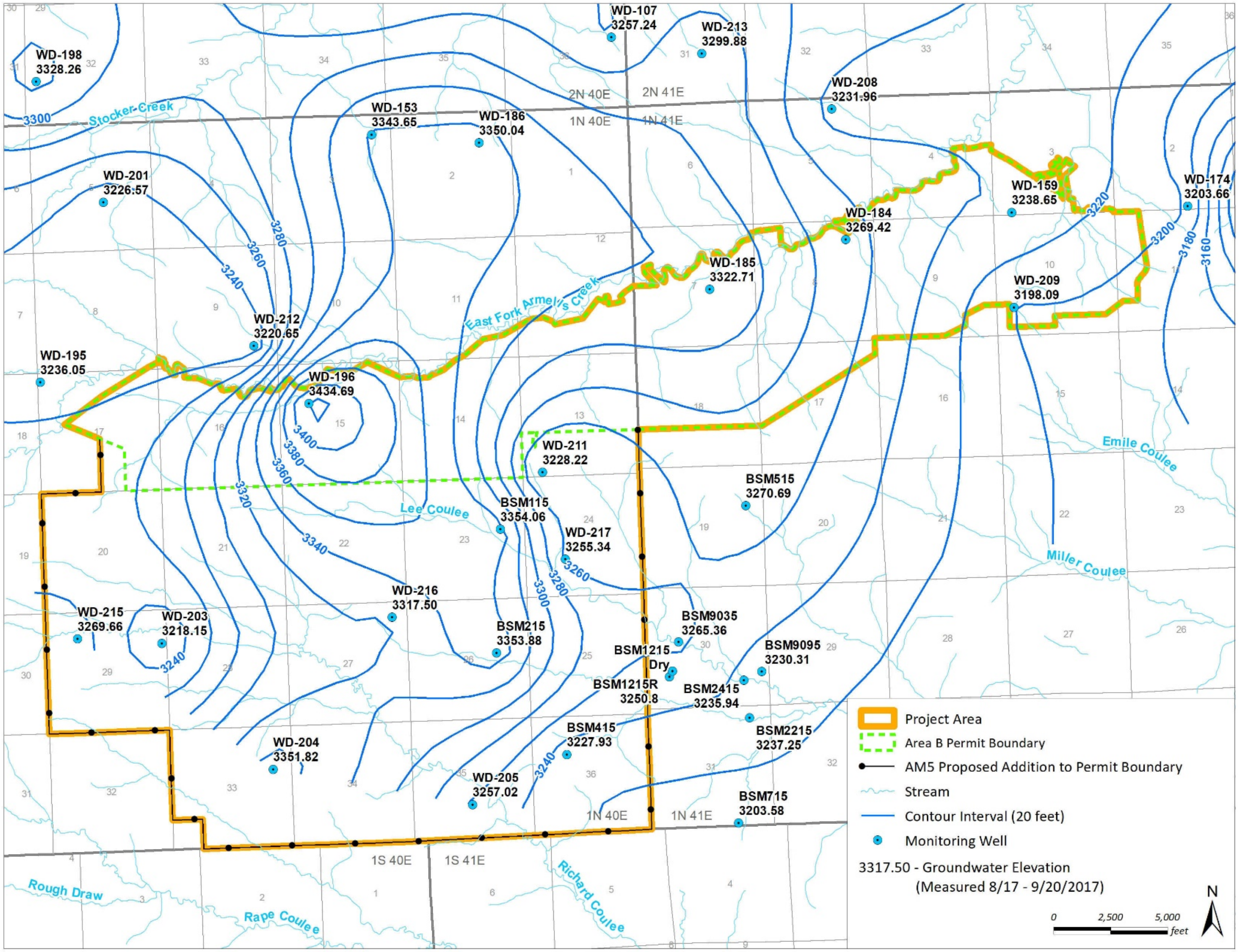

Figure 41. Potentiometric Surface in Sub-McKay.

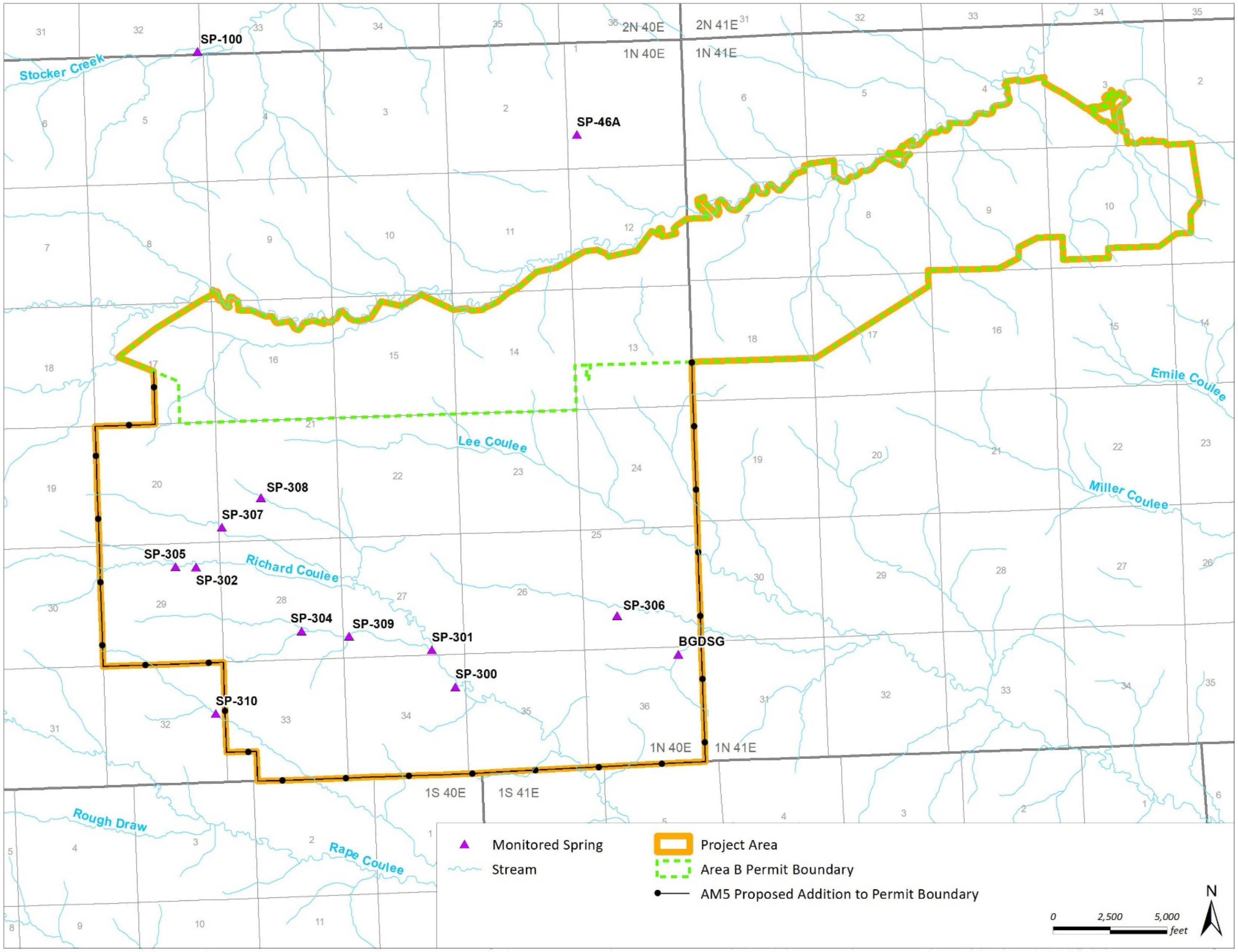

Figure 42. Monitored Spring Sites.

3.6.2.3 Ground Water Use

Ground water in the Project area is used for both stock and rural domestic water needs. Most existing domestic wells are completed in Sub-McKay sandstones and support private water supply uses (Application Appendix O). Within the Project area, ground water use from wells and springs is limited to stock and wildlife watering. Although discharges from springs may vary seasonally, some are reported to be reliable sources of water, except during periods of extended drought (Van Voast et al. 1977). In addition, many wells have been drilled in the region, most of which are less than 200 feet deep (Van Voast et al. 1977). Well yields are generally low (less than 10 gallons per minute) but adequate for the intended use, which is stock watering. Ground water wells produce water from the various sandstone units of the Tongue River Member and the thicker coals, such as the Rosebud and McKay Coals. /See **Section 3.7, Water Resources – Water Rights**, for additional discussion of ground water use.

3.6.2.4 Ground Water Quality

Limited pre-mining ground water quality data were collected in July or August 1923 by the U.S. Geological Survey (Van Voast et al. 1977). At that time, the city of Colstrip did not exist, ground water was less extensively developed in the area but was being used for stock watering, and the Northern Pacific Railway was building a rail line to the Rosebud Mine, which began operating in 1924. Water quality data from 10 wells ranging from 48 to 340 feet deep, a 40-foot coal shaft, and two test holes installed by the Northern Pacific Railway Company are provided in **Table 56**. Limited information is available on the water-bearing formations of the 10 wells; however, the data indicate ground water conditions similar to the present, with less mineralized water in some coal beds and poorer-quality water in nearby inorganic geologic materials such as the overburden (Van Voast et al. 1977).

Table 56. Ground Water Quality in the Colstrip Area in 1923.

Parameter	Minimum	Maximum
Carbonate alkalinity (mg/L)	0	36
Bicarbonate alkalinity (mg/L)	63	1,210
Total dissolved solids (mg/L)	334	3,266
Sulfate (mg/L)	2.8	1,749
Chloride (mg/L)	3	35
Nitrate (mg/L)	“trace”	8.13
Calcium (mg/L)	4.4	194
Iron (mg/L)	“trace”	8
Magnesium (mg/L)	2.4	238
Sodium + potassium (mg/L)	16	380
Hardness (mg/L)	21	1,261

All metals are dissolved.
Data source: Van Voast et al. 1977.

Table 57, Table 58, **Table 59, Table 60**, **Table 61**, **Table 62**, and **Table 63** provide baseline water quality data for the alluvium, overburden, spoil, Rosebud Coal, interburden, McKay Coal, and sub-McKay hydrostratigraphic units in the Project area. The summary statistics presented in the tables were based on queries performed in the March 31, 2020 Rosebud Mine Access database (Application Appendix B) based on permit areas and hydrostratigraphic units assigned to each well in the database. In some instances, data from a particular well may be designated as from the existing Area B permit area or AM5 expansion area but may be located slightly outside of the Project area boundaries. These data were still considered representative of the hydrostratigraphic unit the well is screened in and are summarized as

such. Water quality data were limited to data from January 2008 to the latest data presented in the database of February 2020. There may be existing minor impacts on ground water quality in the Project area from ground water recharge from areas with livestock and current mining in Area B, particularly from wells screened in the alluvium, overburden, and Rosebud Coal. Because the summary statistics are representative of current conditions in the Project area, well data potentially affected by current mining were not separated from well data not potentially influenced by current mining.

In general, water quality varies by the geologic lithologies screened; overall dissolved solids typically decrease with depth. Ground water throughout all lithologies indicates a slightly basic ground water at a median pH of about 8. Based on the relatively high values and higher number of detections of iron and manganese in nonalluvium wells, mildly anaerobic ground water conditions exist outside of the alluvial sediments. The dominant major anion in ground water from each lithologic unit is sulfate. The dominant major cation varies by unit. Sodium is the dominant cation in the overburden, Rosebud Coal, McKay Coal, and Sub-McKay. Calcium and magnesium are the dominant cations in the spoil and interburden. Sodium and magnesium are the dominant cations in the alluvium.

Based on the median conductivities of ground water summarized below, Project area ground water in the interburden would be classified as Class II ground water, while the remaining units (alluvium, overburden, spoil, Rosebud Coal, McKay Coal, and Sub-McKay) would be classified as Class III ground water (**Table 57, Table 58**, **Table 59**, **Table 60**, **Table 61**, **Table 62**, and **Table 63**). Although measured conductivity for an individual well may at times be less than or equal to 1,000 µS/cm, indicating a Class I water quality, in general, individual wells in the Project area have not consistently been measured less than or equal to 1,000 µS/cm and classifications are not defined on a well by well basis. Examples of individual wells which would be reflective of Class I ground water from hydrostratigraphic units that are classified as Class III ground water based on all wells analyzed in the Project area include S-23, WO-160, and BAL2011.

In the wells analyzed, median TDS in the alluvium is 3,890 mg/L, the overburden has a median TDS of 3,580 mg/L, the spoil is 3,185 mg/L, the Rosebud Coal is 2,200 mg/L, the interburden is 1,180 mg/L, the McKay Coal is 2,150 mg/L, and the Sub-McKay is 1,990 mg/L. Water hardness also displays a general decrease with depth with the alluvium and spoil displaying the highest median results (1,615 and 2,000 mg/L, respectively) and the McKay Coal and Sub-McKay displaying the lowest median hardness results (481 and 338 mg/L, respectively).

Exceedances of Montana Water Quality Standards (**Table 54**) occur in each of the hydrostratigraphic units except the interburden and McKay Coal. Exceedance of the arsenic standard was found in data collected from the alluvium, spoil, Rosebud Coal, and Sub-McKay. Exceedance of the cadmium standard occurred in the alluvium and overburden. Exceedance of the fluoride standard occurred in the overburden and Sub-McKay. Exceedance of the lead standard occurred in the Rosebud Coal (the maximum McKay Coal lead value listed in **Table 62** reflects an elevated reporting limit). Exceedance of the selenium standard occurred in the alluvium. Exceedance of the nitrate plus nitrate standard occurred in the overburden. In the data evaluated, exceedances were typically limited to one or two well results and not reflective of a consistent exceedance over the majority of samples collected from a well.

The water quality of springs monitored in and near the Project area is provided in **Section 3.5.2**.

Table 57. Ground Water Quality in the Project Area Alluvium.

Parameter	Number of Samples	Number of Detections	Minimum	Median	Maximum	Water Quality Standard
Acidity (mg/L)	193	18	1.0	1.0	40	NS
Aluminum (mg/L)	206	180	0.00221	0.040	2.86	NS
Ammonia (mg/L)	193	98	0.004	0.050	7.57	NS
Arsenic (mg/L)	206	119	0.000035	0.0010	**0.0581**	0.01
Bicarbonate alkalinity (mg/L)	206	206	240	532	1,170	NS
Boron (mg/L)	206	200	0.0010	0.32	1.3	NS
Cadmium (mg/L)	206	111	0.000040	0.00050	**0.00714**	0.005
Calcium (mg/L)	193	193	60.8	214	446	NS
Carbonate alkalinity (mg/L)	199	26	0	1.0	65	NS
Chloride (mg/L)	206	206	4.68	16.1	217	NS
Copper (mg/L)	193	133	0.000018	0.0020	0.192	1.3
Fluoride (mg/L)	206	175	0.0040	0.300	1.69	4.0
Hydroxide alkalinity (mg/L)	182	0	1.0	1.0	5.0	NS
Iron (mg/L)	206	138	0.00050	0.020	2.09	NS
Laboratory conductivity (µS/cm)	206	206	752	4,235	6,950	NS
Laboratory pH (s.u.)	206	206	5.63	8.12	8.50	NS
Lead (mg/L)	206	74	0.0000023	0.0000858	0.00701	0.015
Magnesium (mg/L)	193	193	26	249	578	NS
Manganese (mg/L)	206	180	0.0000867	0.00651	1.8	NS
Nickel (mg/L)	193	94	0.00050	0.002	0.043	0.1
Nitrate+nitrite (mg/L)	206	140	0.0030	0.116	2.7	10
Potassium (mg/L)	193	192	3.0	11.9	18.4	NS
Selenium (mg/L)	193	138	0.000135	0.0010	**0.11**	0.05
Sodium (mg/L)	193	193	10	583	1,140	NS
Sulfate (mg/L)	206	206	84	2,165	3,790	NS
Total alkalinity (mg/L)	206	206	240	532	962	NS
Total dissolved solids (mg/L)	206	206	470	3,890	9,140	NS
Total hardness (mg/L)	206	206	298	1,615	3,200	NS
Total phosphate (mg/L)	8	8	0.0098	0.027	2.9	NS
Vanadium (mg/L)	193	130	0.0000136	0.01	0.01	NS
Zinc (mg/L)	206	54	0.00070	0.0031	0.046	2.0

Application Appendix B.
Data range is January 2008 to February 2020.
Wells included: BAL2011, BAL2321, BAL2411, BAL9031, BAL9041, P-03, P-04, P-05, WA-104, WA-114, WA-124, WA-171, WA-214, WA-215, WA-228, WA-229, WA-235, WA-237, WA-238, WA-239, and WA-240.
All metals are dissolved.
NS = no numeric standard or recommended concentration. µS/cm = micro Siemens/centimeter; s.u. = standard units.
For less than detection limit concentrations, detection limits are used to calculate summary statistics.
Concentrations in bold exceed Montana numeric ground water quality standards (**Table 54**).

Table 58. Ground Water Quality in the Project Area Overburden.

Parameter	Number of Samples	Number of Detections	Minimum	Median	Maximum	Water Quality Standard
Acidity (mg/L)	130	4	1.0	1.0	22	NS
Aluminum (mg/L)	131	126	0.00221	0.053	0.455	NS
Ammonia (mg/L)	130	114	0.0050	0.453	1.62	NS
Arsenic (mg/L)	131	94	0.000035	0.0010	0.00771	0.01
Bicarbonate alkalinity (mg/L)	135	135	281	550	1050	NS
Boron (mg/L)	131	131	0.058	0.30	0.592	NS
Cadmium (mg/L)	131	75	0.000005	0.0005	**0.007**	0.005
Calcium (mg/L)	130	130	22.5	172	309	NS
Carbonate alkalinity (mg/L)	132	13	0	1.0	50	NS
Chloride (mg/L)	135	133	2.0	10	39	NS
Copper (mg/L)	126	107	0.000018	0.0020	0.0106	1.3
Fluoride (mg/L)	135	102	0.0040	0.20	**4.09**	4.0
Hydroxide alkalinity (mg/L)	129	0	1.0	1.0	5.0	NS
Iron (mg/L)	135	127	0.000688	0.24	4.52	NS
Laboratory conductivity (µS/cm)	135	135	600	4,170	6,580	NS
Laboratory pH (s.u.)	135	135	7.0	8.0	8.7	NS
Lead (mg/L)	131	72	0.0000023	0.00030	0.0070	0.015
Magnesium (mg/L)	130	130	9.29	158	431	NS
Manganese (mg/L)	135	135	0.0022	0.090	0.508	NS
Nickel (mg/L)	126	82	0.00058	0.0020	0.0271	0.1
Nitrate+nitrite (mg/L)	135	56	0.0030	0.0066	**15.7**	10
Potassium (mg/L)	130	128	3.0	10.7	17.3	NS
Selenium (mg/L)	126	69	0.000135	0.0010	0.0378	0.05
Sodium (mg/L)	130	130	14.6	771	1,250	NS
Sulfate (mg/L)	135	135	48.4	1,930	2,980	NS
Total alkalinity (mg/L)	135	135	281	554	1050	NS
Total dissolved solids (mg/L)	135	135	337	3,580	6,300	NS
Total hardness (mg/L)	135	135	94.5	1,140	2,480	NS
Total phosphate	4	4	0.018	0.082	0.231	NS
Vanadium (mg/L)	126	91	0.0000136	0.010	0.010	NS
Zinc (mg/L)	131	93	0.000855	0.010	0.0702	2.0

Application Appendix B.
Data range is January 2008 to February 2020.
Wells included: BOV112, BOV212, BOV412, BOV512, WO-160, WO-162, WO-171, WO-173, WO-188, WO-190, WO-191, WO-195, WO-196, and WO-197.
All metals are dissolved.
NS = no numeric standard or recommended concentration. µS/cm = micro Siemens/centimeter; s.u. = standard units.
For less than detection limit concentrations, detection limits are used to calculate summary statistics.
Concentrations in bold exceed Montana numeric ground water quality standards (**Table 54**).

Table 59. Ground Water Quality in the Project Area Spoil.

Parameter	Number of Samples	Number of Detections	Minimum	Median	Maximum	Water Quality Standard
Acidity (mg/L)	45	15	1.0	1.0	170	NS
Aluminum (mg/L)	52	35	0.0040	0.030	0.701	NS
Ammonia (mg/L)	45	44	0.0448	0.99	3.19	NS
Arsenic (mg/L)	52	35	0.000035	0.001	**0.014**	0.01
Bicarbonate alkalinity (mg/L)	52	52	400	603	926	NS
Boron (mg/L)	52	52	0.12	0.30	1.02	NS
Cadmium (mg/L)	52	16	0.00004	0.0005	0.001	0.005
Calcium (mg/L)	45	45	159	365	555	NS
Carbonate alkalinity (mg/L)	50	3	0	1.0	6.7	NS
Chloride (mg/L)	52	52	9.0	28.7	191	NS
Copper (mg/L)	45	21	0.000018	0.0020	0.045	1.3
Fluoride (mg/L)	52	30	0.0040	0.10	2.0	4.0
Hydroxide alkalinity (mg/L)	33	0	1.0	1.0	5.0	NS
Iron (mg/L)	52	49	0.019	0.11	8.38	NS
Laboratory conductivity (µS/cm)	52	52	2,490	3,355	7,830	NS
Laboratory pH (s.u.)	52	52	6.60	7.53	8.29	NS
Lead (mg/L)	52	25	0.0000023	0.00030	0.00679	0.015
Magnesium (mg/L)	45	45	168	310	720	NS
Manganese (mg/L)	52	52	0.264	0.704	4.53	NS
Nickel (mg/L)	45	28	0.0005	0.005	0.02	0.1
Nitrate+nitrite (mg/L)	52	14	0.0030	0.0083	0.020	10
Potassium (mg/L)	45	45	9.0	14.3	22.2	NS
Selenium (mg/L)	45	11	0.000135	0.0010	0.00165	0.05
Sodium (mg/L)	45	45	93	253	751	NS
Sulfate (mg/L)	52	52	1,160	1,815	5,110	NS
Total alkalinity (mg/L)	52	52	400	590	923	NS
Total dissolved solids (mg/L)	52	52	2,230	3,185	8,200	NS
Total hardness (mg/L)	52	52	1,290	2,000	4,230	NS
Total phosphate (mg/L)	5	5	0.030	0.052	0.66	NS
Vanadium (mg/L)	45	23	0.00002	0.01	0.01	NS
Zinc (mg/L)	52	20	0.000855	0.0100	0.0684	2.0

Application Appendix B.
Data range is January 2008 to February 2020.
Wells included: BSP1216, BSP9946R, BSP9966, BSP9976, T-5B-P, WS-118, WS-157, WS-158, WS-159, WS-184, and WS-191.
All metals are dissolved.
NS = no numeric standard or recommended concentration. µS/cm = micro Siemens/centimeter; s.u. = standard units.
For less than detection limit concentrations, detection limits are used to calculate summary statistics.
Concentrations in bold exceed Montana numeric ground water quality standards (**Table 54**).

Table 60. Ground Water Quality in the Project Area Rosebud Coal.

Parameter	Number of Samples	Number of Detections	Minimum	Median	Maximum	Water Quality Standard
Acidity (mg/L)	218	3	1.0	1.0	37	NS
Aluminum (mg/L)	223	215	0.00221	0.048	3.96	NS
Ammonia (mg/L)	218	208	0.0050	0.53	2.61	NS
Arsenic (mg/L)	223	148	0.000035	0.0010	**0.0191**	0.01
Bicarbonate alkalinity (mg/L)	226	226	297	470	838	NS
Boron (mg/L)	223	223	0.040	0.23	0.702	NS
Cadmium (mg/L)	223	110	0.0000050	0.000294	0.00086	0.005
Calcium (mg/L)	218	218	11	117	432	NS
Carbonate alkalinity (mg/L)	222	84	0	1.0	69	NS
Chloride (mg/L)	226	226	1.0	6.91	51.5	NS
Copper (mg/L)	215	164	0.000018	0.0020	0.0588	1.3
Fluoride (mg/L)	226	204	0.0040	0.30	1.97	4.0
Hydroxide alkalinity (mg/L)	218	0	1.0	1.0	5.0	NS
Iron (mg/L)	226	224	0.000688	0.0892	21.2	NS
Laboratory conductivity (µS/cm)	226	226	902	2,940	5,710	NS
Laboratory pH (s.u.)	226	226	6.8	8.2	8.8	NS
Lead (mg/L)	223	124	0.0000023	0.00030	**0.0458**	0.015
Magnesium (mg/L)	218	218	4.0	73.9	415	NS
Manganese (mg/L)	226	226	0.0050	0.098	1.66	NS
Nickel (mg/L)	215	126	0.00050	0.0020	0.036	0.1
Nitrate+nitrite (mg/L)	226	104	0.0030	0.0066	8.54	10
Potassium (mg/L)	218	216	3.70	7.79	21.9	NS
Selenium (mg/L)	215	89	0.000094	0.00076	0.00568	0.05
Sodium (mg/L)	218	218	25.7	422	1,230	NS
Sulfate (mg/L)	226	226	131	1,175	2,590	NS
Total alkalinity (mg/L)	226	226	297	474	838	NS
Total dissolved solids (mg/L)	227	227	506	2,200	6,460	NS
Total hardness (mg/L)	226	226	46	600	2,430	NS
Total phosphate (mg/L)	6	6	0.025	0.041	0.17	NS
Vanadium (mg/L)	215	159	0.0000136	0.010	0.0128	NS
Zinc (mg/L)	223	135	0.000855	0.0080	0.108	2.0

Application Appendix B.
Data range is January 2008 to February 2020.
Wells included: BRC113, BRC213, BRC513, BRC9163, S-19, S-21, S-24, WR-108, WR-124, WR-125, WR-160, WR-162, WR-164, WR-173, WR-205, WR-240, WR-241, WR-242, WR-243, WR-244, WR-246, WR-247, WR-248, and WR-249.
All metals are dissolved.
NS = no numeric standard or recommended concentration. µS/cm = micro Siemens/centimeter; s.u. = standard units.
For less than detection limit concentrations, detection limits are used to calculate summary statistics.
Concentrations in bold exceed Montana numeric ground water quality standards (**Table 54**).

Table 61. Ground Water Quality in the Project Area Interburden.

Parameter	Number of Samples	Number of Detections	Minimum	Median	Maximum	Water Quality Standard
Acidity (mg/L)	53	3	1.0	1.0	10	NS
Aluminum (mg/L)	61	57	0.00221	0.0300	1.67	NS
Ammonia (mg/L)	53	46	0.0073	0.18	3.4	NS
Arsenic (mg/L)	61	34	0.000035	0.0010	0.0030	0.01
Bicarbonate alkalinity (mg/L)	64	64	315	423	3,280	NS
Boron (mg/L)	61	61	0.083	0.21	0.79	NS
Cadmium (mg/L)	61	19	0.00004	0.00008	0.0005	0.005
Calcium (mg/L)	53	53	66.5	107	464	NS
Carbonate alkalinity (mg/L)	62	9	0	1.0	33	NS
Chloride (mg/L)	64	64	1.0	4.2	40	NS
Copper (mg/L)	50	37	0.000018	0.0020	0.0060	1.3
Fluoride (mg/L)	64	54	0.0040	0.20	0.984	4.0
Hydroxide alkalinity (mg/L)	53	0	1.0	1.0	5.0	NS
Iron (mg/L)	64	63	0.0049	0.12	2.3	NS
Laboratory conductivity (μS/cm)	64	64	878	1,675	4,590	NS
Laboratory pH (s.u.)	64	64	6.80	7.97	8.50	NS
Lead (mg/L)	61	37	0.0000023	0.00030	0.00288	0.015
Magnesium (mg/L)	53	53	70.6	83.1	352	NS
Manganese (mg/L)	64	64	0.0050	0.041	1.34	NS
Nickel (mg/L)	50	38	0.00050	0.0020	0.017	0.1
Nitrate+nitrite (mg/L)	64	36	0.0030	0.010	1.69	10
Potassium (mg/L)	53	53	3.0	5.1	19.7	NS
Selenium (mg/L)	50	16	0.000094	0.00050	0.00167	0.05
Sodium (mg/L)	53	53	19	28	404	NS
Sulfate (mg/L)	64	64	124	462	2,460	NS
Total alkalinity (mg/L)	64	64	315	422	897	NS
Total dissolved solids (mg/L)	64	64	427	1,180	4,460	NS
Total hardness (mg/L)	64	64	460	808	2,740	NS
Total phosphate (mg/L)	9	9	0.024	0.037	0.62	NS
Vanadium (mg/L)	50	41	0.0000136	0.010	0.010	NS
Zinc (mg/L)	61	48	0.000855	0.0080	0.098	2.0

Application Appendix B.
Data range is January 2008 to February 2020.
Wells included: BIN1317, S-23, WI-157, WI-159, WI-160, WI-162, WI-164, WI-171, WI-173, WI-184, WI-185, and WI-187.
All metals are dissolved.
NS = no numeric standard or recommended concentration. μS/cm = micro Siemens/centimeter; s.u. = standard units.
For less than detection limit concentrations, detection limits are used to calculate summary statistics.
Concentrations in bold exceed Montana numeric ground water quality standards (**Table 54**).

Table 62. Ground Water Quality in the Project Area McKay Coal.

Parameter	Number of Samples	Number of Detections	Minimum	Median	Maximum	Water Quality Standard
Acidity (mg/L)	198	4	1.0	1.0	20	NS
Aluminum (mg/L)	206	198	0.0040	0.037	0.407	NS
Ammonia (mg/L)	198	178	0.0050	0.43	2.55	NS
Arsenic (mg/L)	206	124	0.000035	0.0010	0.0030	0.01
Bicarbonate alkalinity (mg/L)	210	210	257	389	994	NS
Boron (mg/L)	206	206	0.0491	0.17	0.875	NS
Cadmium (mg/L)	206	96	0.0000050	0.000081	0.000647	0.005
Calcium (mg/L)	198	198	17	72	376	NS
Carbonate alkalinity (mg/L)	204	93	0	5.0	66	NS
Chloride (mg/L)	210	210	1.0	8.24	26	NS
Copper (mg/L)	194	153	0.000018	0.0020	0.0123	1.3
Fluoride (mg/L)	210	189	0.0040	0.362	1.83	4.0
Hydroxide alkalinity (mg/L)	201	0	1.0	1.0	5.0	NS
Iron (mg/L)	210	205	0.020	0.132	4.9	NS
Laboratory conductivity (µS/cm)	210	210	814	2,840	6,100	NS
Laboratory pH (s.u.)	210	210	7.0	8.2	8.8	NS
Lead (mg/L)	206	99	0.0000023	0.00010	1.0*	0.015
Magnesium (mg/L)	198	198	4.0	61	324	NS
Manganese (mg/L)	210	210	0.0027	0.044	1.09	NS
Nickel (mg/L)	194	120	0.00050	0.0020	0.0631	0.1
Nitrate+nitrite (mg/L)	210	116	0.0030	0.014	1.05	10
Potassium (mg/L)	198	195	3.2	6.4	19.5	NS
Selenium (mg/L)	194	88	0.000094	0.00076	0.034	0.05
Sodium (mg/L)	198	198	23.4	608	1130	NS
Sulfate (mg/L)	210	210	163	1,150	3,020	NS
Total alkalinity (mg/L)	210	210	267	394	971	NS
Total dissolved solids (mg/L)	211	211	550	2,150	5,090	NS
Total hardness (mg/L)	210	210	61	481	1,920	NS
Total phosphate (mg/L)	9	9	0.011	0.046	0.181	NS
Vanadium (mg/L)	194	142	0.0000136	0.010	0.010	NS
Zinc (mg/L)	206	135	0.000855	0.0080	0.468	2.0

Application Appendix B.
Data range is January 2008 to February 2020.
Wells included: BMC114, BMC214, BMC414, BMC514, BMC9154, S-18, S-20, S-22, WM-139, WM-158, WM-159, WM-162, WM-164, WM-173, WM-184, WM-185, WM-191, WM-202, WM-203, WM-204, WM-207, WM-210, WM-212, WM-213, and WM-214.
All metals are dissolved.
* = Lead maximum result of 1.0 represents elevated reporting limit; analyte was not detected at reporting limit listed.
NS = no numeric standard or recommended concentration. µS/cm = micro Siemens/centimeter; s.u. = standard units.
For less than detection limit concentrations, detection limits are used to calculate summary statistics.
Concentrations in bold exceed Montana numeric ground water quality standards (**Table 54**).

Table 63. Ground Water Quality in the Project Area Sub-McKay.

Parameter	Number of Samples	Number of Detections	Minimum	Median	Maximum	Water Quality Standard
Acidity (mg/L)	185	10	1.0	1.0	26	NS
Aluminum (mg/L)	193	185	0.00316	0.0558	3.19	NS
Ammonia (mg/L)	185	178	0.0073	0.562	7.8	NS
Arsenic (mg/L)	193	116	0.000035	0.0010	**0.019**	0.01
Bicarbonate alkalinity (mg/L)	196	196	87.1	373	1,130	NS
Boron (mg/L)	193	193	0.047	0.22	0.69	NS
Cadmium (mg/L)	193	81	0.0000050	0.000081	0.00143	0.005
Calcium (mg/L)	185	185	8.0	79	241	NS
Carbonate alkalinity (mg/L)	190	109	0	6.7	44	NS
Chloride (mg/L)	196	196	2.59	8.4	29	NS
Copper (mg/L)	182	147	0.000018	0.0020	0.0131	1.3
Fluoride (mg/L)	196	175	0.004	0.58	**5.11**	4.0
Hydroxide alkalinity (mg/L)	181	0	1.0	1.0	5.0	NS
Iron (mg/L)	196	195	0.020	0.24	4.76	NS
Laboratory conductivity (µS/cm)	196	196	391	2,750	6,440	NS
Laboratory pH (s.u.)	196	196	6.6	8.3	8.9	NS
Lead (mg/L)	193	113	0.0000023	0.00030	0.0018	0.015
Magnesium (mg/L)	185	185	2.0	34.4	307	NS
Manganese (mg/L)	196	196	0.0060	0.035	1.2	NS
Nickel (mg/L)	182	101	0.00050	0.0020	0.024	0.1
Nitrate+nitrite (mg/L)	196	65	0.0030	0.0066	3.5	10
Potassium (mg/L)	185	184	3.0	8.8	15.8	NS
Selenium (mg/L)	182	57	0.000094	0.00076	0.0237	0.05
Sodium (mg/L)	185	185	41.7	603	1,180	NS
Sulfate (mg/L)	196	196	35.3	1,035	2,720	NS
Total alkalinity (mg/L)	196	196	87.1	378	1,130	NS
Total dissolved solids (mg/L)	196	196	177	1,990	4,960	NS
Total hardness (mg/L)	196	196	30	338	1,620	NS
Total phosphate (mg/L)	8	8	0.0032	3.02	15	NS
Vanadium (mg/L)	182	130	0.0000136	0.010	0.01	NS
Zinc (mg/L)	193	106	0.000855	0.0080	0.17	2.0

Application Appendix B.
Data range is January 2008 to February 2020.
Wells included: BSM115, BSM1215R, BSM215, BSM2415, BSM415, BSM515, WD-159, WD-160, WD-184, WD-185, WD-195, WD-196, WD-203, WD-204, WD-205, WD-209, WD-211, WD-215, WD-216, and WD-217.
All metals are dissolved.
NS = no numeric standard or recommended concentration. µS/cm = micro Siemens/centimeter; s.u. = standard units.
For less than detection limit concentrations, detection limits are used to calculate summary statistics.
Concentrations in bold exceed Montana numeric ground water quality standards (**Table 54**).

3.6.3 Environmental Consequences

3.6.3.1 Alternative 1 – No Action

Under the No Action Alternative, the AM5 amendment (proposed Project) would not be permitted. Westmoreland Rosebud would complete mining and reclamation in the Area B permit area according to its currently approved operating permit. Mining is permitted in Area B until 2030, and initial stages of reclamation would be completed within 2 years of the cessation of mining. There would be no Project impacts on ground water resources described in **Section 3.6.2, Affected Environment**, because any changes or disturbances associated with the proposed Project would not occur.

The No Action Alternative would not change the status of the existing Area B permit area or other permit areas, including Area F, of the Rosebud Mine (**Section 2.2, Existing Operating Permits, Disturbance, and Reclamation**), nor would it affect the federal coal lease MTM 80697 (tracts in Areas B and C) modification application, which is currently being evaluated by the Bureau of Land Management (**Section 3.1.4.2, Related Future Actions**). Impacts on ground water due to current and future mining and reclamation in the existing Area B permit area and other permit areas of the Rosebud Mine would continue.

3.6.3.2 Alternative 2 – Proposed Action

Ground Water Quantity

Most of the Tongue River Member sedimentary units in the Project area are saturated and contain ground water. However, due to the overall low hydraulic conductivity, only some of the units are capable of producing water to a well. Ground water in the more continuous and permeable bedrock units such as sub-McKay sandstones and the Rosebud Coal of the AM5 expansion area flows from the upland areas west-northwest of the Project area to the southeast, which is also the trend of Richard and Lee Coulees. Saturated zones in bedrock that overlie the coal (overburden) are typically perched on low-permeability layers and can be discontinuous. Where those low-permeability layers associated with the overburden intersect the ground surface, the overlying saturated zones can be exposed to form seeps and springs. Within the AM5 expansion area, removal of the coal and the eventual replacement of the coal by spoil would occur in the upstream reaches of Richard and Lee Coulees and would have impacts on ground water quantity in the analysis area during mining and until ground water levels recover. The impacts discussion is organized by timeframe and provided below.

Mining Period – Direct Impacts

Removal of overburden would remove saturated zones within the overburden. This would result in a more homogeneous mixture of sedimentary lithologies such as shale, siltstone, and sandstone that would be replaced in the mined areas as spoil. It is unlikely that significant quantities of ground water would flow into the mine pits from the overburden walls because of the overall low hydraulic conductivity and the discontinuous nature of the saturated zones in the overburden. Due to the characteristics of the overburden, it is likely that ground water drawdown in the overburden would extend only a short distance from the pits being mined.

Removal of the Rosebud Coal would likely result in low to moderate ground water inflow to the pits, some of which would be pumped from the pits into storage ponds. Some of the inflowing ground water would evaporate from the walls of the pits due to low inflow rates. The mine pits would intercept ground water that would otherwise have discharged to alluvium in the Project area drainages. Both Richard and Lee Coulees are ephemeral, indicating that the majority of ground water reaching the alluvium does so

without surfacing as stream flow. Removal of the overburden would temporarily reduce the amount of ground water reaching the downstream alluvial deposits. Removing the alluvium, overburden, and Rosebud Coal within the Project area drainages would likely result in reduced baseflow, if present, in nearby downstream reaches during and after mining until ground water levels have recovered. The hydraulic gradient in the unmined Rosebud Coal upgradient of the AM5 mining would not change as a result of mining since the ground water flow direction would be toward the pits. The hydraulic gradient of the unmined Rosebud Coal underlying the topographic high separating Richard and Lee Coulees and the immediate area west of the Richard Coulee mining area would temporarily change toward the mined area. The direction of ground water flow in the McKay Coal and lower strata would not be altered due to mining.

Ground water levels in the unmined portions of the Rosebud Coal would decline as the mined coal is dewatered and removed. Drawdown created by removal of the coal would extend out from the mined areas as more of the coal is dewatered and removed. The maximum depth of drawdown in the Rosebud Coal would be limited by the depth of the coal. The Westmoreland Rosebud ground water model indicated that the maximum drawdown in the Rosebud Coal at the end of mining (Year 2043) would be about 90 feet in the Richard Coulee mining area, and about 70 to 80 feet in the Lee Coulee mining area (**Figure 43**; Application Appendix I). The modeling also indicated that the maximum drawdown in the McKay Coal at the end of mining (Year 2043) would be 47 feet and broadly located between Richard and Lee Coulees (**Figure 44**; Application Appendix I). Westmoreland Rosebud would be required to replace any water supply where reduced bedrock inflow or drawdown precluded the beneficial use.

Ground water levels at the end of mining would decrease around the Project area such that drawdown of about 5 feet would extend to a distance typically about 1 to 2 miles with slightly greater distance in the downgradient southeastern direction (**Figure 43** and **Figure 44**). Ground water drawdown in the Rosebud (**Figure 43**) and McKay (**Figure 44**) Coals outside of the Project area to the southeast would reduce ground water levels in private wells screened in one or both of the coal units. Based on the well assessment outlined in Westmoreland Rosebud's Application (Appendix O Sections 4.4.7 and 4.4.8), DEQ anticipates that up to 16 wells would be impacted by Project activities, excluding wells that were field verified to no longer exist and wells only impacted by the existing Area B permit. Of these 16 wells, 15 are stock wells and 1 is of unknown purpose. Of the 16 wells, 11 would be removed by mining and 5 are within the disturbance area.

Table 64 provides a summary of which springs are likely to be directly impacted by mining. Eight of the 11 monitored springs in the Project area would be affected by mining due to their location in the area being mined and their source being overburden. Spring flows would not be reduced or eliminated until the overburden in the vicinity of the spring was mined out. Two of the 11 monitored springs in the Project area would not likely be affected by mining; SP-310 is located just outside of the Project area but within the analysis area in Rape Coulee, and BGDSG is located outside of the area of proposed mining in the Project area in a tributary to Lee Coulee. The source of SP-306 is spoil, and just upgradient of the spring is the proposed AM5 expansion area. SP-306 is listed as being less than 0.1 mile downgradient of the AM5 expansion mine cuts (Application Appendix O) and likely would be impacted by the AM5 expansion area mining.

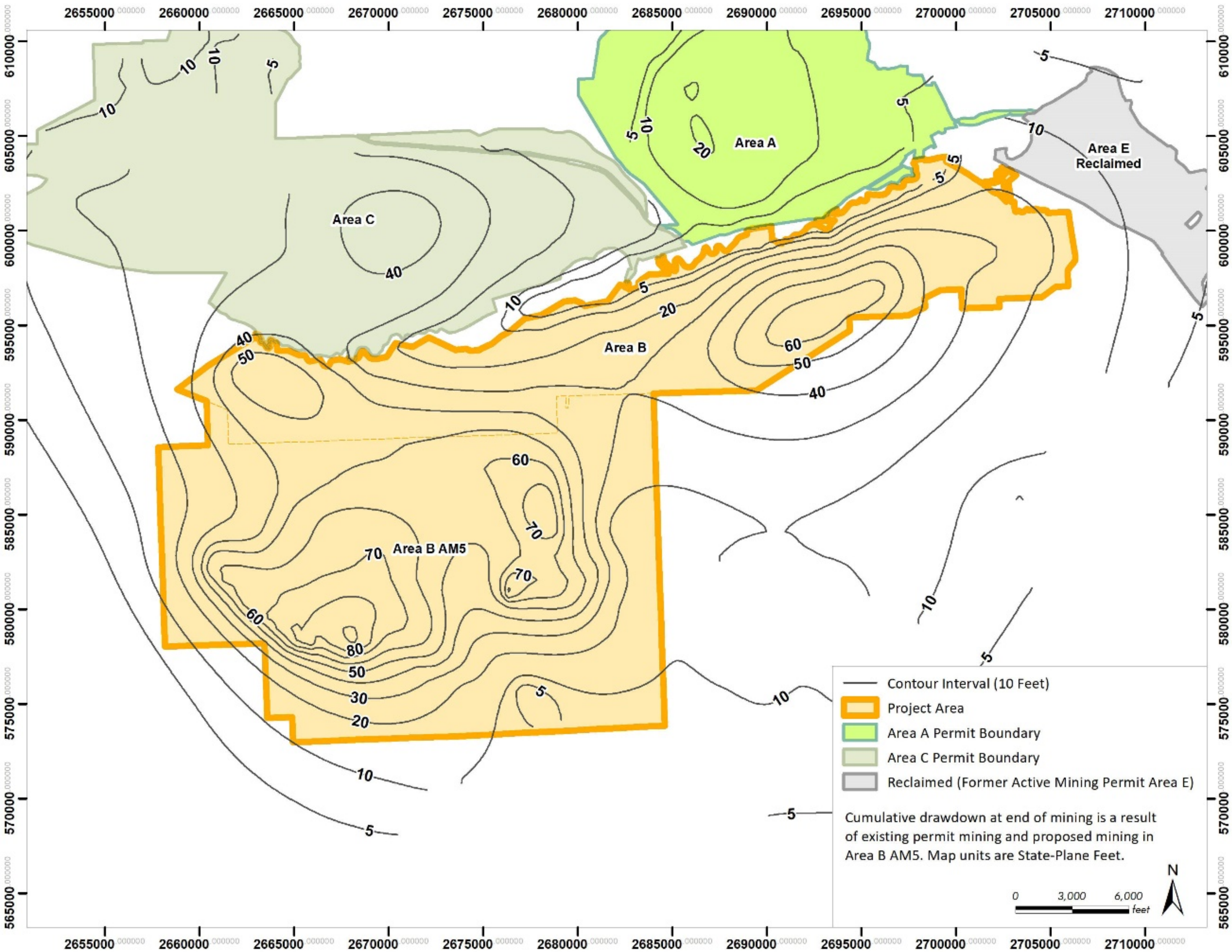

Figure 43. Ground Water Drawdown in the Rosebud Coal at End of Mining.

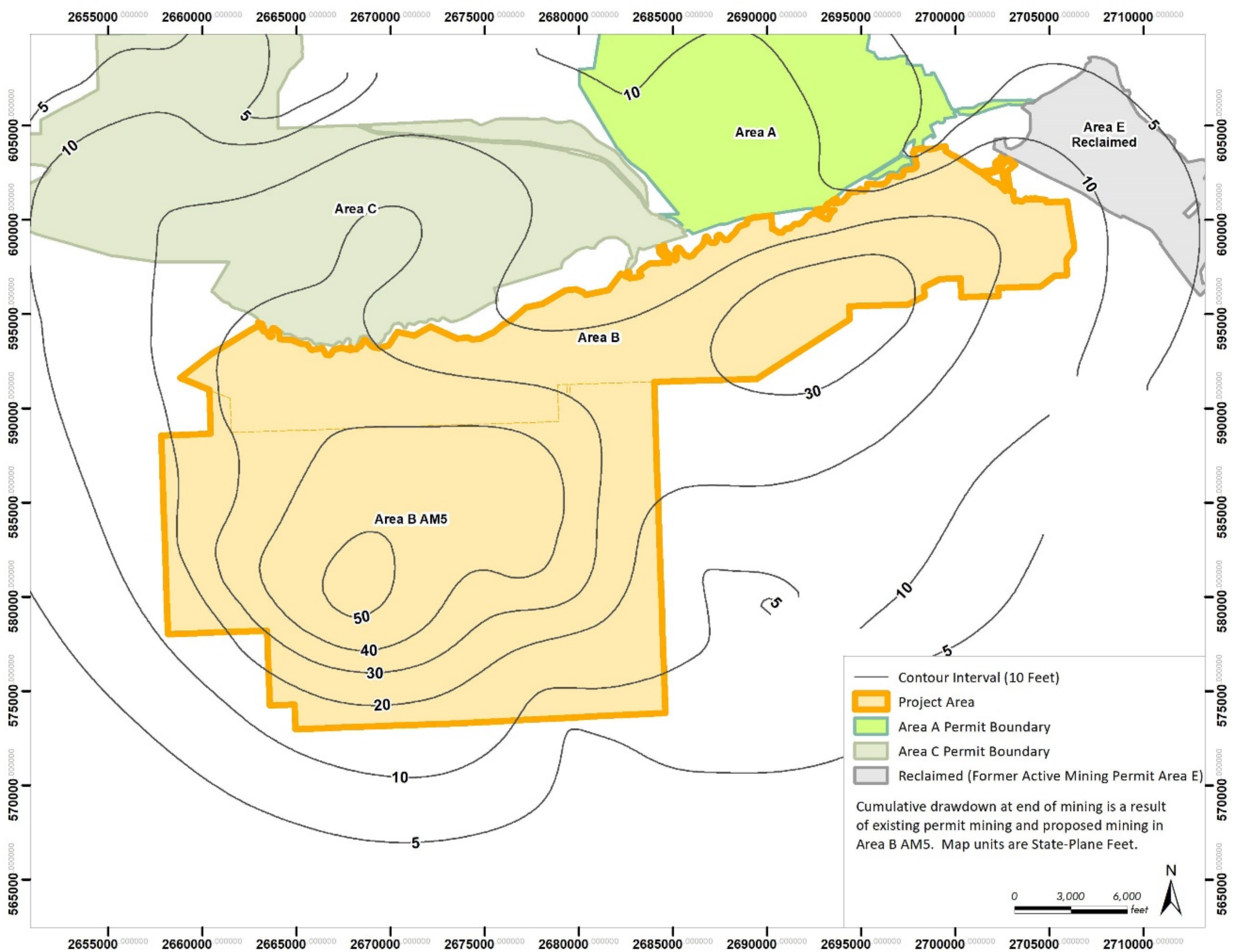

Figure 44. Ground Water Drawdown in the McKay Coal at End of Mining.

Table 64. Impact on Identified Springs in the Project Area.

Spring	Ground Water Source	Likely to Be Impacted	Potential Impact During Mining	Potential Impact Postmining
SP-300	Alluvium/Overburden	Yes	Spring removed during mining	Spring removed during mining
SP-301	Overburden	Yes	Spring removed during mining	Spring removed during mining
SP-302	Alluvium/Overburden	Yes	Spring removed during mining	Spring removed during mining
SP-304	Overburden	Yes	Spring removed during mining	Spring removed during mining
SP-305	Alluvium/Overburden	Yes	Spring removed during mining	Spring removed during mining
SP-306	Spoil	Yes	Likely impacted, spring located in Big Sky Mine spoil at edge of AM5 mining area	Likely impacted
SP-307	Overburden	Yes	Spring removed during mining	Spring removed during mining
SP-308	Overburden	Yes	Spring removed during mining	Spring removed during mining
SP-309	Overburden	Yes	Spring removed during mining	Spring removed during mining
SP-310	Overburden	No	Impact not likely, outside of the Project area in Rape Coulee	Not likely to be impacted
BGDSG	Overburden	No	Impact not likely, outside of proposed mining area	Not likely to be impacted

Source: Application Appendix B and Appendix O.

Areas of clinker would not be disturbed except for scoria pits where clinker would be mined for use as road material. Clinker deposits are typically areas with high infiltration rates and provide significant recharge to the subsurface. Water entering the clinker may discharge to drainages as springs, or slowly discharge to lower-permeability units such as overburden and possibly the Rosebud Coal. Clinker deposits left unmined would continue to provide recharge to the subsurface and springs, while those deposits that would be mined would be reclaimed using more permeable materials so there was no reduction of infiltration in the areas mined.

Postmining Period – Secondary Impacts

The postmining impacts on ground water quantity would include a change in hydrologic characteristics of the overburden as it becomes spoil and the slow (greater than 50 years) recovery of ground water levels in the Project area.

Removal of the overburden and Rosebud Coal by mining would temporarily reduce lateral inflow to the alluvium of Lee and Richard Coulees immediately downstream of the Project mine pits until the pits are backfilled along with lowering ground water levels throughout the Project area. Ground water that currently discharges to the alluvium would be intercepted by pit dewatering during mining and would discharge to the reclaimed spoil placed in the pits after mining. Until the spoil is resaturated, less ground water would reach the alluvium. It is not known how much time would be required to resaturate the spoil, but the process is expected to require many decades due to the nature of the spoil (as discussed below). Ground water quality impacts are described below.

The overburden consists of a mixture of lithologies in a layered sequence. Removal and replacement of overburden would tend to homogenize the various lithologies, eliminating the higher hydraulic conductivity sandstone layers in the overburden. The result would be to mix fine-grained and coarse-grained material, leading to overall slightly lower horizontal hydraulic conductivity. According to the Application Appendix I, the spoil would be more isotropic than the undisturbed overburden, which is defined as having equal hydraulic conductivity in all directions. As a result, the vertical percolation rate would be greater than in the overburden (Application Appendix I), but the spoil would be less capable of transmitting ground water horizontally than the permeable sandstones in the original overburden. Replacement of spoil for the alluvium associated with Richard and Lee Coulees would result in lower transmissivity as the high transmissivity of the alluvium is replaced with the lower transmissivity of the spoil.

Assuming at least part of the resaturation process is due to vertical recharge from precipitation, ground water would begin to flow from higher topographic areas to lower topographic areas (toward stream channels). Springs may develop where the water table in the spoil intersects the surface, or discharge from the spoil may be sufficiently diffuse to be lost by evapotranspiration from the soil and vegetation. Due to removal of low permeability layers in the overburden and replacement with more homogeneous and isotropic spoil, it is unlikely that overburden-sourced springs that would be removed during mining would redevelop at the same locations in the postmine period. Springs would be most likely to redevelop where the spoil/interburden contact intersects the ground surface. The Rosebud Coal would be removed, and the nature of the overburden would be permanently changed due to removal and replacement during mining. Because portions of flowing water exist in Richard Coulee associated with springs, the location of pre-mining wet or flowing reaches within the permit area would likely change and may no longer flow in the reaches after mining activities.

Saturation of the spoil after mining would develop over time from lateral inflow from adjacent saturated strata and downward flow of infiltration from the surface. At the Big Sky Mine, spoil ground water recovery rates ranged from 0.06 to 1.01 feet per year with an average of 0.61 feet per year (Application Appendix O). Recovery rates for wells screened in spoil were calculated for various mining areas associated with the Rosebud Mine (Application Appendix O). At the Rosebud Mine, calculated spoil recovery rates were slightly higher for Area B (averaging 0.83 feet per year) in comparison to Areas A, C, D, and E, which ranged from 0.25 to 0.5 feet per year (Table 48 of Application Appendix O).

The Westmoreland Rosebud ground water model indicated that residual drawdown in the Rosebud and McKay Coals upgradient of the Project area would require more than 50 years to recover to pre-mine conditions (Application Appendix I). The Westmoreland Rosebud ground water model indicated that the maximum drawdown in the Rosebud Coal 50 years after the end of mining would be about 45 feet, indicating a maximum recovery of about 45 feet 50 years after the end of mining (**Figure 45**; Application Appendix I). The modeling also indicated that the maximum drawdown in the McKay Coal 50 years after the end of mining would be slightly more than 30 feet, indicating a maximum recovery of about 20 feet 50 years after the end of mining (**Figure 46**; Application Appendix I). For both the Rosebud and McKay Coals, the 5-foot drawdown contour would extend about 1 mile to the southwest 50 years after the end of mining but would be similar in extent to the south and southeast. Ground water modeling results of the full recovery steady state simulation following all mining indicates that residual drawdown of just more than 10 feet would persist in the Rosebud Coal /spoil and less than 5 feet would persist within the McKay Coal. This permanent change in ground water levels is a result of the different hydraulic properties of the spoil compared with the overburden/Rosebud Coal.

Wells determined to have the highest potential to be impacted include wells within the mine area that would be removed by mining, wells in the immediate vicinity of the mining, and wells to the south within the area of drawdown determined by the modeling (Application Appendix O). Excluding wells that would be removed by mining, well characteristics such as well depth, depth to water, pump location, and specific capacity of the well would determine if the drawdown experienced would negatively impact their use. Wells are not likely to be adversely affected unless the water level in the well is drawn down to the point that the required pumping column for the well cannot be maintained, which is specific to each well potentially impacted. In the event that a well is adversely impacted, it could be replaced with a deeper well as needed (Application Appendix O). Based on the well assessment outlined in Westmoreland Rosebud's Application (Appendix O Section 4.4.8), DEQ does not expect mining in the Project area to result in additional impacts on private wells outside the permit boundary. If any private wells unexpectedly became unusable, Westmoreland Rosebud would be required to replace the well. Westmoreland Rosebud has identified the Sub-McKay sandstones as the most likely suitable ground water source for any private wells that require replacement.

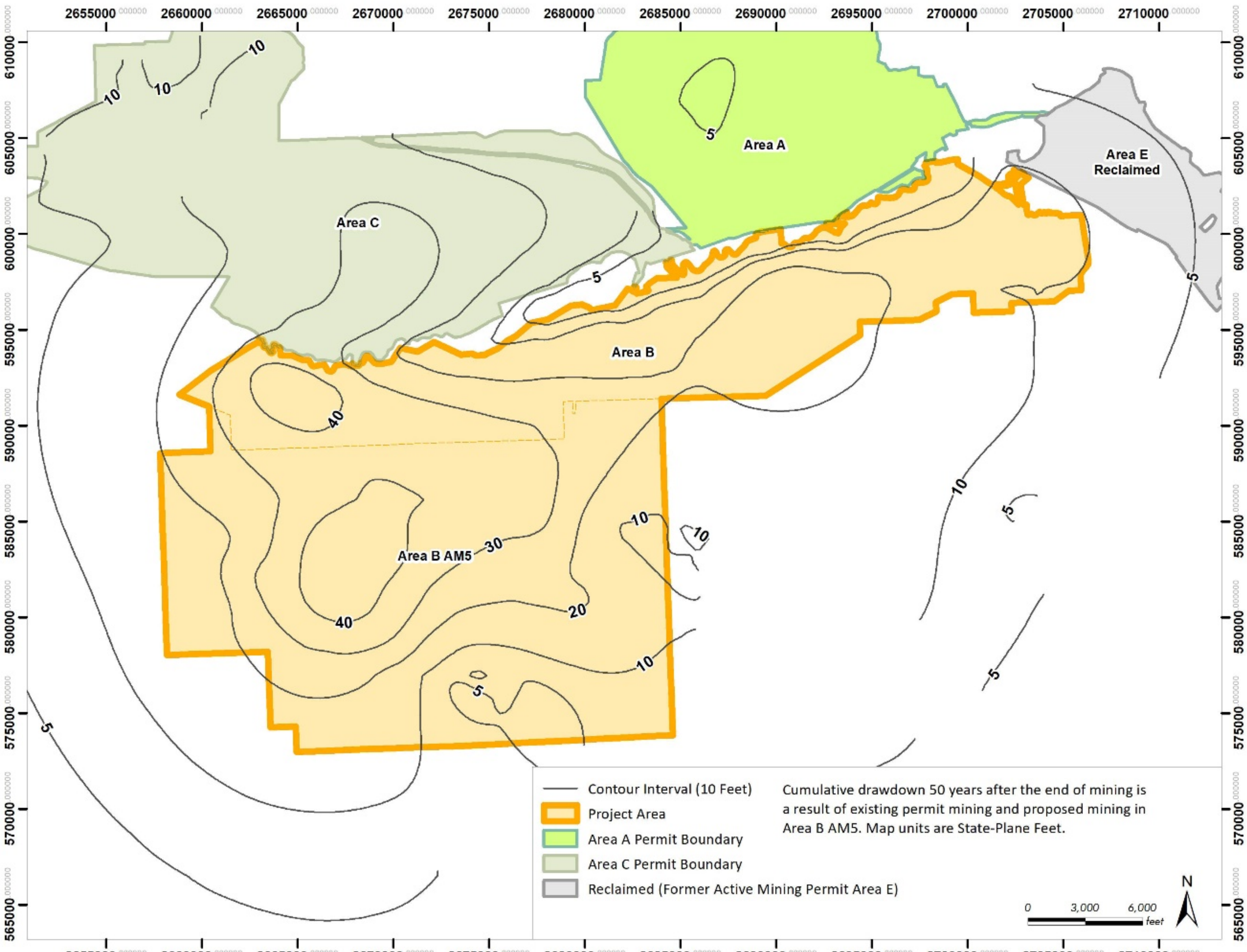

Figure 45. Ground Water Drawdown in the Rosebud Coal 50 Years after End of Mining.

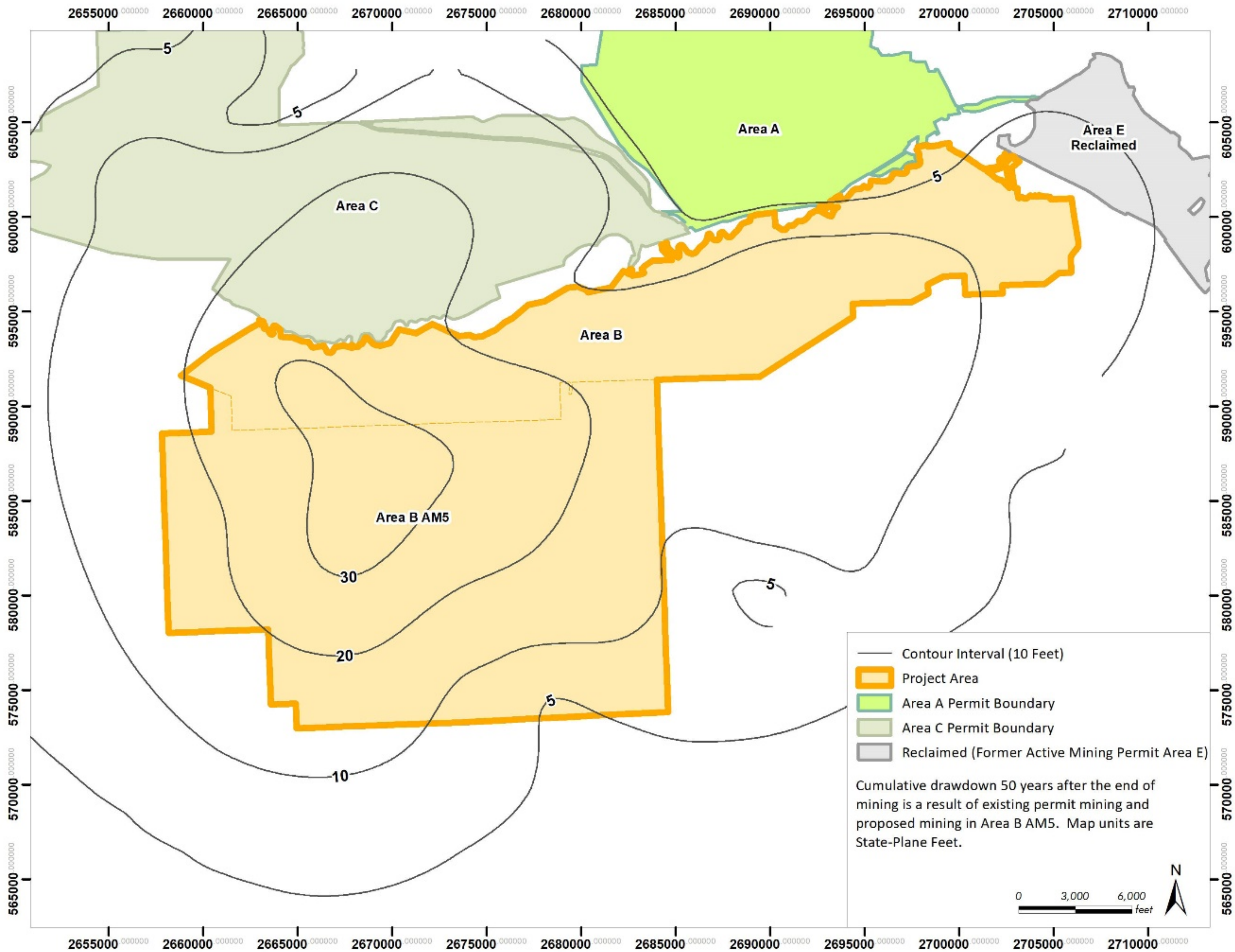

Figure 46. Ground Water Drawdown in the McKay Coal 50 Years after End of Mining.

Ground Water Quality

Mining Period – Direct Impacts

The primary change to ground water quality would result from removing the Rosebud Coal and replacing the coal with overburden as spoil. Removing and returning the overburden material to the pits as spoil would mix and homogenize the overburden lithologies, exposing fresh mineral surfaces to water during the resaturation process. As a result, soluble salts would dissolve into ground water, increasing TDS concentrations in ground water. Van Voast and Reiten (1988) reported that TDS concentrations in spoil ground water in southeastern Montana mine sites were between 50 and 200 percent higher than TDS concentrations in undisturbed aquifers. Bench scale test results by Van Voast and Reiten (1988) indicated that TDS concentrations in the backfill water would reach a maximum during initial saturation and then decrease to an equilibrium level.

Site-specific water quality data indicate that the average TDS concentration in spoil from Westmoreland Rosebud's mined Areas A, B, and C is 100 percent higher than the average overburden TDS concentration (Application Appendix O). The increased TDS concentrations are due to increases in the concentration of all major ions, but primarily calcium, magnesium, sodium, and sulfate (Van Voast and Reiten 1988).

Spoil TDS concentrations from Areas A, B, and C are highly variable, with concentrations ranging from 860 to 8,750 mg/L (Application Appendix O). As noted previously, based on Project area spoil well data, the median TDS of the spoil is less than that of the overburden (**Table 58** and **Table 59**). The variability is likely due to the variability of the overburden mineralogy and the somewhat random nature of spoil backfilling. Ground water in the Richard Coulee drainage is characterized by higher TDS concentrations than in the Lee Coulee drainage (Application Appendix O), so variability within the Project area exists. Consequently, some mine areas have shown rapid increases in TDS concentrations during about 40 years of data collection, while other areas show only small increases in TDS concentrations through the same period. Most data for spoil ground water collected from other Westmoreland Rosebud Mine sites have low nitrate concentrations (< 5 mg/L), but there are a few locations with nitrate concentrations that equaled or exceeded the standard (10 mg/L). In the AM5 PHC (Application Appendix O), it is stated that elevated nitrate plus nitrite concentrations have been detected in alluvial and spoil wells, with a maximum concentration in spoil (near Areas A, B, and C) of 34 mg/L at WS-100. The AM5 PHC (Application Appendix O) noted that elevated nitrate plus nitrite may have been due to ongoing saturation of spoil containing "residuals from ammonium-nitrate explosives used in blasting coal and overburden," with cattle also identified as another possible source for nitrate plus nitrite exceedances. The water quality of the spoil in Areas A, B, and C when monitored between 1978 and 2018 had exceedances in arsenic, cadmium, lead, nitrate, and zinc ground water standards, and concentrations of calcium, magnesium, manganese, sulfate, and TDS at times exceeded one or more of the recommended limits for livestock listed in **Section 3.7, Water Resources – Surface Water.** The exceedances of water quality standards in spoil were rare. Regarding the livestock recommended limits, pre-mining ground water concentrations within the Project area also show exceedances of one or more of the recommended limits for livestock for calcium, magnesium, manganese, sodium, sulfate, and TDS; therefore, these would also be expected to be exceeded at times in the spoil generated. However, due to the redox sensitivity of manganese, manganese exceedances in ground water may not be directly comparable to livestock recommended limits since exposure of ground water containing dissolved manganese to oxygen would precipitate out the manganese. As noted previously, of the material that would be removed during mining and replaced as spoil (alluvium and overburden), pre-mining Project area data also indicate rare exceedances of water quality standards for arsenic, cadmium, fluoride, and selenium. The pre-mining Project area data

exceedances indicate the potential for spoil exceedances of water quality standards would be low, although some spatial and temporal variability would be expected.

As noted above, the concentration trend for TDS over the 40-year data collection period varies significantly between locations, with some showing rapid and large increases and others showing minimal increases over the same period. After nearly 40 years of ground water sampling, there is no clear indication that TDS concentrations in the spoil have reached equilibrium or have shown decreases. According to Van Voast and Reiten (1988), about one pore volume of water must circulate through mine spoil before a pre-mining salt balance is restored. However, Van Voast and Reiten (1988) noted that this concept is valid only where there is no vertical recharge. Vertical recharge does occur in some areas of the Project area, particularly in areas of clinker deposits located in the topographic highs between drainages and in portions of the valley bottoms along the drainages. In semi-arid environments where the potential evaporation rate exceeds the annual precipitation, it is not uncommon for there to be net vertical recharge to ground water under certain conditions, such as unusually wet periods. Therefore, one or two pore volumes of ground water in the Project area may not be sufficient to reach equilibrium with respect to water quality of the spoil. Based on the spoil water quality from Areas A, B, and C, it will require more than 40 years postmining to reach equilibrium in Project area spoil.

It is unlikely that ground water quality in upgradient areas would be affected by mining because the regional flow direction is toward the mined areas.

Postmining Period – Secondary Impacts

During the postmine period after resaturation of the spoil, flushing of the spoil would proceed generally from northwest to southeast as the ground water gradient is reestablished. Within the Lee Coulee drainage, ground water would flow from the spoil to a small portion of undisturbed strata and then into spoil from the Big Sky Mine. Within the Richard Coulee drainage, ground water would flow from spoil to undisturbed strata located downgradient of the mining area. Physical processes such as dilution and dispersion, and geochemical processes such as sulfate reduction, mineral precipitation, adsorption, and cation exchange within the undisturbed strata receiving the ground water affected by the spoil has the potential to reduce TDS concentrations within the undisturbed strata ground water (Application Appendix O).

During the postmine period, alluvial ground water TDS concentrations near the mine would likely increase from pre-mine concentrations due to the expected higher TDS concentration in spoil ground water. Overburden ground water TDS concentrations within Lee Coulee are less than the combined TDS average for Areas A, B, and C, while the opposite is found for Richard Coulee (Application Appendix O). Because the average TDS concentration in Richard Coulee overburden ground water is higher compared to other mine areas, it is reasonable to assume that the average TDS concentration in Richard Coulee spoil ground water may be higher than observed in mine Areas A, B, and C (Application Appendix O). The AM5 PHC (Application Appendix O) predicted an average TDS concentration in the Richard Coulee drainage spoil of 8,320 mg/L and for the Lee Coulee of 2,546 mg/L. Since the majority of spoil ground water will discharge to Lee Coulee and Richard Coulee alluvium, impacts on those drainages are expected. Based on Big Sky Mine impacts on the downgradient Lee Coulee alluvial ground water TDS concentrations, the AM5 PHC (Application Appendix O) predicted that concentrations in the Richard Coulee alluvium at the mine permit boundary would increase somewhere between 10 and 40 percent. A mass balance analysis performed for the AM5 PHC (Application Appendix O Attachment R) calculated a TDS increase of 27.7 tons per year into the alluvium from both Lee (4.2 tons per year) and Richard (23.5 tons per year) Coulees; and, when compared to the Rosebud Creek mass load of 22,181 tons per year, the impact of mining the Project area would result in a trivial increase of TDS in Rosebud Creek alluvial ground water of 8 percent and in Rosebud Creek surface water of 0.1 percent or 0.9 mg/L. The AM5 PHC

(Application Appendix O Section 4.4.8) noted ground water quality changes downgradient from mining would not impact existing and viable beneficial uses to support the primary pre-mine uses of domestic and livestock watering. In the event that a well is adversely impacted, Westmoreland Rosebud would be required to provide a suitable replacement source.

3.6.3.3 Cumulative Impacts

The analysis area for cumulative ground water impacts comprises all of the Rosebud Mine and Big Sky Mine, including areas previously and presently mined. A review of ground water–level data from the various mined permit areas indicates that ground water drawdown resulting from mine dewatering and removal of the Rosebud Coal would be limited mainly to areas near the mine pit high walls and would not extend any significant distance from each specific permit area. Some alluvial wells in the East Fork Armells Creek alluvium appear to have responded to dewatering/mining activities in nearby areas. The majority of overburden wells have not responded to dewatering/mining activities. Variable responses have been observed in Rosebud Coal wells. Wells screened in the hydrogeologic zones beneath the Rosebud Coal have generally not responded to dewatering/mining activities (Application Appendix O). The AM5 PHC (Application Appendix O) noted that the radius of influence of mining activities on water levels seems to be relatively greater in southern areas of the Area B and Area B extension, which is explained by the higher degree of confinement of the Rosebud Coal and underlying strata in the southern portions of the mine compared to the northern mine portion along with the structural base of the Rosebud Coal decreasing southward in this portion of the mine. Ground water level recovery rates average about 6 inches per year for all Rosebud Mine areas and ongoing mining activities in Areas A, B, and C are likely impacting the rate of recovery of spoil ground water (Application Appendix O). The extension of mining as proposed in the AM5 Amendment would likely delay the ground water level recovery accordingly (Application Appendix O).

The Area F permit area is too distant from the Project area to affect ground water levels in the Project area once it is in production or to overlap offsite ground water drawdown. Because the total drawdown during mining would be limited by the depth of the Rosebud Coal and the coal would eventually be removed from the Project area, there would not be any long-term cumulative impacts of overlapping drawdown cones from Area F and Area B AM5 in the Rosebud Coal.

TDS is the main indicator parameter of spoil impacts on water quality. In overburden well data from Areas A, B, and C, TDS impacts have generally not been observed (Application Appendix O). Within wells screened within the Rosebud Coal and interburden from Areas A, B, and C, with some localized exceptions, TDS increases are generally not observed (Application Appendix O). Evidence of water quality impacts from resaturating spoil in the other previously mined permit areas are not generally observed in the ground water data collected below the Rosebud Coal in the McKay and Sub-McKay (Application Appendix O) except in instances of a thin interburden thickness. In Areas A and B, no water quality impacts were observed in the interburden (Application Appendix O). East Fork Armells Creek flows to the east, dividing Areas B and C to the west and Areas B and A to the east. Alluvial ground water wells show an increasing trend in TDS from west to east with the highest concentrations observed in alluvial ground water near the city of Colstrip (Application Appendix O). Along the Rosebud Creek drainage, mining within the Richard Coulee would be the first to contribute an increased TDS load to the Rosebud Creek alluvial ground water due to its upgradient location, followed by mining within the Lee Coulee, which would cumulatively add to TDS loads from the Big Sky Mine and further downstream TDS loads from the previously mined areas, existing Area B, further downstream TDS loads from the previously mined Areas D and E, and a historic mining area (Pit 6). The cumulative predicted increase in TDS loads at the mouth of Rosebud Creek from the historic and reasonably foreseeable mining (including Big Sky Areas A and B, Rosebud Mine Areas D, E, and Pit 6, and pre-law Burlington Northern mining) was calculated to be 1.7 percent in an average water year (DSL and OSM 1988). The TDS contribution to

Rosebud Creek alluvium from the AM5 expansion area is calculated to increase the TDS load of the Rosebud Creek alluvial ground water 8 percent and increase Rosebud Creek surface water TDS concentration, assuming complete mixing, 0.1 percent (Application Appendix O Attachment R).

Other past, present, and future mining under concurrent consideration activities in southeastern Montana, as described in **Section 3.1.4, Actions Considered in Cumulative Impacts Analyses**, are too distant to have any cumulative impact with respect to ground water level changes in the Project area.

3.6.3.4 Unavoidable Adverse Impacts

Unavoidable adverse impacts on overburden and Rosebud Coal ground water quantity would occur as ground water seeped into the mined pits during mining. At the end of mining, backfilling of the mine pits with spoil would result in unavoidable adverse impacts on ground water quality (see **Postmining Period – Secondary Impacts** under **Ground Water Quality**).

3.6.3.5 Irreversible and Irretrievable Impacts

The Rosebud Coal aquifer within the mine pit footprint would be irreversibly and irretrievably lost due to mining. The coal would be replaced with spoil, which would have very different hydrologic characteristics and water quality.

Springs in the Project area would be irreversibly and irretrievably lost due to mining. It is possible that after the spoil resaturates, new springs may appear along the various drainages.

Ground water quality in the saturated zones that would develop in the spoil would require an undetermined but significant amount of time (greater than 50 years) to reach equilibrium and begin to improve. Water quality in the spoil would likely never return to exactly the same as pre-mining quality; as defined under MEPA, this would be a commitment of resources that cannot be reversed except over an extremely long time period.

3.7 WATER RESOURCES – WATER RIGHTS

3.7.1 Introduction

This section describes surface water and ground water rights that occur in and near the analysis area and that may be affected by mine operations in the Project area; the analysis area is defined below in **Section 3.7.1.2, Analysis Area and Methods**. This section includes regulatory requirements to protect water rights. A list and description of surface water and ground water rights in the analysis area is provided in **Appendix B**.

This section also analyzes the environmental consequences including direct, secondary, and cumulative impacts of the No Action Alternative (Alternative 1) and the Proposed Action (Alternative 2) with respect to water rights.

3.7.1.1 Regulatory Framework

Federal Requirements

SMCRA requires that surface coal mining and reclamation operations protect surface and ground water resources, including water rights. DEQ operates an approved state program under SMCRA and therefore has primary jurisdiction over the regulation of surface coal mining and reclamation operations on nonfederal and non-Indian lands within the state.

State Requirements

Water rights in Montana are administered in accordance with laws that were in effect at the time the rights were acquired. Prior to July 1, 1973, water 'use rights' were acquired by appropriating and beneficially using water, generally without government approval or written records. The priority date of 'use rights' generally coincides with the date that the water was first put to beneficial use.

The Montana Water Use Act of 1973 (1973 Act) established a permit system to appropriate new beneficial uses of water. The 1973 Act requires that any person, agency, or government entity intending to acquire new or additional water rights or to change an existing water right in the state obtain a beneficial water use permit or change authorization before commencing to construct a new or additional diversion, withdrawal, impoundment, or water distribution works for appropriations of ground water or surface water. The 1973 Act gives authority to administer water rights in Montana to the Montana Department of Natural Resources and Conservation (DNRC), Water Resources Division, Montana Water Rights Bureau (Water Rights Bureau). The Water Rights Bureau assures the orderly appropriation and beneficial use of Montana’s waters. The Water Rights Bureau administers the 1973 Act and assists the Water Court with the adjudication of water rights.

An application for a Beneficial Water Use Permit requires proof that there is water physically and legally available at the proposed point of diversion in the amount requested (ARM 36.12.1702 and 36.12.1705). Senior water rights have an earlier priority date, and claimants who hold them have a higher priority to divert water from a stream or waterbody than those with more junior rights. Under the 1973 Act, if a senior water user would be adversely affected by a new use, the application is denied unless a mitigation plan exists with specific conditions that would eliminate or mitigate potential adverse impacts on senior water rights holders. Example mitigations could include diversion restrictions based upon timing or flow conditions, or upstream replacement water sources to offset new appropriations.

An exception from the law described above allows rural domestic or agricultural water users the opportunity to drill a small ‘exempt’ well (withdrawing less than 35 gpm and 10 acre-feet per year) without obtaining a permit. This was intended for small, dispersed uses of water with little potential to impact existing rights (Kolman 2012).

Waste and contamination of ground water is prohibited under the 1973 Act (85-2-505, MCA), which prevents contamination of other waters by produced ground water, and requires application of ground water to an approved beneficial use. A specific exclusion applicable to ground water withdrawn for the sole purpose of permitting mine operations or to preserve utility of the mine without further beneficial use is provided in 85-2-505(c), MCA.

DEQ regulates permitting and operation of surface coal mines in Montana under the authority of MSUMRA (82-4-221 *et seq*., MCA) and its implementing rules (ARM 17.24.301-1309). ARM 17.24.648 requires Westmoreland Rosebud to replace the water supply of any owner of interest in real property who obtains all or part of his water supply for domestic, agricultural, or other uses from surface or ground water if such supply has been affected by contamination, diminution, or interruption proximately resulting from mine operations. If a water supply needs replacement, and cannot be replaced under the exemption described above, the water rights owner would need to complete one of the following (Elison, pers. comm. 2018):

- If the well would continue to pump water from the same aquifer, but the well needed to be deepened to increase its yield, the appropriator would need to file a well replacement form with the Water Rights Bureau.
- If ground water needed to be acquired from a different aquifer, such as a change from the Rosebud Coal aquifer to the Sub-McKay aquifer, the water rights owner would need to file a change of appropriation form with the Water Rights Bureau.
- If a surface water right needed to be replaced by ground water, such as from the Sub-McKay aquifer, a new water right permit would need to be acquired from the Water Rights Bureau. For replacement of a surface stock water supply, water could be pumped to a stock tank or pond and then allowed to flow downstream for stock use.

Local Requirements

Water rights are regulated and protected at the state and federal levels. There are no local water rights requirements.

3.7.1.2 Analysis Area and Methods

Analysis Area

Surface water and ground water impacts from mining activity, described in **Section 3.5, Water Resources – Surface Water** and **Section 3.6, Water Resources – Ground Water**, include changes in surface water quantity or quality for springs, seeps, streams, and ponds, and changes in ground water quantity and quality and may induce impacts on or changes to surface water rights and ground water rights. The analysis areas associated with surface water rights and ground water rights are the same impact analysis areas described and depicted in the sections named above, and specifically encompass surface watersheds extending through and downstream from the 15,153-acre proposed Project area that receives surface water drainage from the 11,202-acre disturbance area as modified by AM5 (**Figure 47**). This analysis area primarily includes the Richard Coulee and Lee Coulee drainages of the Rosebud Creek watershed, as well as disturbance areas within the existing Area B permit boundary. The analysis also includes all areas where ground water drawdown of 5 feet or greater was predicted by Westmoreland

Rosebud's ground water model. **Figure 48** depicts surface water rights and **Figure 49** depicts ground water rights in and near the analysis area.

Analysis Methods

Impacts on spring water rights were evaluated based on the location of the water rights in or near disturbed areas within the analysis area and the source of water to the springs. Possible impacts on surface water rights due to changes in stream flow or water quality were evaluated based on the locations of the points of diversion for these existing water rights relative to where surface water would be impounded during mining, and where streams have baseflow from ground water discharge. Impacts on ground water rights were evaluated based on the location of the ground water rights with respect to the drawdown contours and the source of water to the wells (see **Section 3.6, Water Resources – Ground Water**), predicted by Westmoreland Rosebud's ground water model (Application Appendices I-A and I-B).

Potential impacts on water rights, including the volume and timing of withdrawals, are tied to hydrologic and water quality changes associated with mining and reclamation activities. Impacts on ground water and surface water hydrology and water quality are discussed in greater detail in **Section 3.5, Water Resources – Surface Water** and **Section 3.6, Water Resources – Ground Water**.

3.7.2 Affected Environment

Surface water and ground water rights have been compiled for portions of Township 1 North, Range 40 East; Township 1 North, Range 41 East; Township 1 South, Range 40 East; and Township 1 South, Range 41 East in Rosebud County (Application Appendix O; MBMG 2018; DNRC 2018). The analysis area is within this area. **Appendix D** provides a list of the 117 surface water and ground water rights on record with the Water Rights Bureau that are within the analysis area as well as downgradient water rights that may be affected by mine operations. Some water rights are listed more than once to account for multiple points of diversion. Nearly all of the 117 water rights are for stock water use; a few are for irrigation, domestic, and industrial use. Forty-one percent of the rights are for ground water diversions. Twenty-one percent of the rights are for spring water diversions. Twenty-four percent of the surface rights are for on-stream reservoirs for stock watering. Stock water rights are located on East Fork Armells Creek and Rape, Lee, Richard, and Miller Coulees, and on tributaries to East Fork Armells Creek and Rape, Lee, and Richard Coulees (see **Section 3.5, Water Resources – Surface Water**). Twenty-one percent of the water rights are owned by Big Sky Coal Company, and 12 percent of the water rights are owned by Booth Land & Livestock Company, most of which are for stock use. Westmoreland Rosebud owns 12 water rights in this area, all for stock use. Existing surface water rights in and near the analysis area, which include both direct diversion and storage rights, are shown on **Figure 48**, and existing ground water rights in and near the analysis area are shown on **Figure 49.**

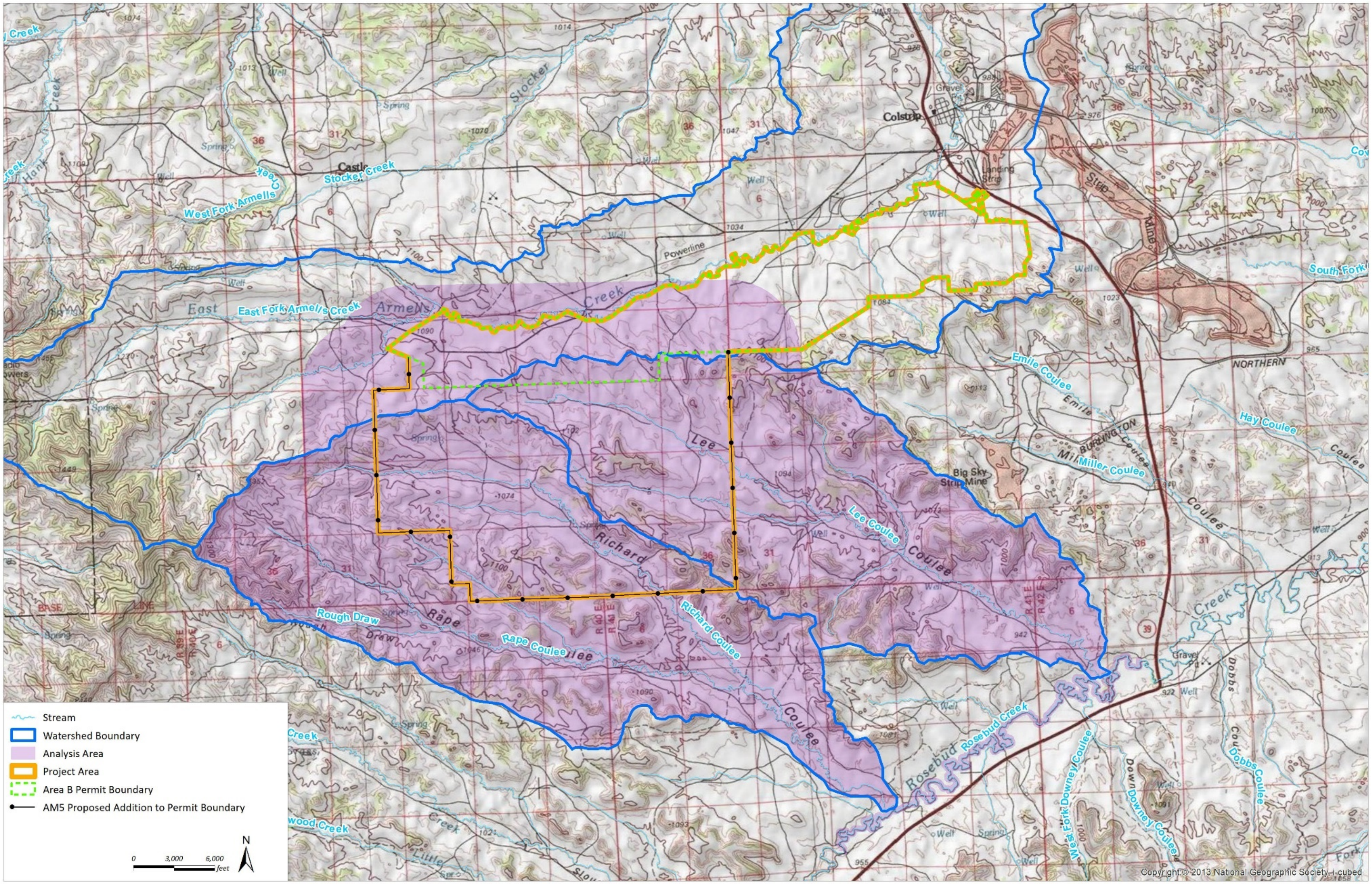

Figure 47. Water Rights Analysis Area

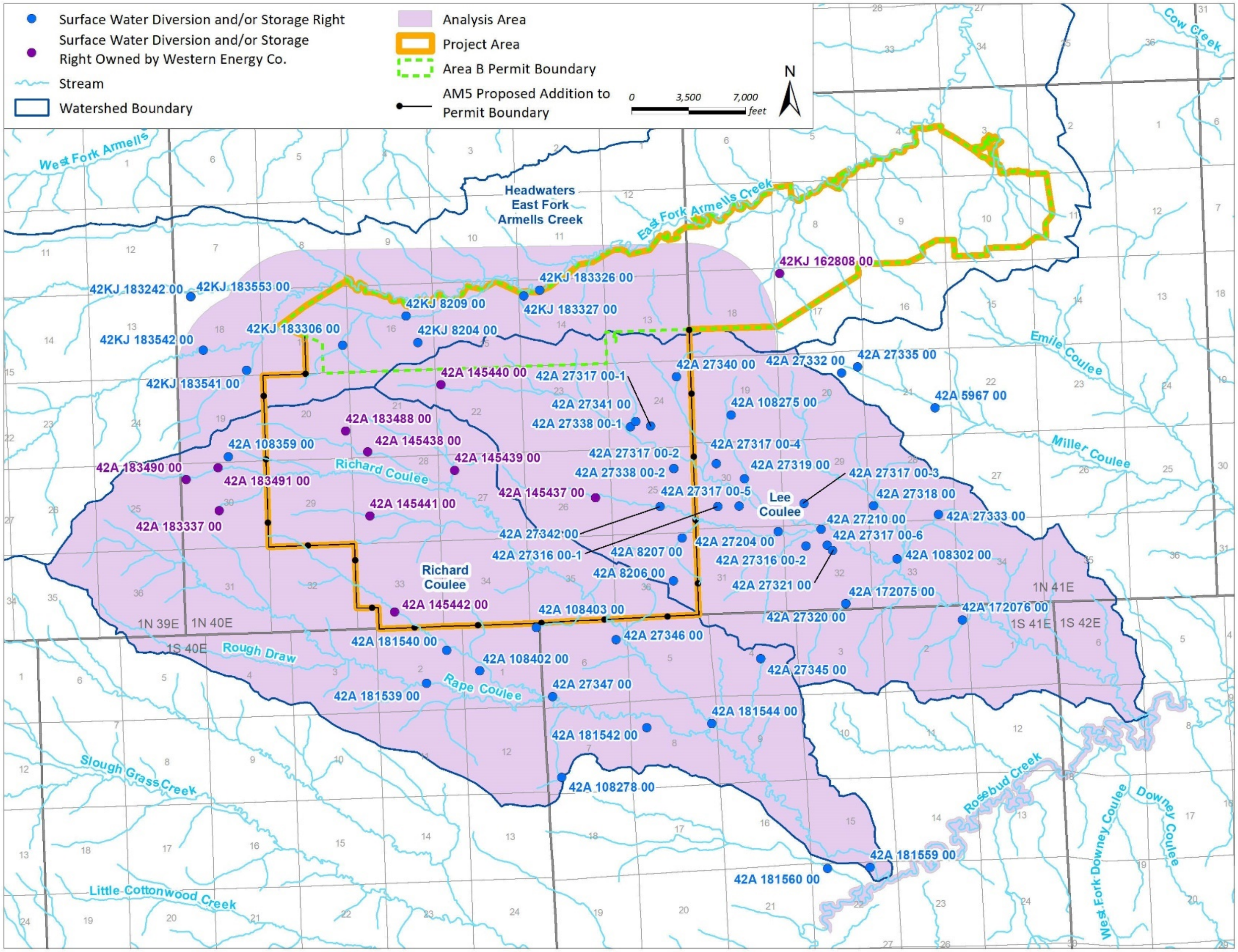

Figure 48. Surface Water Rights in and near the Analysis Area.

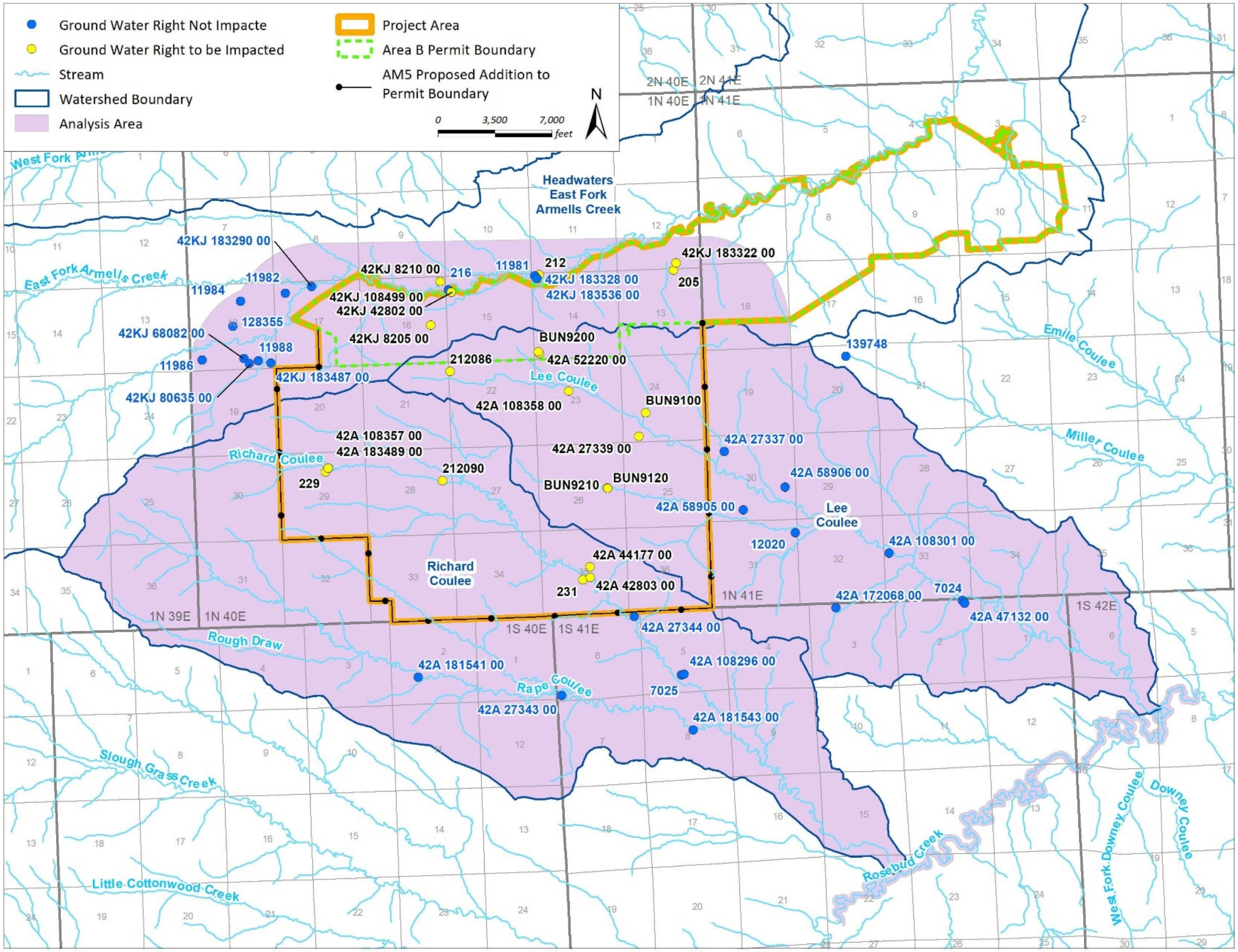

Figure 49. Ground Water Rights in and near the Analysis Area.

3.7.3 Environmental Consequences

3.7.3.1 Alternative 1 – No Action

Under the No Action Alternative, the AM5 amendment (proposed Project) would not be permitted. Westmoreland Rosebud would complete mining and reclamation in the Area B permit area according to its currently approved operating permit. Mining is permitted in Area B until 2030, and initial stages of reclamation would be completed within 2 years of the cessation of mining. There would be no Project impacts on water rights described in **Section 3.7.2, Affected Environment**, because any changes associated with the proposed Project would not occur.

The No Action Alternative would not change the status of the existing Area B permit area or other permit areas, including Area F, of the Rosebud Mine (**Section 2.2, Existing Operating Permits, Disturbance, and Reclamation**), nor would it affect the federal coal lease MTM 80697 (tracts in Areas B and C) modification application, which is currently being evaluated by the BLM (**Section 3.1.4.2, Related Future Actions**). Impacts on water rights due to current and future mining and reclamation in the existing Area B permit area and other permit areas of the Rosebud Mine would continue.

3.7.3.2 Alternative 2 – Proposed Action

Direct Impacts

There are over two dozen surface water rights downgradient from the Project area within the Lee and Richard Coulee drainages, two of which are for irrigation (42A 27204 00 and 42A 27210 00) and the remaining of which are for stock watering. Westmoreland Rosebud conducted an impact assessment of 62 surface water rights in and around the AM5 proposed addition to the permit boundary (Application Appendix O, Table 36). Of the 62 surface water rights, 42 are not anticipated to be impacted due to their location in drainages or due to remaining water sources that are expected to provide adequate supply. Short-term water quantity (no water quality) impacts are possible in 12 of the 62 surface water rights; all 12 constitute stock use directly from the source. Of the 62 surface water rights, 8 are anticipated to be impacted by the Project due to their location within the disturbance area including seven dams (42A 145437 00, 42A 145438 00, 42A 145439 00, 42A 145440 00, 42A 145441 00, 42A 8207 00, and 42KJ 183306 00) and one spring (42A 183488 00), all used for stock purposes.

The following sections provide detailed descriptions of water rights impacts.

Water Rights for Springs

There are 14 spring rights used for stock watering in the impact analysis area in Richard and Lee Coulee drainages (**Figure 48** and **Table 65**). None of the springs listed in **Table 65** are the same as any of the springs that have been monitored by Westmoreland Rosebud (see **Section 3.5, Water Resources – Surface Water**). Of the 14 spring water rights listed in **Table 65**, 13 are not likely to be impacted because of their location upgradient or outside of the mining area. One of the spring water rights listed in **Table 65** may experience a temporary reduction of flow rate, nearby ground disturbance, or removal of its water source. The process of addressing potential impacts is described in the section **Replacement Water Sources and Replacement Process**.

Table 65. Potential Impacts on Spring Water Rights in the Analysis Area.

DNRC Water Right Number	Water Source	Potential Impact During Active Mining	Potential Impact Postmining
42A 108359 00	Overburden	Not likely, upgradient of Project area	Not likely, upgradient of Project area
42A 108402 00	Overburden	Not likely, outside of mining area	Not likely, outside of mining area
42A 108403 00	Overburden	Not likely, outside of mining area	Not likely, outside of mining area
42A 181540 00	Overburden	Not likely, outside of mining area	Not likely, outside of mining area
42A 183488 00	Overburden	Possible, temporary reduction of flow rate and nearby ground disturbance (near haul road); water source could be removed (near edge of mine passes)	Possible, water source could be removed and may not return (near edge of mine passes)
42A 183490 00	Overburden	Not likely, upgradient of Project area	Not likely, upgradient of Project area
42A 183491 00	Overburden	Not likely, upgradient of Project area	Not likely, upgradient of Project area
42A 27318 00	Unknown	Not likely, outside of mining area	Not likely, outside of mining area
42A 27319 00	Unknown	Not likely, outside of mining area	Not likely, outside of mining area
42A 27333 00	Rosebud Coal	Not likely, outside of mining area	Not likely, outside of mining area
42A 27345 00	Overburden	Not likely, outside of mining area	Not likely, outside of mining area
42A 8206 00	Overburden	Not likely, outside of mining area	Not likely, outside of mining area
42KJ 183242 00	Unknown	Not likely, upgradient of Project area	Not likely, upgradient of Project area
42KJ 183553 00	Unknown	Not likely, upgradient of Project area	Not likely, upgradient of Project area

Surface Water Rights

During mining in Richard and Lee Coulees, runoff from disturbed areas would be detained and contained in mining pits or sediment-control structures, resulting in a loss of water downstream. Richard and Lee Coulees and some of their tributaries in the Project area would be mined, temporarily reducing ephemeral stream flows. Impounded water would be discharged at times, after sediment settling treatment, from the sediment ponds to MPDES discharge points, changing the timing of water availability to downstream surface water users for precipitation events less than the 10-year, 24-hour defined event, or as the result of a planned discharge event. Some of the impounded water would be used for dust control or would evaporate or infiltrate. In addition, removal of the alluvium/colluvium, overburden, and Rosebud Coal within the Project area drainages would likely result in reduced baseflow in nearby downstream reaches during and after mining until ground water levels have approached equilibrium. Impacts on stream flow are described in greater detail in **Section 3.5, Water Resources – Surface Water**. Due to the ephemeral nature of stream flow in Richard and Lee Coulees, it is not possible to quantify the impacts on water rights for these drainages. The process of addressing potential impacts is described in the section **Replacement Water Sources and Replacement Process**.

There is one surface water right (stock water) on East Fork Armells Creek adjacent to Area B with a 20.3-square-mile (13,000-acre) drainage area contributing flow to the location of the water right. Because AM5 disturbance within the East Fork Armells Creek watershed is limited to 125 acres of haul road with sediment ponds and traps that would only temporarily detain flow, it is expected that impacts on these water rights would not be measurable. The impact on any surface water right on East Fork Armells Creek as a result of mining would be short-term.

Twelve existing ponds are used as livestock water impoundments, and all except two of the ponds have year-round surface water rights with allowable diversion volumes of 30 gallons per day per animal (Montana Department of Natural Resources & Conservation 2018; Application Appendix O, Attachment G). Stock ponds located within the disturbance area would be lost due to mining. Water supply to ponds located near mining disturbance within the permit boundary may be potentially disrupted due to:

- Reductions in stream flow as a result of impounding water during mining
- Reductions in stream flow due to the loss of mined sections of the watersheds
- Reductions or elimination in ground water discharge from mined material to receiving streams

As discussed in **Section 3.5, Water Resources – Surface Water**, the water quality of the stock ponds may be degraded as a result of mining. The process of addressing potential impacts is described in the section **Replacement Water Sources and Replacement Process**.

Ground Water Rights

Ground water wells located within the disturbance area, described in **Section 3.6, Water Resources – Ground Water**, would be removed as a result of mining. Westmoreland Rosebud's ground water model (Application Appendix I) estimated that the maximum drawdown in the Rosebud Coal at the end of mining would be about 90 feet in the Richard Coulee mining area and about 70 to 80 feet in the Lee Coulee mining area. Maximum drawdown in the McKay Coal would be 47 feet broadly located between Richard and Lee Coulees (see **Section 3.6, Water Resources – Ground Water**). Ground water levels at the end of mining would decrease around the Project area to a maximum extent of 5 feet of drawdown at a distance typically about 1 to 2 miles with slightly greater distance in the downgradient southeastern direction. Ground water drawdown in the Rosebud and McKay Coals outside of the Project area to the southeast would reduce ground water levels in private wells screened in one or both of the coal units. Whether or not water level decreases of between 5 and 10 feet in private wells in this area as a result of mining would impair the owner's ability to produce water would depend on the characteristics of the individual wells such as depth, depth to water, pump location, and specific capacity.

Westmoreland Rosebud provided an impact assessment of 48 individual wells in proximity to the Project area (Application Appendix O, Table 51). Due to multiple sources of well data, and limited information for some wells, some wells may be represented by more than one record. In general, wells would not be affected by mining if they are located outside the permit area or if they are screened in the Sub-McKay unit. Of the 48 wells, 16 (42A 108357 00, 42A 108358 00, 42A 183489 00, 42A 27339 00, 42A 42803 00, 42A 44177 00, 42A 52220 00, 42KJ 183322 00, 229, 231, 212086, 212090, BUN9100, BUN9120, BUN9210, and BUN9200) would be impacted by Project mining as they are either anticipated to be mined out or are in the disturbance area. Impacts for some wells may not be assessable due to a lack of information on the screened interval, static water level, or water column. No wells outside the disturbance area are anticipated to be impacted by drawdown or water quality impacts. The process of addressing potential impacts is described in the section **Replacement Water Sources and Replacement Process**.

Secondary Impacts

Water Rights for Springs

Secondary (postmining) impacts on spring water rights are described in **Table 65**, which shows that 42A 183488 00 (SP-77) is the only spring water right near the edge of mine passes and may lose its water source. The process of addressing potential impacts is described in the section **Replacement Water Sources and Replacement Process**.

Surface Water Rights

After mining, when the site was reclaimed and the hydrologic balance restored in accordance with MSUMRA requirements for Phase IV bond release (ARM 17.24.1116(6)(d); see also **Section 1.6.4, Bond Release**), impacts on surface water rights would diminish and would likely return to near pre-mine

conditions. The process of addressing potential impacts is described in the section **Replacement Water Sources and Replacement Process**.

Stock ponds with water rights located near the disturbance area whose source of supply was runoff would return to near pre-mine conditions after reclamation was completed and the hydrologic balance restored to the extent possible. The ponds would fill when precipitation events occurred, resulting in stream flow and direct runoff to the ponds. For stock ponds located near the disturbed area whose source of supply was at least in part spring flows, there would not be a return to pre- mine conditions. Stock ponds for livestock and wildlife watering in the Project area would be reestablished or mitigated by Westmoreland Rosebud during postmining reclamation. The process of addressing potential impacts is described in the section **Replacement Water Sources and Replacement Process**.

Ground Water Rights

Westmoreland Rosebud's ground water model showed that 50 years after the end of mining, there would still be residual drawdown in the coal aquifers outside of the mined area (Application Appendices I-A and I-B). No wells outside the disturbance area are anticipated to be impacted by drawdown or water quality impacts. The process of addressing potential impacts is described in the section **Replacement Water Sources and Replacement Process**.

Replacement Water Sources and Replacement Process

If a water right associated with a spring, stream, stock pond, or well became inadequate or unusable for its specified beneficial use due to water quantity or water quality changes attributed to mining, and if the impact was detected and a complaint of harm was filed by a water right holder, DEQ would determine if harm had occurred, and a suitable replacement source would be provided by Westmoreland Rosebud. If a water right associated with a spring, stream, stock pond, or well was impacted during or after mining but still contained sufficient water of adequate quality to meet beneficial use needs, the impact would extend until such time that the impact was detected and a replacement water source was provided or until water quantity returned to pre-mining conditions after reclamation.

Possible sources of replacement water for stock and domestic ground water, spring, and surface water rights would likely be ground water pumped from the unmined areas of the coal aquifers and Sub-McKay sandstone. The most likely source may be the Sub-McKay aquifer because it generally yields more water than the coal aquifers and is not anticipated to be impacted by mining. The water quality of this aquifer is comparable to the existing quality of the streams, springs, and wells in and near the Project area, so it is unlikely that beneficial uses of the existing water rights would be impaired. All of these aquifers would produce water if developed. MSUMRA requires the applicant to provide "a description of alternative water supplies, not to be disturbed by mining that could be developed to replace water supply diminished or otherwise adversely impacted in quality or quantity by mining activities so as not to be suitable for the approved postmining land uses." Approximate yields in Sub-McKay wells range up to 50 gpm (Application Appendix O), which should be sufficient for stock and domestic water use. Power would need to be provided to the pumps in any wells installed for replacement water. Water could also be delivered by truck or pipeline from other areas, which may be a viable alternative for domestic water rights, but may be cost prohibitive for stock watering. Stock ponds would be constructed in the Project area during reclamation.

The process for replacing a water right impacted by mining is described in **Section 3.7.1.1**, **Regulatory Framework**. If a water supply was replaced, it likely would be replaced with a well not requiring a permit that could pump up to 35 gpm and 10 acre-feet per year. A senior water rights user could legally make a call against such a well, but significant practical and legal challenges are associated with

implementing and enforcing such a call. DEQ would require Westmoreland Rosebud to pay any additional costs for water replacement above and beyond the pre-mining costs in perpetuity, such as administrative costs and the costs for electricity, installation of pumping equipment, and operation and maintenance of a pumping system. This could be accomplished with a cash settlement or trust fund to the water rights owner whose water right was replaced.

3.7.3.3 Cumulative Impacts

The cumulative impacts analysis area for water rights includes the watersheds in which impacts on water rights may be expected to occur, including the East Fork Armells Creek, Richard Coulee, and Lee Coulee watersheds as described in **Section 3.5, Water Resources – Surface Water** and **Section 3.6, Water Resources – Ground Water**.

Past, current, and related future actions under concurrent consideration that would affect surface and ground water resources and therefore surface and ground water rights include past, present, and future mining activities in the analysis area, and the use of surface and ground water for agriculture, including livestock watering. These activities result in ground water drawdown in area wells and affect water availability, either in terms of volume or timing, that may result in long-term impacts on existing surface and ground water rights.

3.7.3.4 Unavoidable Adverse Impacts

Unavoidable adverse impacts include water rights that become unusable for their specified purpose due to flow or water quality changes. If a water right became unusable, a suitable replacement source would be provided by Westmoreland Rosebud.

3.7.3.5 Irreversible and Irretrievable Impacts

Because any adversely affected water rights would be replaced with an adequate water supply, no irreversible or irretrievable impacts would occur.

3.8 VEGETATION

3.8.1 Introduction

This section describes the affected environment with respect to vegetation, including the regulatory requirements to protect vegetation resources. The analysis area is defined below in **Section 3.8.1.2, Analysis Area and Methods**.

This section also analyzes the environmental consequences, including the direct, secondary, and cumulative impacts, of the No Action Alternative (Alternative 1) and the Proposed Action (Alternative 2) with respect to vegetation in the analysis area.

3.8.1.1 Regulatory Framework

Federal Requirements

Federally listed threatened and endangered (T&E) plant species are protected under the Endangered Species Act (ESA) of 1973, as amended under 16 USC 1531–1543 (Supp. 1996), and implemented by the U.S. Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration (NOAA). The ESA defines an endangered species as "a species in danger of becoming extinct throughout all or a portion of its range" and a threatened species as "a species likely to become Endangered in the foreseeable future" (50 CFR 17.3). Candidate species are plants and animals for which there is sufficient information on their biological vulnerability to support federal listing as threatened or endangered (63 *Federal Register* [FR] 13347), but listing is precluded by other higher-priority listing activities. Potential impacts on a federally listed species or its habitat resulting from a project with a federal action require consultation with USFWS under Section 7 of the ESA. MSUMRA requires this consultation for state permitting of coal mines (implemented by DEQ). Modification of designated critical habitat for a federally listed species also requires consultation with USFWS.

State Requirements

MSUMRA (82-4-233 and 82-4-235, MCA) and its implementing rules (ARM Subchapters 3, 5, 6, 7, 8, and 11) include regulations applicable to vegetation including requirements for baseline investigations, requirements for reclamation and revegetation, protection of federally T&E species, and conditions for bond release. **Table 66** summarizes the applicable rules.

Table 66. Applicable Vegetation and Reclamation Rules and Statutory Requirements.

Applicable Administrative Rules of Montana	
Subchapter	**Summary of Rule**
3	Contains requirements of the surface-mine permit application, including gathering vegetation baseline information (ARM 17.24.304 and ARM 17.24.305), requirements of the reclamation plan (ARM 17.24.313), special application requirements for prime farmlands (ARM 17.24.324), and special-use requirements for coal-mining operations on or adjacent to areas including alluvial valley floors (ARM 17.24.325)
5	Contains backfilling and grading requirements suitable for revegetation
6	Lists requirements for road and railroad construction (ARM 17.24.601), hydrologic impact of roads and railroads (ARM 17.24.605), general hydrology requirements (ARM 17.24.631), performance standards for drainage reclamation (ARM 17.24.634), and sediment-control measures (ARM 17.24.638)
7	Includes requirements for establishment of vegetation (ARM 17.24.711), timing of seeding and planting (ARM 17.24.713), methods of revegetation (ARM 17.24.716), planting of trees and shrubs (ARM 17.24.717), monitoring (ARM 17.24.723), revegetation success criteria (ARM 17.24.724), normalized difference vegetation measurements (ARM 17.24.726), T&E species/designated critical habitat (ARM 17.24.751), and cropland reclamation (ARM 17.24.764)
8	Contains requirements for preservation of essential hydrologic functions (ARM 17.24.801), protection of farming (ARM 17.24.802), alluvial valley floor monitoring (ARM 17.24.804), significance determination (ARM 17.24.805), and prime farmland revegetation (ARM 17.24.815)
11	Contains requirements for bond release
Applicable Requirements under Montana Strip and Underground Mine Reclamation Act	
82-4-2, MCA Subpart	**Summary of Requirement**
233	Contains requirements for planting of vegetation after grading of disturbed area
235	Determination of successful revegetation—final bond release

Montanan Natural Heritage Program (MNHP) is operated by the Montana State Library and contains the Montana State Library's Natural Resource Information System. MNHP and Montana Fish, Wildlife, and Parks (FWP) designate the state Species of Concern (SOC). MNHP maintains the list of state SOC and uses the international Natural Heritage Program's species ranking system ranging from 1 (highest risk, imperiled) to 5 (relatively stable). Designation of state SOC is not a statutory or regulatory classification; it aids in species conservation needs, data collection priorities, and agency management guidance. State SOC are native plant and animal species that are considered rare or at risk of becoming endangered or extirpated in Montana.

MSUMRA and the associated administrative rules prohibit surface or underground mining operations that are likely to jeopardize the continued existence of any listed endangered or threatened species or that are likely to result in the destruction or adverse modification of designated critical habitat of such species in violation of the ESA. MSUMRA and the associated administrative rules also prohibit surface or underground mining operations that would result in the unlawful taking of a bald or golden eagle, its nest, or any of its eggs as a result of the mining operations outlined in ARM 17.24.751(1).

Noxious weeds are managed under the Montana County Weed Control Act, as implemented under MSUMRA (ARM 17.24.308(1)(f)). The act states, "It is unlawful for any person to permit any noxious weed to propagate or go to seed on the person's land, except that any person who adheres to the noxious weed management program of the person's weed management district or who has entered into and is in compliance with a noxious weed management agreement is considered to be in compliance with this section" (Montana Department of Agriculture [MDA] 2015). MDA maintains lists of noxious weeds categorized by the severity of potential impacts and other factors and, depending on the category, may require management or eradication of the species to prevent the negative impacts of noxious weeds on the economic and environmental values of Montana (MDA 2017).

Local Requirements

There are no applicable local regulations for vegetation resources within or near the analysis area.

3.8.1.2 Analysis Area and Methods

Analysis Area

Direct impacts on vegetation from the proposed Project would occur from disturbances related to Project activities. Secondary impacts on vegetation in Richard and Lee Coulees may occur from changes to surface water or ground water flow quantities due to mining activities.

The analysis area used to describe the affected environment as it relates to vegetation and used to assess direct and secondary impacts on vegetation is the 15,153-acre Project area (**Figure 50**). Within the Project area is an 11,202-acre disturbance area where proposed Project activities would disturb 5,711 acres. Analysis of direct vegetation impacts focuses on the 5,711 acres where disturbance would occur. Analysis of secondary impacts looks at the wider Project area and the area outside of the permit boundary where surface water or ground water drawdowns are anticipated.

Analysis Methods

To provide a baseline assessment of impacts and reference for reclamation, surveys of pre-mining vegetation were conducted in 2013 and 2016 on the area within the analysis area proposed for Project-related disturbance (Cedar Creek Associates, Inc. (Cedar Creek Associates) 2016); 8,942 acres were surveyed within the areas proposed for disturbance, and an additional 8,223 acres were surveyed as part of an extended wildlife study area. The initial baseline assessment was completed in 2013; however, the proposed disturbance boundary was extended in 2015 to an area along the western border of the permit area that had not been previously surveyed; therefore, additional surveys were completed in 2016 (Cedar Creek Associates 2016). Baseline vegetation conditions were evaluated to determine ground cover, annual herbaceous production, woody-plant density, and species composition (Cedar Creek Associates 2016). Assessment methods follow ARM 17.24.304 (Baseline Information, Environmental Resources) and DEQ Vegetation Guidelines (DEQ 2009). Surveys for sensitive plant populations potentially occurring in the AM5 portion of the analysis area proposed for disturbance were also conducted (Cedar Creek Associates 2016).

Baseline vegetation surveys for the existing Area B permit area were completed in 1980 and 1984 (ECON 1980a, 1980b, 1984); 7,278 acres were surveyed. A portion of the analysis area was also surveyed in 1984 as part of the Big Sky Mine Area B (Western Technology and Engineering, Inc. 1985). The assessment methods for all surveys followed Montana Department of State Lands (MDSL) Draft Vegetation Guidelines 1980 and quantified canopy coverage and annual plant biomass production within the identified vegetation communities. The communities mapped in the 1980s studies were similar to those identified in the 2013 and 2016 baseline assessment and therefore were lumped together.

To assess direct impacts on vegetation, Westmoreland Rosebud's Application and the surface water and ground water analyses conducted for this EIS (see **Section 3.5, Water Resources -Surface Water** and **Section 3.6, Water Resources-Ground Water**) were reviewed. Estimated acreages of impacts from the Proposed Action by vegetation community and proposed reclamation acreages by vegetation community were calculated based on information provided in Westmoreland Rosebud's Application, including appendices and exhibits such as Exhibit E (Existing Vegetation) and Exhibit C (proposed revegetation plan). Westmoreland Rosebud's Application was also used to determine where ground-disturbing activities would occur (5,711 acres) that would result in impacts on vegetation. Westmoreland Rosebud's

Application included a hydrology analysis, which was used in conjunction with the surface water and ground water analyses in this EIS to determine where changes to hydrology would occur within the analysis area and how those changes could affect vegetation communities.

3.8.2 Affected Environment

3.8.2.1 Existing Vegetation Communities

The Project area is located on the Missouri Plateau, an unglaciated section of the Great Plains with generally rolling to steep slopes and occasional bluffs rising above the plains. The analysis area ranges in elevation from 3,300 feet above sea level (asl) to more than 3,930 feet asl. The majority of the northern section of the analysis area (within the existing Area B permit area) has been mined or disturbed by mining activities. The southern portion of the analysis area, where the AM5 expansion is proposed, has also been affected by human disturbance, primarily from Big Sky Area B mining activities, livestock grazing, agriculture, and roads. The 2012 Chalky fire impacted the majority of this southern portion of the analysis area, with most of the vegetation (trees, shrubs, and grasses) consumed by the fire. However, the 2016 baseline survey did indicate that vegetation appears to be recovering, with only the conifer/sumac and sagebrush communities significantly altered by the fire. Eight major vegetation communities were identified in the analysis area: grassland, conifer/sumac, sagebrush, mixed shrub, woody draw, improved pasture, cropland, and revegetation (**Figure 50**). The plant communities were segregated by dominant plant species, influence of soil type, topography, elevation, and other related factors (Cedar Creek Associates 2016; ECON 1980a, 1980b, 1984). In addition, four minor communities are associated with different land types: pond, sandstone rock, ranch yard, and wetlands/wet meadow (**Figure 50**). Wetland plant communities are described in more detail in **Section 3.9, Wetlands**.

The grassland, conifer/sumac, revegetation, and sagebrush plant communities dominate the land-surface cover of the analysis area, comprising 90 percent of the total area, with grassland comprising over 40 percent of the total area (**Table 67**). All other vegetation communities and land-use types each occupy less than 5 percent of the Project area. Field assessments documented the presence of 36 grass, 116 forb, 22 tree and shrub, and 8 subshrub species (Cedar Creek Associates 2016).

Table 67. Project Area Acreage Summary by Plant Community Type.

Vegetation Community and Land Types Supporting Vegetation	Vegetated Acres in Analysis Area	Percentage of Total
Lowland		
Deciduous tree/shrub (woody draw)	106	0.86
Lowland grassland	14	0.11
Upland		
Grassland	5,035	41.1
Conifer	2,891	23.6
Sagebrush		
• Big sagebrush	476	3.9
• Silver sagebrush	722	5.9
Skunkbush sumac	546	4.5
Mixed shrub	293	2.4
Improved pasture (disturbed grassland improved)	116	0.95
Revegetation (existing reclamation area)	1,857	15.2
Other		
Cropland	102	0.82
Wetlands/wet meadows	11	0.09
Ranch yard	4	0.03
Sandstone rock	6	0.04
Pond	62	0.50
Total	**12,241[1]**	**100.00**

[1]Total acreage of the analysis area, which is the same as the Project area, is 15,153 acres and includes nonvegetated areas (active mining, roads, and other disturbance in the Project area).

Grassland Community

The grassland community is the dominant vegetation type in the analysis area, occupying 41 percent of the land cover (**Table 67**). Grasslands occur on deep soil of flat valley bottoms to gently sloping hillsides and occasionally on hilltops surrounded by conifers. Although the community is dominated by grasses, scattered sagebrush is also present.

The grasslands of eastern Montana are recognized as mixed-grass prairies containing a blend of tallgrass and shortgrass prairie species. The baseline vegetative assessment in the portion of the analysis area where activities are proposed recorded 111 plant species in the grassland community in 2013 and 68 plant species in 2016 (Cedar Creek Associates 2016). The average grassland vegetative ground cover was 53 percent in 2013 and 40 percent in 2016. The dominant herbaceous species is western wheatgrass (*Agropyron smithii*), bluebunch wheatgrass (*Pseudoroegneria spicata*), and needle-and-thread (*Stipa comata*). Subdominants include the following native species: blue grama (*Bouteloua gracilis*), threadleaf sedge (*Carex filifolia*), and bluegrass (*Poa pratensis/agassizensis*). Woody shrub species are present in the grasslands, but no tree species were recorded. The most common woody species are silver sagebrush (*Artemisia cana*), western snowberry (*Symphoricarpos occidentalis*), and prairie rose (*Rosa arkansana*) (Cedar Creek Associates 2016). Similar dominant species were observed in the 1980 and 1984 surveys (ECON 1980a, 1980b, 1984).

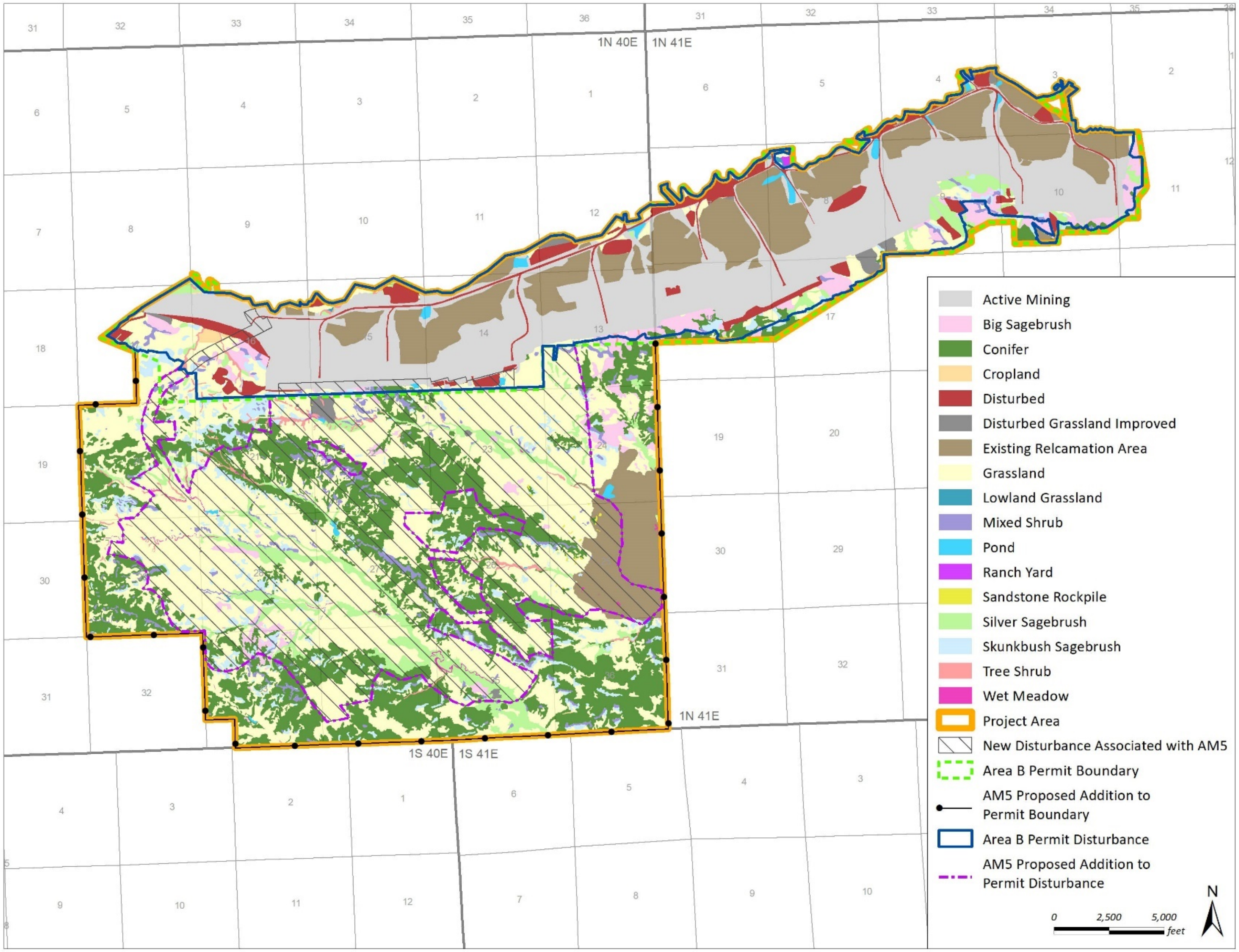

Figure 50. Vegetative Communities in the Analysis Area.

Conifer/Sumac Communities

The conifer/sumac communities are widespread in eastern Montana at elevations below 4,800 feet asl and are the driest forest types in Montana with a historically frequent fire interval. The conifer/sumac communities are found on moderately deep soil of sedimentary parent material. This soil is deeper than that where mixed shrub communities are found but shallower than that where grassland and shrubland communities are found.

The conifer/sumac communities cover 28 percent of the land in the analysis area (**Table 67**). A total of 111 plant species were recorded in this community in 2013 and 97 plant species in 2016 (Cedar Creek Associates 2016). Ponderosa pine (*Pinus ponderosa*), western snowberry, and skunkbush sumac (*Rhus trilobata*) dominate the overstory. Other dominant ground-cover shrub species include yucca (*Yucca glauca*) and Arkansas rose (*Rosa arkansana*). The herbaceous understory consists mostly of grasses. Dominant grasses include bluebunch wheatgrass and western wheatgrass. This community was altered by a wildfire in 2012, with burned ponderosa pine identified during the baseline surveys. Similar dominant species were observed in the 1980 and 1984 surveys (ECON 1980a, 1980b, 1984).

Sagebrush Communities

The sagebrush communities are the third-most-common plant community in the analysis area, occupying 10 percent of the land cover (**Table 67**). These communities are present on moderate to deep nonsaline soil. A total of 103 plant species were recorded in this community in 2013 and 54 plant species in 2016 (Cedar Creek Associates 2016). Two sagebrush species dominate the sagebrush communities: big sagebrush (*Artemisia tridentata*) and silver sagebrush. Big sagebrush occurs on moderately sloping hillsides, in open areas surrounded by conifers, and along drainage bottoms. Silver sagebrush is more common along slopes near drainage bottoms and in upland meadows. The composition of the two sagebrush species can vary from one species dominating to near-equal mixes of the two; however, the analysis area contains significantly more silver sagebrush than big sagebrush due to the recent Chalky wildfire. Other shrub species contribute to the total shrub ground cover, including snowberry, which has the greatest cover. The dominant grass species is western wheatgrass or Kentucky bluegrass (Cedar Creek Associates 2016; ECON 1984).

Revegetation Community

The revegetation (also referred to as existing reclamation area) community makes up about 15 percent of the land cover in the analysis area (**Table 67**). This community occurs in the northern portion of the analysis area where reclamation activities have occurred in the existing Area B permit area, as well as on the eastern edge of the analysis area where reclamation activities were completed on the Big Sky Mine in 2006. The areas are primarily low rolling hills or flat drainageways or grasslands.

A total of 33 species were documented in this community in 2013, with the study focusing on the eastern edge of the analysis area (Cedar Creek Associates 2016). The dominant grass species is western wheatgrass. Subdominant species include Japanese brome (*Bromus arvensis*), green needlegrass (*Stipa viridula*), and alfalfa (*Medicago sativa*). Woody species are a limited component within this community, with winterfat (*Krascheninnikovia lanata*) being the dominant woody species observed.

Mixed Shrub Community

The mixed shrub community makes up only 2.4 percent of the land cover in the analysis area (**Table 67**), occurring on ridgeline saddles and steep slopes below ridgelines on all aspects. Mixed shrub communities

have shallow soil with little to no topsoil present, making them prone to erosion and resulting in a high percentage of bare ground (38 percent). The mixed shrub community type transitions to sandstone cliff areas where the associated vegetative cover decreases as slope angle increases. Where slope angle decreases, soil becomes deeper, and this community transitions into the sagebrush, conifer/sumac, or grassland plant community types.

The mixed shrubland community is diverse with 93 species observed in 2013 and 75 species observed in 2016 (Cedar Creek Associates 2016). The dominant shrub species include skunkbush sumac, rubber rabbitbrush (*Chrysothamnus nauseosus*), big sagebrush, silver sagebrush, four-wing saltbush (*Atriplex canescens*), yucca, and prairie rose (Cedar Creek Associates 2016; ECON 1984). Bluebunch wheatgrass, few-flowered buckwheat (*Eriogonum pauciflorum*), and western wheatgrass dominate the herbaceous cover.

Woody Draw Community

The woody draw (also known as tree/shrub) community makes up less than 1 percent of the land cover in the analysis area (**Table 67**). Woody draws are linear, moist riparian corridors and basins along drainage channels. They develop where moisture is trapped or concentrated and where intermittent streams and springs are present. Depending on the size of the drainage, soil can be deep to shallow, and slopes have gentle to steep banks. Woody draw corridors provide important wildlife habitat for cover, forage, and movement.

The woody draw community is relatively diverse with 82 species recorded during the baseline assessment in 2013 and 64 species documented in 2016. The dominant tree and shrub species in the woody draw community are snowberry, chokecherry (*Prunus virginiana*), and prairie rose. Other prominent species present include American plum (*Prunus americana*), silver sagebrush, skunkbush sumac, box elder (*Acer negundo*), and fleshy hawthorn (*Crataegus succulenta*). Dominant herbaceous species include Kentucky bluegrass, western wheatgrass, and Canada thistle (*Cirsium arvense*). Woody draws have greater resource availability (e.g., water and nutrients) for plant growth. They are also areas where wildlife and livestock travel and congregate, leading to increased disturbances and seed dispersal. These factors increase the likelihood for weed-species invasion in woody draws. Two noxious weeds, Canada thistle and houndstongue (*Cynoglossum officinale*), occur in the woody draw community.

Improved Pasture Community

The improved pasture (also referred to as disturbed grassland improved) community makes up about 1 percent of the land cover in the analysis area (**Table 67**). This community generally occurs near ranch operations and access roads in the valley bottoms where slopes are gentle and soil is deep. Improved pasture is defined as native grasslands that have been interseeded with introduced "improved" grass cultivars to increase overall production. The improved grass communities were likely seeded in the early to middle 20th century by homesteaders and ranchers. The introduced grass species continue to persist today.

A total of 48 species were documented in this community in 2013 (Cedar Creek Associates 2016). The dominant grass species is crested wheatgrass (*Agropyron cristatum*). Subdominant species include Japanese brome, pale madwort (*Alyssum alyssoides*), and western wheatgrass. Crested wheatgrass was seeded to improve the pasture, whereas Japanese brome is an aggressive introduced invader. Some woody species including silver sagebrush and western snowberry were observed in this community. The noxious weed field bindweed (*Convolvulus arvensis*) is also present.

Cropland Community

The cropland community makes up about 1 percent of the land cover in the analysis area (**Table 67**). This community occurs on the northern edge of the analysis area and is primarily winter wheat fields or hay meadows. Hay meadows vary between entirely composed of alfalfa or crested wheatgrass and a mixture of the two (ECON 1984).

Minor Vegetative Communities

Four minor vegetation communities occur within the analysis area: wetlands, ranch yards, sandstone rock, and ponds. Ranch buildings, yards, and livestock pens are all long-term disturbed areas that lack permanent vegetation or are too small for vegetation sampling. Together these lands occupy 4 acres. Sandstone rock outcrops (6 acres) occur along ridges and as geologic monolith features in the valley bottoms. Cliffs and outcrops have varied erosion rates and little to no soil and vegetation. These features are a minor community type but are important for some wildlife species. Human-made stock ponds scattered throughout the analysis area total 62 acres. These ponds are seasonal and depend on annual precipitation patterns, and they may support wetlands or rooted aquatic vegetation. Wetlands/wet meadows occupy 11 acres of the Project area and are described in more detail in **Section 3.9, Wetlands**.

3.8.2.2 Special Status Plant Species

Federally Listed Threatened, Endangered, and Candidate Species

Three plant species are listed as federally threatened in Montana: Spalding's catchfly (*Silene spaldingii*), Ute ladies'-tresses orchid (*Spiranthes diluvialis*), and water howellia (*Howellia aquatilis*). The whitebark pine (*Pinus albicaulis*) is listed as a federal candidate species in Montana (**Table 68**; USFWS 2018). None of these federally threatened or candidate vegetation species are listed as potentially occurring in Rosebud County (USFWS 2018). No federally listed plant species were documented in the AM5 expansion portion of the analysis area during the field surveys in 2013 or 2016 (Cedar Creek Associates 2016). The 1980 and 1984 Area B surveys did not consider special status species (ECON 1980a, 1980b, 1984).

Montana Natural Heritage Program Species of Concern

Fifteen vegetation SOC potentially occur in Rosebud County (**Table 68**; MNHP 2018a). The analysis area contains suitable habitat for nine SOC. None of the SOC were documented in the analysis area during the field assessments in 2013 or 2016 (Cedar Creek Associates 2016).

Table 68. MNHP Plant Species of Concern in Rosebud County and Montana's Federally Listed Plant Species.

Common Name	Scientific Name	Status	General Habitat Affinity	Suitable Habitat Present in the Analysis Area?
Barr's milkvetch	*Astragalus barrii*	S3	Sparsely vegetated knobs and buttes; often along rivers or streams	Yes
Bractless blazingstar	*Mentzelia nuda*	S1/S2	Sandy or gravelly soil of open hills and roadsides on the plains	No
Bush morning-glory	*Ipomoea leptophylla*	S1/S2	Open prairie habitats in sandy or gravelly soil	Yes
Heavy sedge	*Carex gravida*	S3	Green ash ravines and woody draws	No
Lead plant	*Amorpha canescens*	SH	Grasslands and woodlands; often in sandy soil	Yes
Narrowleaf milkweed	*Asclepias stenophylla*	S2	Sandy soil of prairies and open pine woodland	Yes
Nuttall desert-parsley	*Lomatium nuttallii*	S2	Open pine woodlands 3,400 to 7,200 feet in elevation	Yes
Persistent-sepal yellow-cress	*Rorippa calycina*	SH	Moist sandy to muddy banks of streams, stock ponds, and reservoirs	Yes
Woolly twinpod	*Physaria didymocarpa* var. *lanata*	S2/S3	Sandy, often calcareous soil of open grassland or shrubland slopes	Yes
Scarlet ammannia	*Ammannia robusta*	S2	Plains in moist soil, along edge of wetlands, or in fields	No
Ovalleaf milkweed	*Asclepias ovalifolia*	S1/S2	Open pine woodlands, prairies, and dry riparian terraces	Yes
Mat buckwheat	*Eriogonum caespitosum*	S2/S3	Dry, stony limestone sagebrush steppe	
Silver bladderpod	*Physaria ludoviciana*	S2/S3	Sandy sites on the plains, often around sandstone outcrops	Yes
Scribner's ragwort	*Senecio integerrimus* var. *scribneri*	S2/S3	Grasslands and big sagebrush community	Yes
Slim-pod Venus'-looking-glass	*Triodanis leptocarpa*	S3	Plains and grasslands	Yes

Source: MNHP 2018a, 2018b.
S1: At very high risk of extinction or extirpation in the state due to extremely limited or rapidly declining numbers, range, or habitat, or extirpation in the state.
S2: At high risk of extinction or extirpation in the state due to very limited or declining numbers, range, or habitat, or extirpation in the state.
S3: At risk of extinction or extirpation in the state due to limited or declining numbers, range, or habitat, even though it may be abundant in some areas.
SH: Historical, known only from records usually 40 or more years old; may be rediscovered.

3.8.2.3 Noxious Weeds

Four noxious weed species on list Priority 2B of the State of Montana Noxious Weed list (MDA 2017)—Canada thistle, houndstongue, field bindweed, and spotted knapweed (*Centaurea maculosa*)—were documented in the analysis area during the baseline assessment (Cedar Creek Associates 2016). List Priority 2B weed species are abundant in Montana and widespread in many counties, requiring management by local weed districts. Canada thistle was found in woody draw areas with some areas

containing high amounts of infestation. Bindweed was found in the pasture and wood draw communities with small but locally abundant infestations. Minus Canada thistle, all of the noxious weeds were typically low in density. Rosebud County lists other noxious weed species not on the Montana Noxious Weed list; however, none of the county species were observed in the analysis area during the baseline assessment in 2013 or 2016 (Rosebud County 2018; Cedar Creek Associates 2016).

3.8.3 Environmental Consequences

3.8.3.1 Alternative 1 – No Action

Under the No Action Alternative, the AM5 amendment (proposed Project) would not be permitted. Westmoreland Rosebud would complete mining and reclamation in the Area B permit area according to its currently approved operating permit. Mining is permitted in Area B until 2030, and initial stages of reclamation would be completed within 2 years of the cessation of mining. There would be no Project impacts on vegetation described in **Section 3.8.2, Affected Environment**, because any changes or ground disturbances associated with the proposed Project would not occur.

The No Action Alternative would not change the status of the existing Area B permit area or other permit areas, including Area F, of the Rosebud Mine (**Section 2.2, Existing Operating Permits, Disturbance, and Reclamation**), nor would it affect the federal coal lease MTM 80697 (tracts in Areas B and C) modification application, which is currently being evaluated by the BLM (**Section 3.1.4.2, Related Future Actions**). Impacts on vegetation due to current and future mining and reclamation in the existing Area B permit area and other permit areas of the Rosebud Mine would continue.

3.8.3.2 Alternative 2 – Proposed Action

Direct Impacts

The Proposed Action would result in the removal and loss of vegetation communities on up to 5,643 acres[2] in the analysis area during mining operations in the Project area, which would result in a short-term adverse impact on vegetation. The upland grassland community would be most affected, with up to 3,269 acres disturbed, followed by conifer/sumac communities with a total of 1,357 acres impacted. When the various shrub grassland communities are combined, they make up the third-largest vegetation community impacted, with a disturbance of 601 acres. **Table 69** lists the acreages of disturbance for each vegetation type in the analysis area and the proposed postmine revegetation target acres for each type (see also Application Section 17.24.313).

[2] Disturbance includes an additional 68 acres of active mining areas or disturbed areas that are not included in this total.

Table 69. Vegetation Impacts and Proposed Revegetation Acreages.

Vegetation Type	Vegetated Acres in Analysis Area	Acres Disturbed	Postmine Revegetation Target Acres within Disturbance Area
Lowland			
Deciduous tree/shrub (woody draw)	106	57	48
Grassland	14	0	21
Upland			
Grassland	5,035	3,274	3,393
Conifer	2,891	1,162	858
Sagebrush			
• Big sagebrush	477	98	344
• Silver sagebrush	722	405	515
Skunkbush sumac	547	195	309
Mixed shrub	293	147	191
Improved pasture (disturbed grassland improved)	116	30	0
Revegetation (existing reclamation area)	1,857	241	NA
Other			
Cropland	102	9	18
Wetlands/wet meadows	11	9	TBD
Ranch yard	4	0	8
Sandstone rock	6	5	5
Pond	62	12	1
Total	**12,243**[1]	**5,643**[2]	**5,711**

[1]Total acreage of the analysis area, which is the same as the Project area, is 15,153 acres and includes nonvegetated areas (active mining, roads, and other disturbance in the Project area).
[2] Disturbance includes an additional 68 acres of active mining areas or disturbed areas that are not included in this total.

Areas that require vegetation clearing and removal under the Proposed Action would be subject to an overall loss of biodiversity and a short-term loss of productivity in the analysis area during the active mining period. Reclamation would establish plant communities, but biodiversity would be reduced and species composition would not be the same (Holl 2002). Reclamation of the existing ramp roads and the Area B haul road in the existing Area B permit area would be delayed by 15 years, prolonging vegetation establishment in those areas. In 2016, Cedar Creek documented 148 plant species in the analysis area (Cedar Creek Associates 2016). After reclamation of mine disturbances, shrublands and grasslands can take many years to establish a community with a diversity of plants similar to the pre-mine plant community. As discussed in **Section 3.18, Soil**, the Proposed Action would impact soil structure by altering ecological processes and adversely affect soil/plant interaction due to decreased soil water-holding capacity, loss of aeration and pore space, and increased bulk density (Sharma and Doll 1996). Soil compaction, loss of soil structure, loss of organic matter due to mixing and storage, and loss of microorganisms due to prolonged storage of soil could lower postmining vegetation diversity for an extended period.

Upon completion of mining in the Project area, disturbed areas would be reclaimed and revegetated. Westmoreland Rosebud's reclamation requirement is to establish vegetation that is diverse, effective, and permanent; consists of species native to the area or of introduced species when desirable and necessary to achieve the postmining land use; is at least equal in extent of cover to the natural vegetation of the area; and is capable of stabilizing the soil surface to control erosion. The reclamation plan includes areas

designated for various shrublands and grasslands (Application Section 17.24.313). Shrublands would likely take longer to establish to pre-mine conditions, with grasslands recovering more quickly after reclamation. Overall, the reclamation plan would establish plant species that would be compatible with the approved postmining land use, have the same seasonal growth characteristics as the original vegetation, be capable of self-regeneration and plant succession, be compatible with the plant and animal species of the area, and meet the requirements of applicable seed, poisonous and noxious plant, and introduced species laws and regulations (Application Section 82-4-233(2)).

Success of reclamation would be measured through monitoring as described in the revegetation monitoring plan and revegetation success criteria (Application Section 17.24.723-724). Ongoing monitoring of existing reclamation activities at other permit areas of the Rosebud Mine indicates revegetation in most areas is equal to or exceeds reference-area cover values and production values (Application Appendix E). Although the seed mixes for revegetation would be dominated by native species, it is likely over the long term that reclaimed areas would have fewer native species than existing communities.

Overall, the Proposed Action would have a short-term adverse impact on vegetation due to the removal of 5,643 acres of vegetation by mining activities in the analysis area; however, these areas would be reclaimed after mining. Some long-term adverse impacts on vegetation may occur due to decreased vegetation diversity and due to the potential for changes to vegetation communities from the reduced amount of surface and ground water in the area (see **Sections 3.5** and **3.6, Water Resources – Surface Water**, respectively).

No impacts on sensitive plant species are anticipated because none of the potential sensitive species were found in the analysis area.

Secondary Impacts

In addition to ground-disturbing activities, mining dewatering activities could lower the regional water table, which would adversely impact adjacent vegetation communities, especially wetland and riparian areas. As discussed in **Section 3.9, Wetlands**, a majority of the wetlands in the analysis area could be impacted from mining, including a reduction in ground water and surface water support. Although sections of these drainages are outside of the disturbance boundary (such as Section 24) and would not be directly impacted by mining activities, the reduction in surface and ground water could cause changes to the vegetation communities along the drainages. Changes to hydrology could cause these riparian areas to shift to grassland/upland communities. Loss of hydrology to wetland and riparian areas often leads to an increase in noxious and nonnative species along drainages. Although hydrology would be returned during reclamation, it could take decades before the wetland/riparian communities return to pre-mine conditions.

Adverse impacts on surrounding vegetation could also occur from increased dust in the analysis area from mining activities. Increased dust that settles on vegetation can block photosynthesis and growth (Ulrichs et al. 2008). These impacts would be localized, and dust-control measures (see **Section 3.3, Air Quality**) would reduce the short-term negligible impacts from dust.

The Proposed Action may result in new or expanded populations of noxious weeds by disturbing 5,646 acres of land that could become potential paths for dispersal of weed seeds. Existing weed populations could disperse to newly disturbed areas and other areas via vehicular traffic or soil transport. An increase in abundance and distribution of noxious weeds has the potential to displace native species and reduce vegetation diversity. The noxious weed control plan would prevent any large populations of noxious weeds from establishing within the Project area. With the implementation of the noxious weed control

plan, reclamation plan, and BTCA, the Proposed Action would have a short-term adverse impact on surrounding vegetation.

3.8.3.3 Cumulative Impacts

The analysis area for cumulative impacts is the same as the analysis area for direct and secondary impacts. Past, present, and related future actions under concurrent consideration that would contribute to cumulative impacts on vegetation include:

- Agriculture
- Wildland fires
- Past, ongoing, and future permitted mining at the Rosebud Mine and other coal-mining operations
- Past and ongoing gravel quarrying

Agricultural development in the area consists mostly of grazing lands, pastureland, and cropland. Continued agricultural development would alter vegetation in areas adjacent to the mine and increase introduced species and noxious weeds in the area.

Wildland fire affects vegetation through plant mortality, loss of seed sources, and altering of vegetation communities (including community structure and vegetation patterns). Past wildland fires altered or eliminated vegetation composition in the burn areas and likely reduced tree and shrub cover within those areas. Wildland fires can increase introduced or noxious weed species if a seed source for those invasive species is present. Wildland fires can also remove existing invasive species and allow for an increase in native species or new vegetation communities, such as that of the conifer/sumac complex present in the Project area. Fires also can add nutrients to the soil for vegetation and kill insect pests that may be killing native vegetation. Fires are part of the natural ecosystem, and many native plant communities are accustomed to periodic fires. Periodic wildland fires could contribute both beneficial and adverse cumulative impacts on vegetation.

Land disturbance, such as mining in nearby areas and development in Colstrip, has resulted in loss of vegetation. Loss of vegetation due to the proposed expansion of the Area B permit area would contribute to the adverse impacts of vegetation loss from past and future land disturbance associated with construction of infrastructure.

Past and current coal mining and gravel quarries by Westmoreland Rosebud and coal mining by other companies in southeastern Montana could affect vegetation in ways similar to those described for the analysis area. These actions are expected to continue in the future and could have adverse impacts on vegetation. Past and current coal-mining activities have altered the vegetation communities in the region. Vegetation cover and diversity in disturbed areas have decreased. The temporary loss of vegetation, reduction in vegetation diversity, and changes in species composition during mining activities in the analysis area would contribute to regional cumulative impacts on vegetation.

The Proposed Action would contribute short-term adverse cumulative impacts on vegetation from mining activities due to associated vegetation removal. The Proposed Action would also contribute long-term adverse cumulative impacts on vegetation due to decreased vegetation diversity and due to the potential for changes to vegetation communities from the reduced amount of surface and ground water in the area. Overall, when combined with other past, present, and related future actions under concurrent consideration, the Proposed Action would have a long-term adverse impact on vegetation.

3.8.3.4 Unavoidable Adverse Impacts

An unavoidable loss of native species and species composition would occur during mining operations. Reclamation of disturbed areas after mining would revegetate most areas to pre-mining vegetation production over the long term, but vegetation communities would be altered, and not all native species would be established. Introduced species have the potential to increase. This loss of some native species and increase in introduced species would be unavoidable impacts of the Project.

3.8.3.5 Irreversible and Irretrievable Impacts

Alternative 2 would disturb vegetation communities dominated by native species, the impacts of which would be subsequently mitigated by revegetation. Revegetated areas would eventually return to pre-disturbance productivity, but vegetation diversity would be lower than existing conditions. The loss of some native plant species in Alternative 2 would be an irreversible resource commitment.

3.9 WETLANDS

3.9.1 Introduction

This section describes the affected environment with respect to wetlands in the analysis area, including the regulatory requirements to protect them. The analysis area is defined below in **Section 3.9.1.2, Analysis Area and Methods**.

This section also analyzes the environmental consequences, including the direct, secondary, and cumulative impacts, of the No Action Alternative (Alternative 1) and the Proposed Action (Alternative 2) with respect to wetlands in the analysis area.

3.9.1.1 Regulatory Framework

Federal Requirements

Waters of the U.S. are defined broadly in the U.S. Army Corps of Engineers (Corps) regulations to include a variety of waters and wetlands. Waterbodies covered under this definition include streams (perennial, intermittent, and ephemeral), ponds, and lakes under 33 CFR 328.3(a). Habitats included under this definition are deep-water habitats (nonwetland) and special aquatic sites, which include wetlands (Environmental Laboratory 1987). The Corps defines “wetlands” as “areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas” (33 CFR 328.3(b)).

Waters tributary to navigable and interstate waters are considered waters of the U.S. and are subject to the Corps’ jurisdiction. Wetlands subject to the Corps’ jurisdiction (jurisdictional wetlands) meet the Corps’ definition of wetlands and are adjacent, neighboring, or have a surface tributary connection to interstate or navigable waters of the U.S. The Corps determines a water to be jurisdictional if the waterbody is a traditionally navigable water, a relatively permanent water, or a wetland that directly abuts a traditionally navigable or relatively permanent waterbody, or, in combination with all wetlands adjacent to that waterbody, has a significant nexus with traditionally navigable waters (Corps and USEPA 2007). The Corps determines whether a wetland or water is a water of the U.S. and subject to the Corps’ regulatory authority (jurisdictional) based on data received when a jurisdictional determination is requested.

The Corps defines a spring as “any location where there is ground water flow emanating from a distinct point. Springs do not include seeps or other ground water discharge areas where there is no distinct point source” (Corps 2017a). The Corps requires preconstruction notifications for any regulated activities located within 100 feet of a jurisdictional spring.

Federal and state agencies have the responsibility to avoid, minimize, and mitigate unavoidable impacts on wetlands and waters of the U.S. under Section 404(b)(1) of the Clean Water Act (CWA). All activities that result in the discharge of fill material into wetlands or waters of the U.S. are regulated by the Corps. Based on a Supreme Court 2001 ruling, wetlands that are isolated from other waters of the U.S., and whose only connection to interstate commerce is use by migratory birds, are not jurisdictional. Such wetlands are “isolated” or “nonjurisdictional,” and these terms are used synonymously.

Projects subject to the Corps’ jurisdiction also must comply with the 404(b)(1) Guidelines (Guidelines) for discharge of dredged and fill material into wetlands and waters of the U.S. (40 CFR 230). The Guidelines specify “no discharge of dredged or fill material shall be permitted if there is a practicable

alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences.” An alternative is considered practicable if “it is capable of being done after taking into consideration cost, existing technology, and logistics in the light of overall project purposes.” Practicable alternatives under the Guidelines assume that “alternatives that do not involve special aquatic sites are available, unless clearly demonstrated otherwise.” The Guidelines also assume that “all practicable alternatives to the proposed discharge which do not involve a discharge into a special aquatic site are presumed to have less adverse impact on the aquatic ecosystem, unless clearly demonstrated otherwise” (40 CFR 230).

State Requirements

The state of Montana has an overarching goal to have no net loss of the state’s remaining wetland resource base (as of 1989) and to overall increase the quality and quantity of wetlands in Montana (Montana Wetland Council 2013). DEQ is the lead state agency for wetland protection and works with the Montana Wetland Council to help implement the Strategic Framework for Wetland and Riparian Area Conservation and Restoration in Montana 2013–2017, which is considered the state plan for wetland and riparian areas (Montana Wetland Council 2013). Wetlands, including those determined to be nonjurisdictional by the Corps, are waters of the state. In Montana, state waters are defined to mean a body of water, irrigation system, or drainage system, either surface or underground. The term does not apply to ponds or lagoons used solely for treating, transporting, or impounding pollutants or to irrigation waters or land application disposal waters when the water is being used up with the irrigation or disposal system and the water is not returned to state waters (75-5-103(34), MCA).

Under MSUMRA and its implementing rules, wetland resources are considered important as part of the hydrologic balance and wildlife habitat. ARM 17.24.751(2)(f) requires surface mine operators to restore or avoid disturbance to wetlands and, where practicable, to enhance wetlands.

MSUMRA and ARM 17.24.312 require a surface mine operating permit applicants also are required to prepare a fish and wildlife plan that explains how the applicant will use impact control measures, management techniques, and annual monitoring methods to protect or enhance habitat for fish and wildlife, including wetlands and riparian areas. In addition, no land within 100 feet of a perennial or intermittent stream or a stream reach with a specific biological community may be disturbed by surface or underground mining operations, nor may the stream itself be disturbed, unless DEQ determines the original stream function will be restored and the water quality and quantity and other environmental resources of the stream and its adjacent lands will not be adversely affected during or after mining (ARM 17.24.651(1)(a)(b)). The applicant is also required to include in the reclamation plana description of the proposed postmine land uses (ARM 17.24.313(1)(a) and ARM 17.24.762(1)). The description must include the locations and designs of drainages and can include descriptions of wetlands. The reclamation of drainage basins must establish or restore habitats that are consistent with postmining land use and must restore, enhance where practicable, or maintain natural riparian vegetation (ARM 17.24.634(1)(h)).

Local Requirements

There are no applicable local regulations for wetlands and riparian resources within or near the analysis area.

3.9.1.2 Analysis Area and Methods

Analysis Area

Direct impacts on wetlands from the proposed Project may occur from disturbances related to Project activities. Secondary impacts on wetlands may occur in Richard and Lee Coulees from changes to surface water or ground water flow quantities due to mining activities.

The analysis area used to describe the affected environment as it relates to wetlands and used to assess direct impacts on wetlands is the 15,153-acre Project area (see **Figure 51** and **Figure 52**). Within the Project area is an 11,202-acre disturbance area where proposed Project activities would disturb 5,711 acres, 5,643 acres of which are vegetated. Analysis of direct wetland impacts focuses on the 5,643 vegetated acres where disturbance would occur. Analysis of secondary impacts looks at the wider Project area and the area outside of the permit boundary where surface water impacts or ground water drawdowns are anticipated. The analysis of secondary impacts on wetlands is the same as the surface water analysis area (**Section 3.6.1.2**), which encompasses surface watersheds extending through and downstream from the 9,108-acre proposed permit area that receives surface water drainage from the 5,547-acre disturbance area as modified by AM5. The secondary impact analysis is based on the surface water analysis and National Wetland Inventory data because a wetland delineation was not completed for areas outside of the permit boundary.

Analysis Methods

Baseline inventories of wetlands conducted in 2013 and 2016 by Cedar Creek Associates, Inc. (Cedar Creek Associates 2016) and wetland information (Morrison-Maierle Environmental Corporation 1995) from the Area B permit were used to determine presence of wetlands and other potential waters of the U.S. within the direct impacts analysis area. Project plans submitted by Westmoreland Rosebud in its Application were used to determine direct and secondary impacts on wetlands. The surface water and ground water analyses done for this EIS (see **Section 3.5, Water Resources - Surface Water**, and **Section 3.6, Water Resources - Ground Water**) were also used to assess the direct and secondary impacts on wetlands.

3.9.2 Affected Environment

A wetland is an area of land that is saturated or inundated with water either permanently or seasonally, allowing it to support vegetation that is adapted for life in saturated soil conditions. Wetlands are typically present along streams, ponds, and lakes on the gradient between upland areas and aquatic areas. Wetlands play an important role in the ecosystem by providing vegetative diversity and wildlife habitat, improving water quality, providing ground water discharge and recharge, and retaining sediment and nutrients, among other values. Streams, ponds, springs, and other state waters provide aquatic habitat, nutrient and sediment removal, and other functions.

3.9.2.1 Wetlands

The direct impacts analysis area supports several wetlands (**Table 70**), mainly along the drainages that cross through the analysis area. The analysis area includes the Richard Coulee, Lee Coulee, and East Fork Armells Creek drainage basins, all of which are tributaries to the Yellowstone River. Surface water drains and infiltrates quickly as a result of rugged topography and relatively porous soil. The analysis area is located on the south end of the Rosebud Mine (**Figures 1** and **2** in **Chapter 1**). The analysis area contains several small low-order streams but does not contain major stream/river channels or associated floodplain riparian wetlands.

Location and Classification

Twenty-two wetland areas were identified in the analysis area, primarily along several small subdrainages of Richard Coulee and Lee Coulee (Cedar Creek Associates 2016). The majority of the wetlands are located in flat, heavily vegetated drainage bottoms where ground water discharges or surface water accumulates. A few of the wetlands are moderately vegetated upland seeps where surface water ponds or subirrigation supports wetland species (ERM 2018). Some of the wetlands have developed from reclaimed mining areas at the Big Sky Mine as depressional wetlands (G011, G012, G013, and G019). Many have been affected by land use activities, including stock pond development (4-2/2, G514, G044, and G047). Some of the wetlands have also been affected by a 2012 fire, which affected vegetation cover and may have altered hydrology and soil. Wetlands typically extend several to hundreds of feet from the ground water surface discharge point before the water percolates into the soil or evaporates. The existing Area B permit area originally included four wetlands or wet meadows, two within bermed stock ponds and two along East Fork Armells Creek. The two bermed stock pond wetlands were in the east and west sections of Area B and have been mined. The other two wetlands (A-3 and A-5) along East Fork Armells Creek have not been impacted by mining activities. The 22 wetland areas comprise 14.47 acres within the analysis area. Wetlands occupy 0.09 percent of the analysis area. **Table 70** shows the size, classification, description, and water source for each wetland. **Figure 51** shows the wetlands in the analysis area.

All 22 wetlands in the analysis area are located in the headwaters of tributaries to Rosebud Creek (Richard Coulee and Lee Coulee), and East Fork Armells Creek. The wetlands are classified as palustrine emergent wetlands, which are characterized by erect, rooted herbaceous hydrophytes with the vegetation being present for most of the growing season and are usually dominated by perennial plants (Cowardin et al. 1979). The dominant vegetation in the wetlands includes broadleaf cattail (*Typha latifolia*), common threesquare (*Schoenoplectus pungens*), creeping spikerush (*Eleocharis palustris*), foxtail barley (*Hordeum jubatum*), Torrey's rush (*Juncus torreyi*), softstem bulrush (*Schoenoplectus tabernaemontani*), longleaf pondweed (*Potamogeton nodosus*), Nebraska sedge (*Carex nebrascensis*), meadow barley (*Hordeum brachyantherum*), clustered field sedge (*Carex praegracilis*), and prairie cordgrass (*Spartina pectinata*). The wetlands are supported by hydric soil and are generally saturated or inundated.

Table 70. Wetland Size, Classification, and Water Source in the Direct Impacts Analysis Area.

Wetland Identification	Size (acres)	Classification of Wetland Type[1]	Description	Water Source
4-2/2	0.98	PEM	Stock pond fed by seeps with associated wetlands	Seep
G011	0.51	PEM	Wetland in depression within the analysis area	Ground water/precipitation
G012	0.05	PEM	Wetland in depression within the analysis area	Ground water/precipitation
G013	0.39	PEM	Wetland in depression within the analysis area fed by seeps	Seep
G019	1.19	PEM	Depressional wetland adjacent to drainage within analysis area	Ground water/surface flow
G044	1.86	PEM	Stock pond with wetlands below dam	Leakage from pond
G047	2.52	PEM	Stock pond with wetlands	Surface flow
G048	0.10	PEM	Wetland in drainage within the analysis area	Surface flow
G054	2.60	PEM	Wetland in drainage within the analysis area	Surface flow
G055	0.82	PEM	Wetland in drainage within the analysis area	Surface flow
G060	0.37	PEM	Wetland in drainage within the analysis area	Surface flow
G067	0.31	PEM	Wetland in drainage within the analysis area	Surface flow
G200	0.28	PEM	Wetland in drainage within the analysis area fed by spring and seep	Spring/seep
G300	0.03	PEM	Wetland in drainage within the analysis area fed by seep	Seep
G400	0.63	PEM	Wetland in drainage within the analysis area fed by a seep	Seep
G500	0.28	PEM	Wetland in drainage within the analysis area	Surface flow
G514	0.29	PEM	Stock pond fed by seep	Surface flow/seep
G515	0.56	PEM	Wetland in drainage within the analysis area	Surface flow
G600	0.002	PEM	Wetland in drainage within the analysis area	Surface flow
G602	0.15	PEM	Wetland in drainage within the analysis area	Surface flow
A-3	0.09	NA	Wetland in drainage within the analysis area	Surface flow
A-5	0.46	NA	Wetland in drainage within the analysis area	Surface flow
Total area	14.472			

[1]Classification of wetland habitats according to Cowardin et al. 1979.
PEM: Palustrine (P), Emergent (EM).

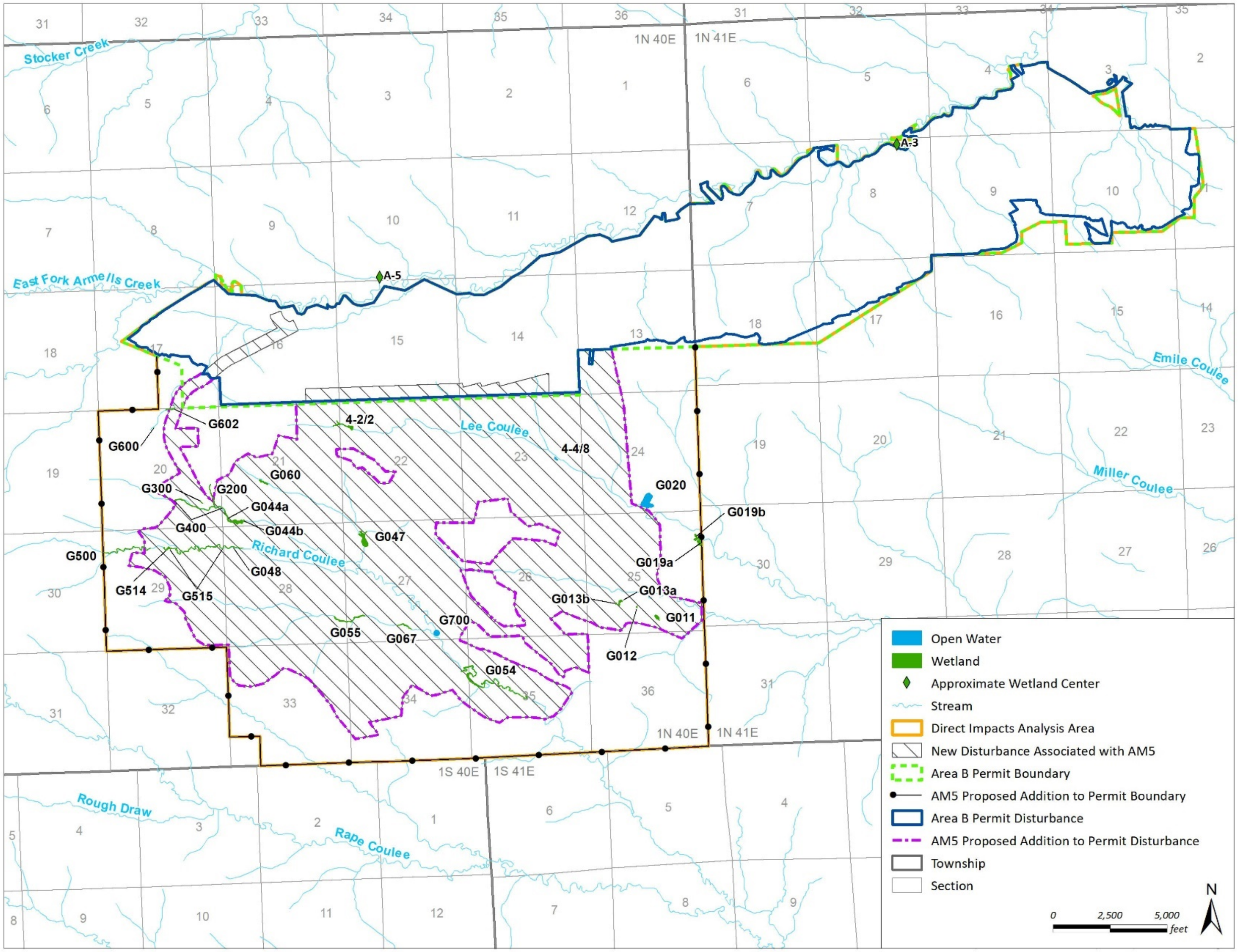

Figure 51. Analysis Area Wetlands.

Functional Assessment

Western Energy (predecessor to Westmoreland Rosebud) evaluated the functions of wetlands that would be impacted by mine operations within AM5 in 2018 (ERM 2018). Western Energy used MDT's 2008 Montana Wetland Assessment Method (Berglund and McEldowney 2008) to assess the wetlands. **Table 71** provides a summary of the scores assigned to each wetland that was evaluated. The wetlands range from a Category III to a Category IV (ERM 2018). Category III wetlands are more common, generally less diverse, and often smaller and more isolated than those in Categories I and II, which are higher-quality wetland categories. Category IV wetlands are the lowest ranking based on uniqueness, diversity, and function. The wetlands are low functioning due to overall low uniqueness, small size, and low diversity and habitat quality (ERM 2018). The wetlands scored zero for federally listed species habitat, fish habitat, and recreation/education potential due to lack of habitat and private property. The wetlands were moderate to high for overall wildlife habitat and MNHP species due to the potential habitat for one MNHP-listed species and overall signs of wildlife use in the area. Some of the wetlands showed some capacity for flood attenuation, and all received moderate scores for sediment, nutrient, or toxicant retention and removal. The majority of the wetlands also scored low for short- and long-term surface water storage and uniqueness. The wetlands varied in score for sediment/shoreline stabilization, production export/food chain support, and ground water discharge/recharge. No wetland functional assessment was completed for the wetlands within the existing Area B permit area.

Table 71. Functional Category and Units for Potentially Impacted Wetlands in the Analysis Area.

Wetland[1]	Functional Units	Percentage of Possible Score	Functional Category
4-2/2	5.7	58	III
G011	1.4	35	III
G012	0.2	46	III
G013	1.6	56	III
G019	2.1	38	III
G044	9.8	54	III
G047	13.6	54	III
G048	0.4	47	III
G054	16.1	62	III
G055	2.2	34	IV
G060	1.8	54	III
G067	0.8	34	IV
G200	1.5	53	III
G300	0.1	51	III
G400	2.9	51	III
G500	1.4	58	III
G514	1.5	52	III
G515	2.6	52	III
G600	0	29	IV
G602	0.4	30	IV
Total Functional Units	66.1		

[1] Functional assessments were not completed for Wetlands A-3 and A-5.

Jurisdictional Determination

The 2016 wetland delineation for the analysis area (Cedar Creek Associates 2016) was submitted to the Corps in 2017. The Corps prepared an approved jurisdictional determination based on the 2016 wetland delineation report and determined that all 20 wetlands in the AM5 expansion area are isolated and

therefore not jurisdictional waters of the U.S. under the authority of Section 404 of the CWA (Corps 2017b).

3.9.2.2 Other Waters of the U.S.

Location

Four named drainages occur in the analysis area: Richard Coulee, Lee Coulee, Rape Coulee, and East Fork Armells Creek. Within the analysis area, these drainages do not have sufficient flow to develop a defined bed and bank; however, some of the drainages contain wetlands (Cedar Creek Associates 2016). Additional descriptions of these drainages are provided in **Section 3.5, Water Resources – Surface Water**. **Figure 51** shows the named drainages in the analysis area.

Two open water features in the analysis area were identified as potential waters of the U.S. (Cedar Creek Associates 2016). One open water feature (4-4/8) is adjacent to Lee Coulee and is a shallow pool with an overland connection to Lee Coulee. The other open water feature (G020) is a remnant pit pond that remains after reclamation in 2006. This pond holds water on a perennial basis and is adjacent to Lee Coulee.

Jurisdictional Determination

Based on the 2016 wetland delineation report, the Corps determined that the open water features in the analysis area are not waters of the U.S. (Corps 2017b) because they are isolated and do not have a surface connection to a known waters of the U.S. No waters of the U.S. were identified within the analysis area.

3.9.2.3 Springs and Seeps

Location

Numerous springs and seeps are located in the analysis area. Springs are associated with Wetlands G500 and G200. Seeps are associated with Wetlands 4-2/2, G013, G300, G400, and G514. Seeps and springs are typically located at the upstream ends of the wetlands and supply the water source for the wetlands. The spring types and locations are described in **Section 3.5, Water Resources – Surface Water**. Springs and seeps in the analysis area are shown on **Figure 52**.

Jurisdictional Determination

The seeps and springs associated with the wetlands in the analysis area were determined to not be jurisdictional waters of the U.S. under the authority of Section 404 of the CWA (Corps 2017b).

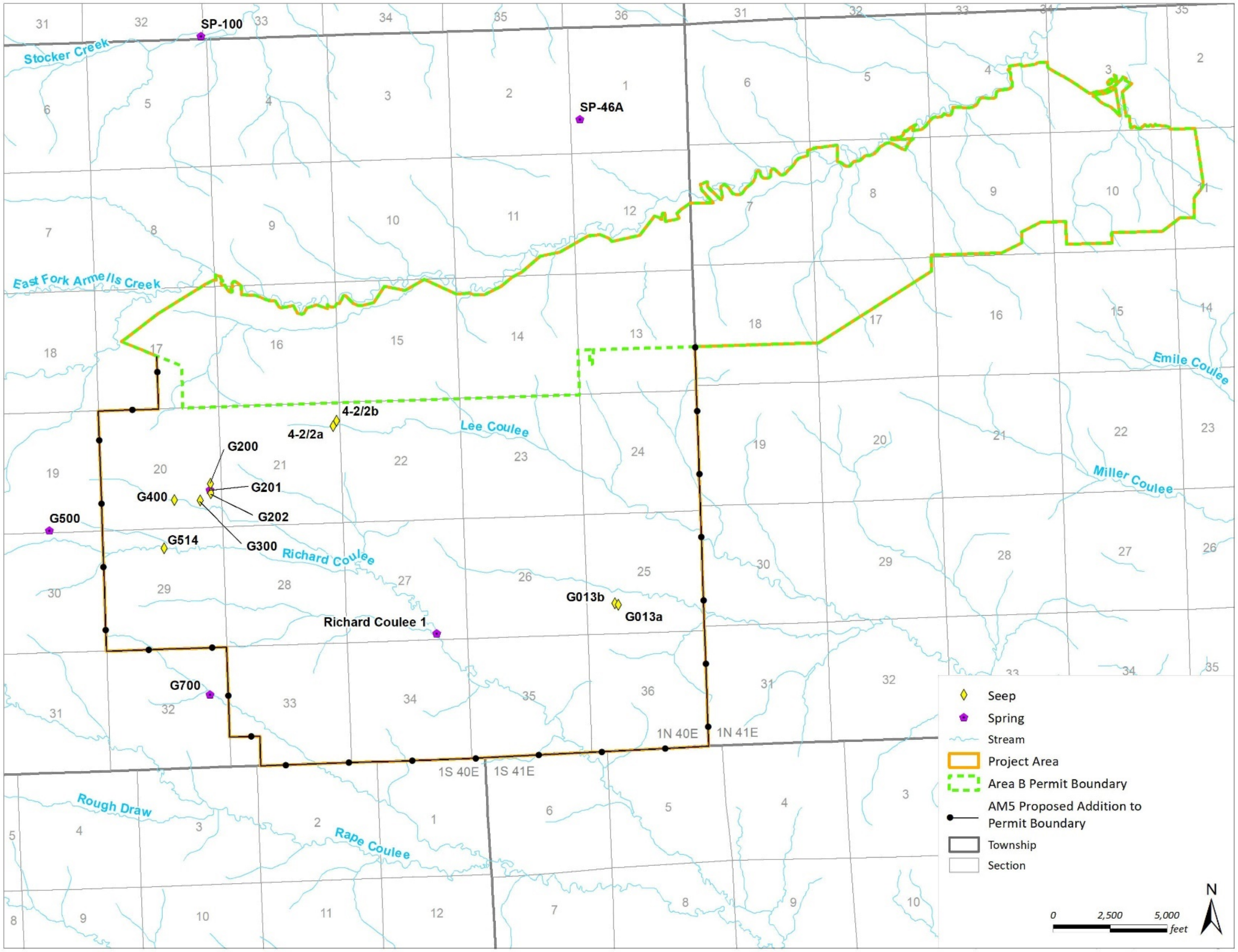

Figure 52. Seeps and Springs.

3.9.3 Environmental Consequences

3.9.3.1 Alternative 1 – No Action

Under the No Action Alternative, the AM5 amendment (proposed Project) would not be permitted. Westmoreland Rosebud would complete mining and reclamation in the Area B permit area according to its currently approved operating permit. Permitted mining is projected in Area B until 2030, and initial stages of reclamation would occur within 2 years of the cessation of mining. There would be no Project impacts on wetlands and riparian areas described above in **Section 3.9.2, Affected Environment**, because none of the disturbances associated with development of the Project would occur.

The No Action Alternative would not change the status of the existing Area B permit area or other permit areas, including Area F, of the Rosebud Mine (**Section 2.2, Existing Operating Permits, Disturbance, and Reclamation**), nor would it affect the federal coal lease MTM 80697 (tracts in Areas B and C) modification application, which is currently being evaluated by the BLM (**Section 3.1.4.2, Related Future Actions**). Impacts on wetlands due to current and future mining and reclamation in the existing Area B permit area and other permit areas of the Rosebud Mine would continue.

3.9.3.2 Alternative 2 – Proposed Action

Direct Impacts

Under the Proposed Action, 12.27 acres of palustrine persistent emergent saturated wetlands would be directly impacted by mining activities in the analysis area (**Table 72**). Two open water features (G700 and 4-4/8) would also be directly impacted by mining activities in the analysis area. The wetlands would be impacted by surface mining, construction of the haul roads and ramp roads, spoil areas, or changes to surface and ground water hydrology due to mining activities. Overall, the Proposed Action would have a short-term and long-term adverse impacts on wetlands (**Figure 53;** see **Section 3.1.1, Definitions Used for Impact Analyses**). **Table 72** lists each wetland that would be impacted.

Table 72. Wetland Impacts.

Wetland Identification	Size (acres)	Direct Impact (acres)	Reason for Impact
4-2/2	0.98	0.98	Mining
G011	0.51	0.51	Topsoil stock pile location
G012	0.05	0.05	Stock pile access road
G013	0.39	0.39	Boxcut spoil area
G019	1.19	0	NA
G044	1.86	1.86	Mining
G047	2.52	2.52	Mining
G048	0.10	0.10	Mining
G054	2.60	2.60	Mining
G055	0.82	0.82	Mining
G060	0.37	0.37	Mining
G067	0.31	0.31	Mining
G200	0.28	0.12	Road construction
G300	0.03	0.03	Haul road
G400	0.63	0.63	Haul road/new pond Rich-4
G500	0.28	0.03	Highwall reduction/new pond Rich-6
G514	0.29	0.29	Mining
G515	0.56	0.56	Mining
G600	0.002	0	NA
G602	0.15	0.10	Haul road
A-3	0.09	0	NA
A-5	0.46	0	Existing Area B[1]
Total	14.472	12.27	

NA = not applicable.
[1]Impacts based on location of A-5 shown in the Rosebud Coal Mine Wetland Report (Morrison-Maierle Environmental Corporation 1995) and Area B Permit Application.

In total, the Proposed Action would have a direct long-term impact on 12.27 acres of wetlands. Based on the mining sequence illustrated in Westmoreland Rosebud's Application, Exhibit A, most of these direct impacts would occur 10 years or more after mining begins. No additional impacts on wetlands would occur from delayed reclamation in Area B along the haul road and ramp roads.

The Project would not require any CWA Section 404 permits because all of the wetlands identified in the analysis area were determined to be nonjurisdictional. MSUMRA and the associated rules (ARM 17.24.751(2)(f)) require wetlands to be restored. The watershed topography and hydrology would be reclaimed to reestablish to the extent possible the hydrologic balance in and near the analysis area; however, as discussed above and in **Section 3.6, Water Resources – Ground Water**, ground water discharge to the channels that support wetlands would not begin until after ground water levels recovered after mining, and discharges to the drainages may occur at different locations than where they occurred before mining. In addition, pre-mine flow conditions would not return to springs whose aquifer sources were removed. There would be no impact on springs supported by aquifers that were not impacted by mining, and these springs would remain fully functional. New wetlands may appear along drainages in the analysis area postmining after the spoil resaturates. After mining, some ponds may be constructed to provide water supplies for wetlands. Reclamation of wetlands onsite would achieve the same functions and values of pre-mining conditions. The mitigation of wetlands would provide replacement of the functions and values lost.

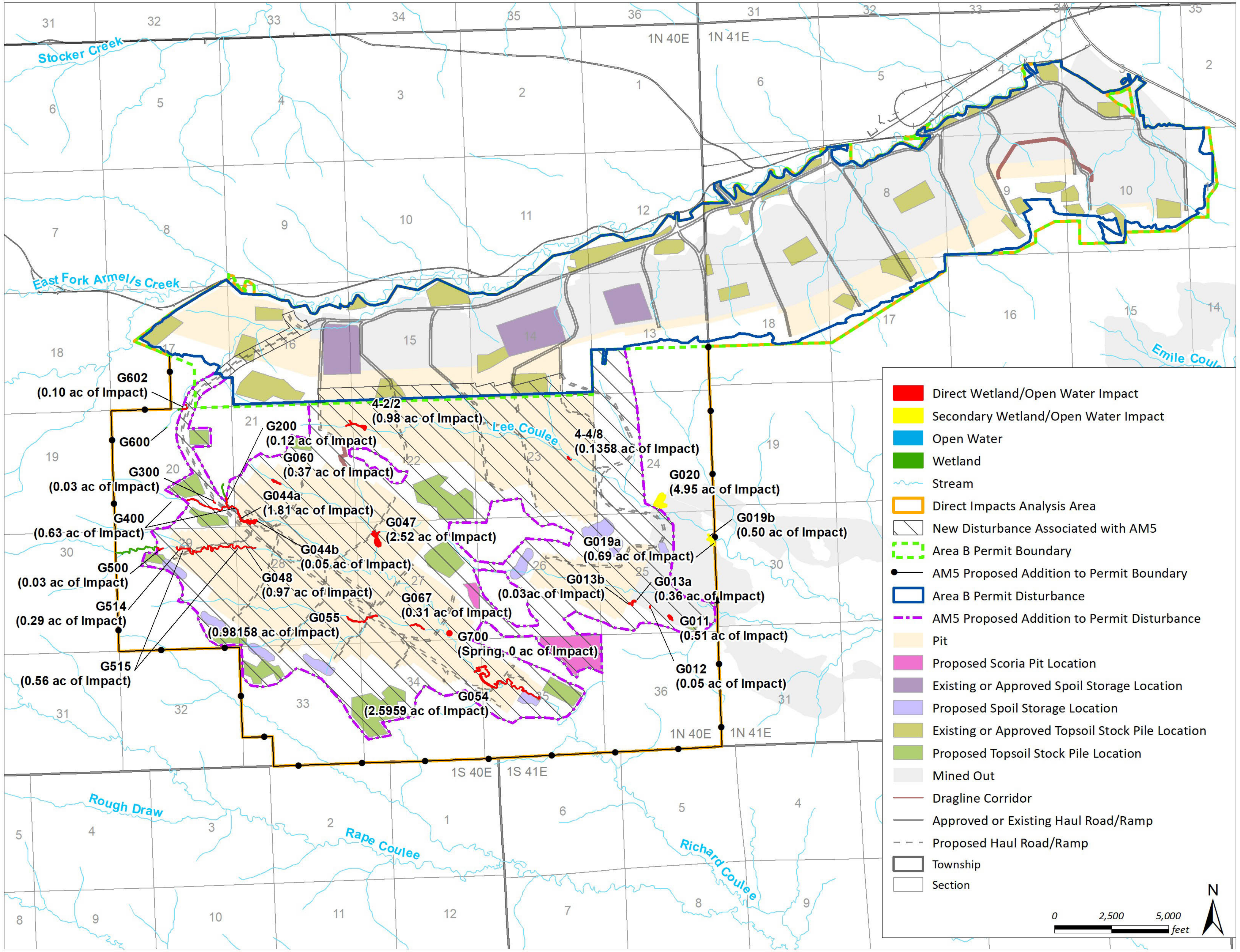

Figure 53. Wetland Impacts, Proposed Action.

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As discussed in **Section 2.4.9.5, Wetland Mitigation Plan**, Westmoreland Rosebud has developed a wetland mitigation plan to mitigate for the loss of wetland functions and values from the proposed Project. A wetland functional assessment was completed on the wetlands to determine the functions and values that need to be replaced. Based on the functional assessment completed, a total of 66 functional units would be impacted by the proposed Project. Westmoreland Rosebud has completed preliminary research into available mitigation options in the watershed service area and would consult with DEQ to establish a mutually agreed upon plan to mitigate for the loss of wetland functions and values. After consultation, Westmoreland Rosebud would develop a detailed mitigation plan for DEQ approval detailing how impacted wetlands would be mitigated. Options that have been researched are described in **Section 2.4.9.5, Wetland Mitigation Plan**.

Westmoreland Rosebud has identified several potential wetland mitigation sites that could be enhanced or expanded in the Rosebud and Armells Creek Drainages, including Wetlands G019, G500 (in areas that would be directly or indirectly impacted), 32A, 049, and 27A (see **Table 11** in **Section 2.4.9.5, Wetland Mitigation Plan; Figure 54**). Mitigation in the section of G500 not impacted by the Project may be potential for mitigation. Wetland G019 may be impacted from changes to surface and ground water flows (see the **Secondary Impacts** section below), and mitigation in this wetland may not be successful if changes to hydrology are observed.

Secondary Impacts

An additional 1.19 acres of wetlands (Wetlands G019a and G019b) may be impacted from changes to surface and ground water flows within the analysis area. Wetland G019 is located outside of the disturbance boundary; however, it is located along Lee Coulee, which would be mined upstream of the wetland. The ground water and surface flows along Lee Coulee would be diminished during mining activities. Therefore, there may be a long-term adverse impact on all 1.19 acres of Wetland G019. In addition, the open water feature G020 may be impacted by water quantity changes due to drawdown during mining and water quality changes due to spoil influence on ground water quality after mining.

The National Wetland Inventory shows an additional 6.3 acres of wetlands within the downstream watersheds/secondary impacts analysis area. As stated in the **Water Resources – Surface Water** section, ground water contributions to stream flow from the reclaimed area would eventually return to the downstream wet reach of Lee Coulee, but it may take several years to recover. In addition, the location of ground water discharge and base flow in the downstream reach may change due to the change in water source. Ephemeral flows may also be affected; however, changes are anticipated to be minor. The reduction in ground water flows and ephemeral flows or changes in discharge location may adversely impact the 6.3 acres of downstream wetlands.

The Rosebud Mine MPDES permit authorizes discharges into East Fork Armells Creek, Stocker Creek, Lee Coulee, West Fork Armells Creek, Black Hank Creek, Donley Creek, Cow Creek, Spring Creek, and Pony Creek. Discharges into creeks may change the water level and may affect wetlands abutting or adjacent to the creeks. Changes in water levels may result in changes to wetland habitat along creek banks and result in a reduction of wetland functions or may provide water to support and/or expand wetland functions.

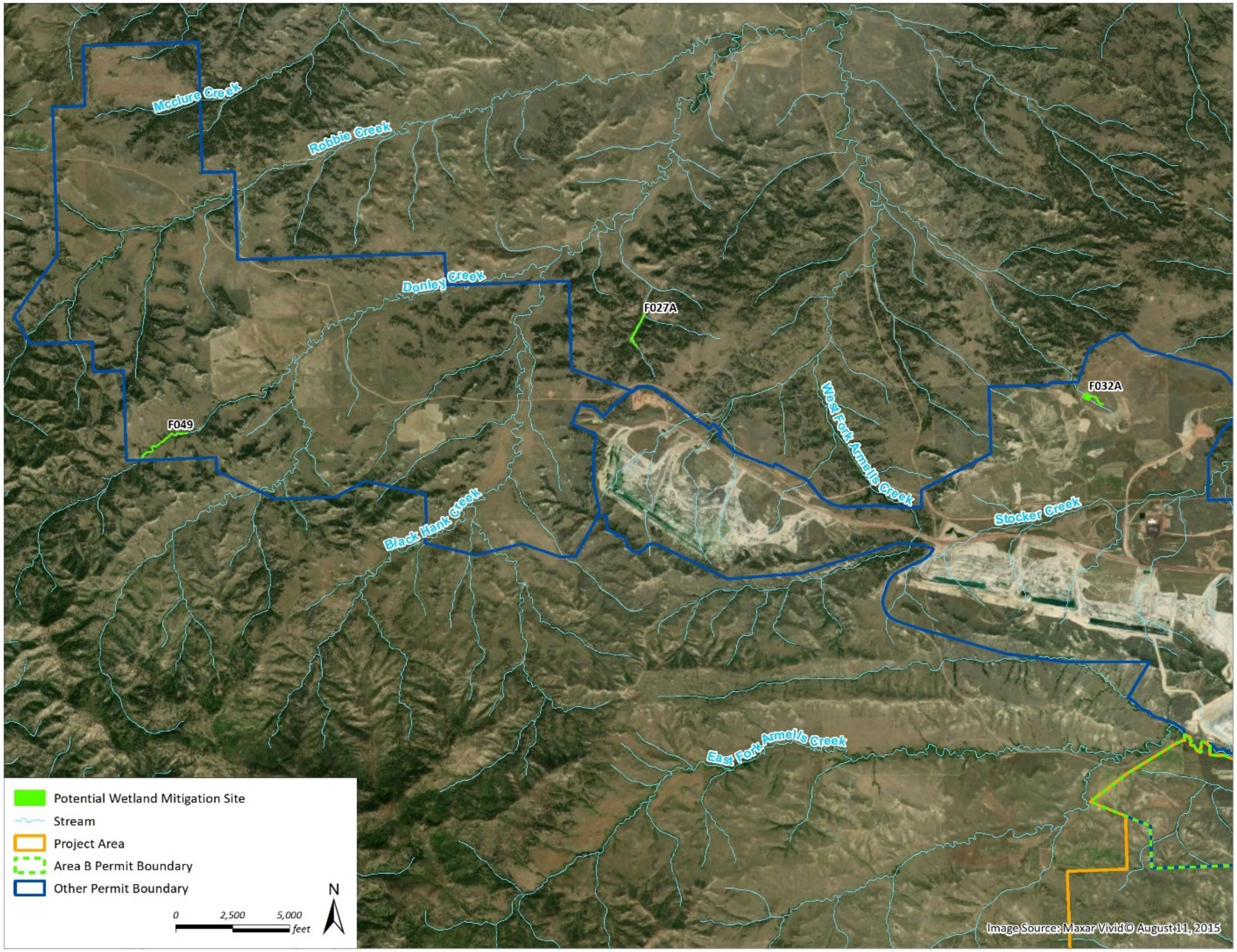

Figure 54. Potential Wetland Mitigation Sites.

3.9.3.3 Cumulative Impacts

The analysis area for cumulative impacts is the same as the analysis area for direct and secondary impacts. Past, present, and related future actions under concurrent consideration that would contribute to cumulative impacts on wetlands include:

- Agriculture
- Actions by federal land management agencies
- Municipal and Industrial Water Uses and Discharges
- Wildland fires
- Past, present, and future permitted coal mining

Agricultural development in the area consists mostly of cropland, pastureland, and grazing lands. Past livestock grazing has destabilized stream channels and disturbed spring and wetland areas. Continued agricultural development would alter wetlands in areas adjacent to the mine and decrease the functions and values of surrounding wetlands.

BLM-authorized actions in the near vicinity of the Project area, such as rights-of-way for powerlines and pipelines, coal leases, mineral material sites, land withdrawals, and land sales and exchanges, may have resulted in wetland loss from new infrastructure development. However, BLM’s ARMP includes implementation of conservation measures and protection of wetland and riparian areas for BLM-authorized projects, resulting in a beneficial contribution to wetlands in those areas.

Past and future fires, both wildland fire and prescribed burns, have affected and will affect wetlands mainly through alteration or reduction of wetland habitat, depending on the severity of the fire. During the 2012 wildland fire season, the McClure Creek and Donley Creek fires burned 221 acres on and around Rosebud Mine Areas C and F, and the Chalky Fire burned 131,000 acres south of Area B, including the majority of the AM5 area, potentially affecting wetland habitat.

Past and current gravel pits near the Project area, as well as coal mining and reclamation at the Rosebud Mine and Big Sky Mine, have likely affected wetlands in ways similar to those described for the Proposed Action (see **Section 4.9, Wetlands**). These actions are expected to continue into the foreseeable future and would have adverse impacts on wetlands.

The Proposed Action would contribute long-term adverse cumulative impacts on wetlands. This would occur due to changes to hydrology, which may adversely affect wetlands. The Proposed Action would also contribute short-term and long-term adverse cumulative impacts on wetlands due to surface disturbances. Overall, when combined with other past, present, and related future actions under concurrent consideration, the Proposed Action would have a long-term adverse impact on wetlands.

3.9.3.4 Unavoidable Adverse Impacts

A loss of wetland functions and services, biodiversity, and species composition would occur under Alternative 2 where wetlands are affected. This loss would be an unavoidable adverse impact. DEQ anticipates that impacts on wetlands and streams would be mitigated and wetland functions and services would return to the area in time. DEQ would be responsible for establishing and approving any wetland mitigation requirements for nonjurisdictional wetlands associated with the Project.

3.9.3.5 Irreversible and Irretrievable Impacts

The following would be irreversible and irretrievable impacts on wetlands:

- The loss of wetlands in the analysis area whose water supply would be permanently affected by mining activities

However, reclamation of wetlands onsite would achieve the same functions and values of pre-mining conditions, and the mitigation of wetlands would provide replacement of the functions and values lost (see **Section 2.4.9.5, Wetland Mitigation Plan**). Changes to surface water and ground water hydrology in the analysis area is discussed in **Section 3.5, Water Resources – Surface Water** and **Section 3.6, Water Resources – Ground Water**.

3.10 FISH AND WILDLIFE RESOURCES

3.10.1 Introduction

This section describes the affected environment with respect to fish and wildlife resources, including the regulatory requirements to protect those resources. The analysis area is defined below in **Section 3.10.1.2, Analysis Area and Methods**. Fish and wildlife resources consist of a variety of state and federal threatened, endangered, candidate, and other sensitive species; big game species; upland game birds; migratory birds; small mammals; amphibians; reptiles; and aquatic species.

This section also analyzes the environmental consequences, including the direct, secondary, and cumulative impacts, of the No Action Alternative (Alternative 1) and the Proposed Action (Alternative 2) with respect to fish and wildlife resources in the analysis area.

3.10.1.1 Regulatory Framework

Federal Requirements

Endangered Species Act

Federally listed T&E species are protected under the Endangered Species Act (ESA) of 1973 under 16 USC 1531–1543 (Supp. 1996), as amended, and implemented by USFWS and NOAA. The ESA defines an endangered species as “a species in danger of becoming extinct throughout all or a portion of its range” and a threatened species as “a species likely to become Endangered in the foreseeable future” (50 CFR 17.3). Candidate species are plants and animals for which there is sufficient information on their biological vulnerability to support federal listing as threatened or endangered (63 FR 13347), but listing is precluded by other higher-priority listing activities. Potential impacts on a federally listed species or its habitat resulting from a project with a federal action require consultation with USFWS under Section 7 of the ESA. Potential impacts on a federally listed species or its habitat resulting from a project with a nonfederal action require preparation of an incidental take permit under Section 10 of the ESA. Pursuant to ARM 17.24.312(1)(d), applicants must provide a statement explaining how the applicant will comply with the ESA through impact control measures, management techniques, and annual monitoring methods.

Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act of 1940 (16 USC 668–668c) prohibits the taking of eagles, their eggs, eagle parts, or their nests without a permit issued by USFWS. A “take” is defined as any of the following actions: to pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb eagles. A recently clarified definition (72 FR 31132) explicitly defines disturbance and protects eagles from impacts of human-initiated activities primarily around active, alternate, and historic nest sites. The definition of “disturb” includes any activity that will cause or is likely to cause, based on the best scientific information available, (1) injury to an eagle; (2) a decrease in its productivity by substantially interfering with normal breeding, feeding, or sheltering behavior; or (3) nest abandonment by substantially interfering with normal breeding, feeding, or sheltering behavior.

Migratory Bird Treaty Act

Migratory birds (including raptors) and active nests are protected under the Migratory Bird Treaty Act (MBTA) (16 USC 703–712). Under the MBTA, it is illegal to take any migratory bird, its eggs, its parts, or any bird nest except as permitted (such as waterfowl hunting licenses, falconry licenses, or bird

banding permits) by USFWS. The definition of take under the act includes any attempts or acts of pursuing, hunting, shooting, wounding, killing, trapping, capturing, possessing, or collecting. Removal of active nests resulting in the loss of eggs or young is also prohibited (16 USC 703–712). In addition, Executive Order (EO) 13186 directs federal agencies to develop a Memorandum of Understanding with USFWS to further implement the MBTA and promote the conservation of migratory bird populations.

State Requirements

Under MSUMRA, Subchapters 3 and 7 of the ARM includes rules on topsoiling, revegetation, and protection of wildlife and air resources. ARM 17.24.751(1) prohibits mining operations that may jeopardize continued existence of federally listed threatened or endangered species, result in adverse modification of critical habitat, or result in unlawful take of bald or golden eagles including active nests or eggs. ARM 17.24.751(2)(a–g) requires avoidance and minimization measures as well as BTCA for siting and construction of electric powerlines, roads, and fencing that minimize adverse impacts on wildlife habitat. MSUMRA and the associated administrative rules require submittal of pre-mine wildlife surveys, preparation of a fish and wildlife plan, periodic monitoring and reporting during operations, and reclamation of wildlife habitats.

FWP regulates wildlife and fish under the state Fish, Wildlife, and Parks Commission (87-1-301, MCA). The Montana Natural Heritage Program (MNHP) is operated by the Montana State Library and contains the Montana State Library’s Natural Resource Information System. MNHP and FWP designate the state Species of Concern (SOC). MNHP maintains the list of state SOC and uses the international Natural Heritage Program’s species ranking system ranging from 1 (highest risk, imperiled) to 5 (relatively stable). Designation of state SOC is not a statutory or regulatory classification; it aids in species conservation needs, data collection priorities, and agency management guidance. State SOC are native plant and animal species that are considered rare or at risk of becoming endangered or extirpated in Montana.

MSUMRA and the associated administrative rules prohibit surface or underground mining operations that are likely to jeopardize the continued existence of any listed endangered or threatened species or that are likely to result in the destruction or adverse modification of designated critical habitat of such species in violation of the ESA. MSUMRA and the associated administrative rules also prohibit surface or underground mining operations that would result in the unlawful taking of a bald or golden eagle, its nest, or any of its eggs as a result of the mining operations outlined in ARM 17.24.751(1).

Executive Order 12-2015

On September 8, 2015, Montana Governor Steve Bullock signed EO 12-2015 amending EO 10-2014, which provided guidelines for certain conservation and management measures for greater sage-grouse populations in Montana. EO 10-2014 created the Montana Sage-Grouse Habitat Conservation Program (MSGHC program) and Montana Sage Grouse Oversight Team (MSGOT). The MSGOT and MSGHC program implement EO 12-2015. Information and management recommendations from EO 10-2014 have been incorporated into EO 12-2015. General stipulations of EO 12-2015 include seasonal restrictions and buffers in which vegetation removal cannot occur. The analysis area for greater sage-grouse described in **Section 3.10.1.2** below was based on buffers outlined in EO 12-2015.

EO 10-2014 outlined conservation measures that include a balance between energy development and minimization of impacts on greater sage-grouse habitat. With regard to mining operations, EO 10-2014 recommended:

- Working cooperatively with agencies, municipalities, and other landowners;

- Baseline assessments to identify important greater sage-grouse habitat and prioritize areas in greatest need of protection;
- Incremental development in order to stagger land disturbance;
- Provision of technical assistance and education to private landowners;
- Use of offsite mitigation through habitat creation or conservation easements to offset habitat loss; and
- Removal of facilities and reclamation of lands after cessation of mining.

Local Requirements

There are no applicable local regulations for fish and wildlife resources within or near the analysis area.

3.10.1.2 Analysis Area and Methods

Analysis Area

The analysis area for fish and wildlife resources is the 15,153-acre Project area plus a 1-mile buffer for all species addressed, except for the greater sage-grouse (*Centrocercus urophasianus*) (**Figure 55**) (Schmitt 2018). The analysis area is also shown on relevant figures in this section, except **Figure 63**.

For the greater sage-grouse, the analysis area is the Project area plus a 4-mile buffer (**Figure 63**). The 4-mile buffer is consistent with Montana's greater sage-grouse conservation strategy under EO 12-2015, which stipulates that certain types of disturbance, including vegetation removal, should not occur within 4 miles of an active lek.

In this resource section, unless the term "greater sage-grouse analysis area" is used, all references to the analysis area refer to the analysis area for fish and wildlife. "Analysis areas" refers to both the fish and wildlife analysis area and the greater sage-grouse analysis area.

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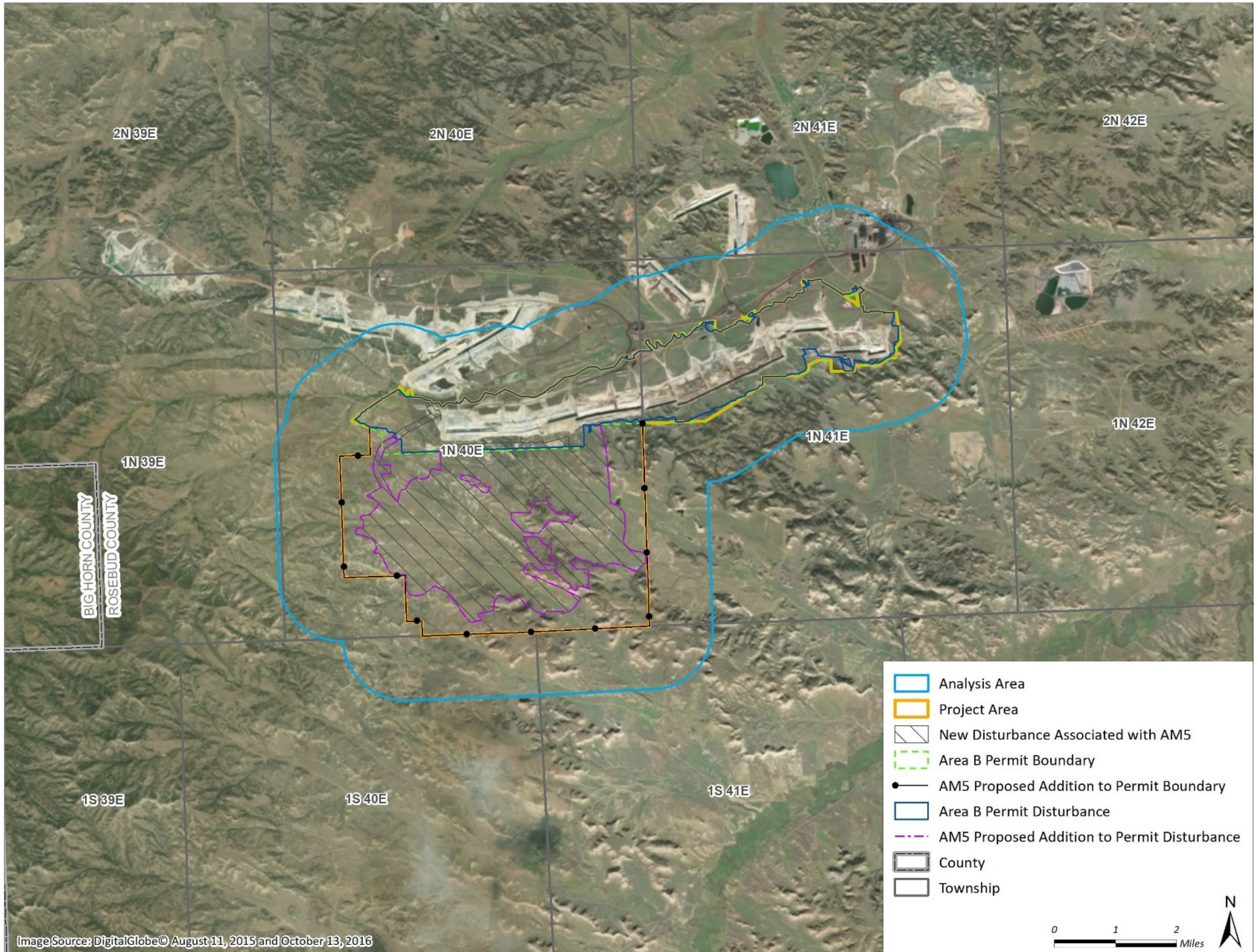

Figure 55. Fish and Wildlife Analysis Area.

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Analysis Methods

Long-term monitoring data available for the entire mine, baseline survey data, annual monitoring reports, and species occurrence data provided by MNHP were used to determine which species are likely present in the analysis areas. In addition to wildlife resources assessed based on existing occurrence records and mapped vegetation communities, data provided by Western Energy (predecessor to Westmoreland Rosebud), DEQ, FWP, USFWS, and other relevant sources were also used. Field guides and published species records of the area were also reviewed to help identify wildlife resources in the fish and wildlife and greater sage-grouse analysis areas.

Long-term monitoring consists of ongoing annual monitoring that has occurred throughout portions of the Rosebud Mine from 1973 to 2016. Long-term monitoring also occurred on the Big Sky Mine between 1974 and 2015. Monitoring ceased in 2015 on the Big Sky Mine after the mine became inactive. Baseline surveys for fish and wildlife in the analysis area were initiated in 2013, and surveys were conducted by ICF International (ICF) between 2013 and 2015. Baseline and annual surveys conducted by ICF also included the 1-mile perimeter buffer around the proposed Project area.

Greater sage-grouse habitat was analyzed using guidance outlined in EO 12-2015, which states that certain types of disturbance should not occur within 4 miles of a lek. Westmoreland Rosebud consulted with the Sage Grouse Program in fall 2018 (see **Section 1.4.2.1, Montana Sage Grouse Habitat Conservation Program and the Montana Sage Grouse Oversight Team**). DEQ determined that the 4-mile buffer be used when searching records provided by MNHP for greater sage-grouse.

Impacts on fish and wildlife, including special status species, were assessed qualitatively based on known species-occurrence data and proposed direct habitat disturbance (5,711 acres; see **Section 2.4.1, Operating Permit and Disturbance Acres** and **Figure 6**) within the analysis areas.

3.10.1.3 Fish and Wildlife Habitat Characteristics

Wildlife habitat types in the analysis area were grouped into seven categories: grasslands, conifer/sumac woodlands, agricultural lands (improved pastures and croplands), lowlands (woody draws, wetlands, and ponds), upland shrublands (sagebrush and mixed shrubland), disturbed/developed lands (scoria pits, ranch yards, and county roads), and revegetation areas (see **Section 3.8.2, Existing Vegetation Communities** for a detailed description of these categories within the Project area). The Project area consists primarily of grasslands, conifer/sumac woodlands, and upland shrublands, which together cover about 89 percent (13,534 acres). All other vegetation communities and land-use types in the Project area each occupy less than 5 percent of the analysis area. Field assessments documented the presence of 36 grass, 116 forb, 22 tree and shrub, and 8 sub-shrub species. Vegetation in the greater sage-grouse analysis area was analyzed using MNHP landcover data (2017).

Upland shrublands and grasslands (including reclaimed grasslands) cover about 69 percent of the analysis area and provide habitat for a variety of species. These species include small animals such as desert cottontail and their predators, rodent species (e.g., voles, mice, ground squirrels, and woodrats), red fox, and badger. Common ground-nesting birds such as meadowlark and lark sparrow are also found. Larger mammals such as mule deer and pronghorn are found in areas dominated by grassland and shrub species. Reptiles such as bullsnake and eastern yellow-bellied racer and amphibians such as plains spadefoot and Woodhouse’s toad are found in moist and dry habitats. SOC including red bats, fringed myotis, sage thrasher, and short-horned lizards also use upland grassland and shrubland habitats.

Conifer/sumac woodlands cover about 24 percent of the analysis area. These areas are dominated primarily by ponderosa pine, skunkbush sumac, snowberry, creeping juniper, blue grama, and green needlegrass. Common wildlife species in wooded areas include mule deer, elk, North American porcupine, least chipmunk, and squirrels. Avian species include nuthatches, hairy woodpecker, black-capped chickadee, and warblers (ICF 2011).

Aquatic habitat is fairly limited within the analysis area. Eleven springs and thirteen manmade stock ponds occur within or very near the analysis area boundary (**Figure 33, Section 3.5.2.4, Water Resources – Surface Water**). Additionally, portions of Richard Coulee, Lee Coulee, Rape Coulee, and East Fork Armells Creek occur within the analysis area boundary (**Figure 33, Section 3.5.2.4, Water Resources – Surface Water**). Several of the springs in the area form the headwaters to the creeks named above. Some contain permanent water and wetlands that extend a few hundred feet from the discharge point before percolating into the soil or evaporating. Ponds are mostly manmade and often contain standing water during the spring and summer. The creeks listed above are intermittent or ephemeral. **Section 3.5.2.4, Water Resources – Surface Water** contains a description of aquatic habitat in the analysis area.

Lowland areas, especially those containing riparian and wetland habitat, provide shelter and foraging for numerous amphibians, reptiles, birds, small and large mammals, and invertebrates. Common species in these areas include boreal chorus frogs, Woodhouse's toad, plains garter snake, red-winged blackbird, North American porcupine, various small mammal species (e.g., mice, voles, and shrews), and big game including mule deer. A variety of ducks and shorebirds (e.g., sandpipers) also use this habitat. Numerous SOC including several bat species, northern leopard frog, and plains spadefoot toad use wet areas for foraging and breeding.

Wildlife species associated with agricultural and disturbed/developed lands consist mostly of generalist species that inhabit a variety of habitats. Barn swallow, black-billed magpie, mourning dove, house and deer mouse, and desert cottontail are common. Predators common in these areas include raccoon, coyote, and red fox.

3.10.2 Affected Environment

3.10.2.1 Mammals

Small Mammals

About 22 small-mammal species (excluding bats) have been documented on the Rosebud Mine and in the vicinity of the analysis area since 1972 (ICF 2014, 2016, 2017). Rodents recorded on or near the analysis area from trapping surveys include mostly deer mice (over 95% of small-mammal captures have been of deer mice). Other species that have been captured in traps include meadow and prairie vole, western harvest mouse, and olive-backed pocket mouse. One Merriam's shrew, a state SOC, was captured in 2000. Other species that have been documented on or near the analysis area include yellow-bellied marmot, red squirrel, least chipmunk, thirteen-lined ground squirrel, northern pocket gopher, Wyoming pocket mouse, bushy-tailed woodrat, house mouse, porcupine, beaver, and muskrat. Masked shrew and at least three rabbit species (white-tailed jackrabbit, desert cottontail, and other cottontail) have also been documented on the mine (ICF 2014, 2016, 2017).

Generalist species including deer mouse, house mouse, red squirrel, and cottontail rabbits likely occur in all habitat types within the analysis area. Grassland, shrubland, and agricultural land within the analysis area provide habitat for other small mammals including desert cottontail, western harvest mouse, and northern pocket gopher. Other small mammals likely to occur in association with grassland and

agricultural areas include thirteen-lined ground squirrel and Wyoming pocket mouse. Wetlands and riparian areas in lowlands provide potential habitat for a variety of mammals such as raccoon, prairie and meadow vole, and western harvest mouse.

Most species that have been documented in the analysis area and other portions of the Rosebud Mine, including the least chipmunk, bushy-tailed woodrat, deer mouse, meadow vole, prairie vole, and raccoon, are wide-ranging in Montana. Species such as the yellow-bellied marmot and red squirrel are more common in western and southern Montana (MNHP 2018a).

Bats

Bat surveys have been conducted in the analysis area. Between 2012 and 2017, acoustic monitoring was conducted at the Big Sky Mine about 0.7 mile east of the AM5 permit boundary. Additionally, summer nighttime acoustical bat surveys and habitat characterization were conducted in 2011 and 2013 about 4.9 miles to the northwest of the analysis area for the proposed Area F permit area (see the Area F EIS; OSMRE and DEQ 2018). **Table 73** lists the bat species that were identified during the Big Sky Mine and Area F surveys between 2011 and 2017, habitat affinity, and their potential to occur in the analysis area.

Table 73. Bat Species Identified between 2011 and 2017 in the Big Sky Mine and Proposed Area F Permit Area.

Common Name	Scientific Name	Status*	General Habitat Affinity	Habitat in Analysis Area
Townsend's big-eared bat[1]	*Corynorhinus townsendii*	SOC	Woodlands, rocky outcrops, caves, tunnels, and abandoned mines; occasionally roosts in tree cavities	Y
Big brown bat[2]	*Eptesicus fuscus*	Not listed	Buildings, bridges, caves, mines, and rock outcrops	Y
Silver-haired bat[2]	*Lasionycteris noctivagans*	PSOC	Forested areas, tree cavities, and rock cavities; occasionally found in buildings	Y
Eastern red bat[1]	*Lasiurus borealis*	SOC	Migrant in Montana; woodlands and riparian areas	Y
Hoary bat[2]	*Lasiurus cinereus*	SOC	Deciduous and occasional coniferous woodlands; typically roost in trees	Y
Small-footed myotis[2]	*Myotis ciliolabrum*	Not listed	Forests, rocky outcrops, riparian areas, buildings, bridges, and caves	Y
Long-eared myotis[2]	*Myotis evotis*	Not listed	Forests, abandoned buildings, bridges, rock outcrops, mines, and caves	Y
Little brown myotis[2]	*Myotis lucifugus*	SOC	Variety of habitats including buildings, woodlands, caves and mines; forages over water	Y
Fringed myotis[1]	*Myotis thysanodes*	SOC	Riparian areas in coniferous woodlands and caves; typically roosts in rock crevices, caves, and abandoned buildings	Y

Table 73. Bat Species Identified between 2011 and 2017 in the Big Sky Mine and Proposed Area F Permit Area.

Common Name	Scientific Name	Status*	General Habitat Affinity	Habitat in Analysis Area
Long-legged myotis[2]	*Myotis volans*	Not listed	High-elevation forests; rocky areas, stream banks, and buildings	Y
Pallid bat[3]	*Antrozous pallidus*	SOC	Forests, rock outcrops, and sagebrush shrublands	Y
Spotted bat[3]	*Euderma maculatum*	SOC	Open dryland habitats dominated by juniper, sagebrush, and sometimes mixed with ponderosa pine and meadows	Y

Source: Bachen et al. 2018; MNHP 2018a, 2018b; ICF 2011, 2016, 2017.
*SOC = Species of Concern; PSOC = Potential Species of Concern.
[1]Detected in Area F only.
[2]Detected at Big Sky Mine and Area F.
[3]Detected at Big Sky Mine only.

In addition to the 2011 and 2013 surveys, the little brown myotis, hoary bat, and pallid bat (also a SOC), were documented near the Big Sky Mine Pond B-9 location, within the analysis area (within the 1-mile buffer outside the Project area; **Figure 59**) (MNHP 2018b). SOC are described in more detail in **Section 3.10.2.7, Special Status Species**.

Habitat surveys in the Area F permit area identified 10 distinct sites for acoustic surveys (ICF 2011). About 11,000 calls were detected, with about 85 percent of those calls being identified as big brown bat and small-footed myotis calls. The big brown bat and small-footed myotis were the most prevalent bats detected during those surveys. Higher levels of bat activity were documented nearer to surface water. Echolocation survey analysis identified 10 of the 15 bat species known to occur in Montana in the Area F expansion area (Foresman 2001).

Upland and riparian woodlands areas provide roosting sites for bats such as red bats, silver-haired bats, and long-eared myotis. Piñon-juniper woodlands and shrublands provide roosting habitat for species such as long-legged myotis. The western small-footed myotis appears to inhabit dry, rocky areas, and the big brown bat is a habitat generalist that ranges throughout the continental US (MNHP 2018a). Bat hibernacula including rock outcrops, caves, and buildings likely occur in the analysis area. Additionally, some bat species, such as silver-haired bats, may hibernate in tree cavities.

Carnivores

Between 1972 and 2015, a total of 10 species of carnivores—coyote (**Figure 56**), red fox, raccoon, long-tailed weasel, American badger, striped skunk, bobcat, mountain lion, mink, and black bear—were documented on the Rosebud Mine and potentially occur in the analysis area (ICF 2014, 2016). Carnivore records from baseline surveys in the analysis area are results of incidental sightings (ICF 2016). During the 2013 though 2015 baseline surveys in the analysis area, three carnivores were documented: coyote, striped skunk, and bobcat. Several coyotes were

Figure 56. Coyote
(Adam Messer 2003 MNHP)

observed in grassland areas, as was the single striped skunk sighting (ICF 2016). The bobcat was documented in a pine forest. Although official surveys for carnivores have not been conducted in the analysis area, common species such as red fox and raccoon likely occur in all habitat types. Other species that potentially occur within the analysis area include least weasel and swift fox, which are SOC (**Section 3.10.2.7, Special Status Species**). The analysis area is within the overall range of the river otter and the historic range of the federally protected black-footed ferret and grizzly bear and the delisted gray wolf (MNHP 2018b); see **Threatened, Endangered, and Candidate Species** in **Section 3.10.2.7**.

3.10.2.2 Big Game

Game animals are considered economically important species in Montana, particularly big game species such as elk and deer. Big game mammals found within the analysis area include elk, mule deer, and pronghorn. Most of the analysis area also provides potential habitat for small game mammals such as cottontail rabbit.

In the falls of 2013 and 2014 and winters of 2014 and 2015, aerial surveys for big game were conducted in the analysis area, and in 2016 over the entire mine (ICF 2016, 2017). During the winter of 2013, mine-wide aerial surveys were conducted, which included the analysis area. Big game were also documented during other ground surveys occurring during various times of the year between 2013 and 2015. Long-term monitoring for big game has been ongoing at the Rosebud Mine since 1974 (Fritzen 1995; ICF 2016, 2017). Mule deer, elk, and pronghorn were all observed during the 2013 through 2015 baseline surveys (ICF 2016). Mule deer were the most abundant large game species detected during baseline surveys; elk were the least prevalent. Mule deer and pronghorn were the only big game mammals detected during the fall surveys of 2013 and 2014. Elk were observed during only the 2015 winter aerial survey.

Mule Deer

Mule deer occupy all ecosystems from grasslands to alpine tundra and are found throughout the western two-thirds of the US. They generally migrate seasonally, spending summer months at higher altitudes and moving to lower elevations during winter. Snow depth often influences mule deer migration between summer and winter range.

According to the MNHP database, the analysis area is considered year-round mule deer range (winter and summer). Mule deer likely migrate locally throughout the analysis area and occur in nearly every habitat on the Rosebud Mine. Previous studies indicate that they favor reclaimed areas and may seasonally avoid mixed-shrub areas (Fritzen 1995). During the four winter aerial surveys conducted in 2014 and 2015, mule deer were documented in every habitat type identified by ICF (2016). Highest deer numbers were observed in conifer forests and revegetation areas.

A study done by Fritzen (1995) indicated that mule deer populations on the Rosebud Mine increased between 1974 and 1994. Mule deer populations on the Rosebud Mine (and the nearby Big Sky Mine) peaked in 1994 with average densities of 12.1 mule deer per square mile. In 1995 mule deer numbers began to drop significantly and reached very low densities of 0.6 deer per square mile in 2004 and 2008 (ICF 2016). The precise reason behind the declines is not entirely known but may be due to a combination of increased hunting and extreme environmental factors (extreme winters and drought) over that time period. Since the drastic decline in mule deer numbers, populations have stabilized over the entire mine but have remained lower than the numbers observed in the mid-1980s to 1990s.

Between 2000 and 2013, mule deer average density was about 1.6 deer per square mile on the Rosebud and Big Sky Mines (ICF 2016). Average density of deer recorded during the four winter aerial surveys in Area B listed in **Table 74** is 0.75 deer per square mile. Winter 2014 aerial surveys conducted in the

analysis area detected 67 mule deer, whereas winter 2015 surveys detected 35 mule deer. **Table 74** summarizes mule deer survey numbers and habitat associations in the 2014 and 2015 winter aerial surveys in the analysis area.

Table 74. Mule Deer Survey Numbers and Habitat Associations in the Analysis Area in 2014 and 2015.

Survey Date	Individual Mule Deer Observed	Density (Deer/mi^2)	Habitat Association (Individual Deer Observed)				
			C	IP	RC	G	S
January 27, 2014	62	1.8	25	0	21	4	12
February 14, 2014	5	0.1	5	0	0	0	0
January 26, 2015	3	0.1	3	0	0	0	0
February 19, 2015	32	1.0	6	5	8	13	0

Source: ICF 2016.
Categories: C = conifer; IP = improved pasture; RC = revegetation community; G = grassland; S = sagebrush.

Elk

Elk are generalists and occur in a variety of habitats. They are adapted to the transitional habitat that occurs within the analysis area. Typically, elk inhabit forested areas that provide shelter and breeding habitat but will migrate to lower-elevation grasslands and shrublands to forage or during periods of heavy snow in higher-elevation forests. Winter range is often located in transitional areas that commonly occur in foothills with a southern or western exposure. Elk occur throughout the Rosebud Mine and the analysis area, with an affinity for conifer woodland habitat. Elk likely migrate locally within the analysis area. The analysis area is considered year-round elk range (winter and summer) (MNHP 2018a).

Elk observations have increased on the Rosebud Mine since monitoring began in 1974, although they tend to be more prevalent in western portions of the mine. In the far southwestern portion of the analysis area, only three bull elk were documented during the 2014 and 2015 winter aerial surveys. Three cow elk were also observed in May 2014 in the analysis area (ICF 2016).

Numbers were too low to calculate densities for the baseline surveys conducted in the analysis area between 2013 and 2015. Fall and winter densities within the entire Rosebud Mine ranged from 1.5 to 3.0 individuals per square mile between 2011 and 2016 (ICF 2011, 2014, 2017). It is likely that elk forage throughout the analysis area periodically at any time of year.

Pronghorn

American pronghorn inhabit grasslands and semidesert shrublands on rolling topography that provides good visibility (MNHP 2018a). Pronghorn tend to favor vast, open areas and are typically sensitive to human presence including residential, commercial, and industrial development (Sawyer et al. 2005). According to the MNHP database, the analysis area is considered year-round pronghorn range, although local migrations within the analysis area are likely.

Pronghorn observations on the entire Rosebud Mine have fluctuated over the data set between 1974 and 2016 with the average density over that time period being 1.3 pronghorn per square mile. During the fall of 2013 and 2014 surveys in the analysis area, four herds of pronghorn were documented during each visit. In 2013, 30 pronghorn were observed, and in 2014, 54 pronghorn were seen, resulting in average densities of 0.9 pronghorn per square mile and 1.6 pronghorn per square mile. During the winter aerial surveys conducted in 2014 and 2015, only one herd of 10 pronghorn was documented, resulting in a low

average density of 0.3 pronghorn per square mile. During other ground surveys conducted during spring and summer, pronghorn were occasionally seen in low numbers.

Pronghorn occur throughout Montana, except in the northwest portion of the state. It is likely that numbers on the Rosebud Mine, and more specifically the analysis area, fluctuate seasonally. Recent survey data as well as long-term data document relatively low densities of pronghorn, suggesting that they use habitat within the analysis area to a limited extent.

Other Big Game Species

Other ungulates with the potential to be present in the analysis area are white-tailed deer, moose, and bighorn sheep. White-tailed deer occur throughout Montana and are present in the Colstrip area, where they mainly use creek-bottom habitats (MDSL 1977). Moose prefer heavily wooded, riparian habitats of willows and aspens, which are not common in eastern Montana or the analysis area. One moose was observed northwest of the analysis area in the Area C portion of the Rosebud Mine in 2014 (Yde 2015). Before this recent observation, the last reported sighting of a moose in Rosebud County near Colstrip was 15–20 years ago (MNHP 2018a). Bighorn sheep occur in a variety of habitats in Montana, from alpine to grasslands. An important component of any bighorn sheep habitat is rough, rocky terrain used to escape from predators (Foresman 2001). Escape habitat is largely absent from the analysis area and the general region. Bighorn sheep have been reported in Rosebud County in the last 10–15 years (MNHP 2018a) and may represent individuals moving through the area on breeding dispersals instead of resident animals (Forbs and Hogg 2006).

3.10.2.3 Birds

Upland Game Bird Species

Upland game birds (e.g., sharp-tailed grouse, wild turkey, and ring-necked pheasant) have close association with various habitats in the analysis area and forage in various habitats including mixed tree and shrub grasslands, agricultural lands, and upland shrublands in the area.

Sharp-tailed grouse typically inhabit pockets of open grassland that contain interspersed shrubs and brush and some trees (MNHP 2018a). Breeding grounds (leks) for sharp-tailed grouse usually occur in open grassland pockets surrounded by shrubs. Nesting usually occurs within about ½ mile of a lek in habitat containing more cover. Foraging typically occurs within both grassland and shrubland habitat, and young typically forage within ½ mile of nests (MNHP 2018a).

Sharp-tailed grouse leks are classified in the same manner as greater sage-grouse leks (see **Greater Sage-Grouse** in **Section 3.10.2.7, Special Status Species**), using a classification system developed by the MSGHC program as outlined in EO 12-2015. The classification system defines leks as active, inactive, extirpated, or unconfirmed. Definitions for each classification (as outlined in the MSGHC program) are provided below, and lek data for sharp-tailed grouse are represented in **Figure 57** (MNHP 2018c).

- Active lek – Data supports existence of a lek. Supporting data defined as 1 year with two or more males lekking onsite followed by evidence of lekking within 10 years of that observation.
- Inactive lek – A confirmed active lek with no evidence of lekking in the last 10 years. Requires a minimum of 3 survey years with no evidence of lekking during a 10-year period.
- Extirpated lek – Habitat changes have caused birds to permanently abandon a lek as determined by the biologists monitoring the lek.
- Unconfirmed lek – Possible lek. Sharp-tailed grouse activity documented. Data insufficient to classify active status.

A total of 50 sharp-tailed grouse leks have been documented on the entire Rosebud Mine. Peak active lek averages ranged from 5.8 to 18.5 males between 1973 and 2013 on the mine with an overall average of 11.9 males per lek during that period. Individual grouse numbers have also fluctuated during the same period, ranging from 37 individuals in 2003 to 318 observed in 1980 (ICF 2014). Of the 50 leks over the entire mine, 26 of the documented leks occur within the analysis area in 2015 (**Figure 57**). A total of 14 active leks, 5 inactive leks, and 5 extirpated leks were documented in Area B. Additionally, in 2015, 2 unconfirmed areas of activity were documented. The average number of males documented in the analysis area between 2013 and 2015 ranges from 8.4 males in 2013 to 12.9 males in 2015 (10.0 in 2014), resulting in an overall average of 10.4 males in the analysis area during that period. The collective counts for male sharp-tailed grouse in the analysis area in 2015 totaled 90, not counting the 7 leks in which counts were not recorded. Lek sizes varied from 3 to 25 males in 2015.

Ring-necked pheasants and wild turkey have also been detected in the analysis area during baseline surveys between 2013 and 2015. A single pheasant was documented during ground surveys in 2013 in a riparian area, and one turkey was observed in a pine forest in April 2014. Although no other game birds (including additional pheasant or turkey) were observed, previous surveys in other permit areas of the Rosebud Mine have documented pheasant in upland grassland, lowland riparian habitat, and agricultural lands. Additionally, wild turkeys have been observed in lowland grassland and woodland habitat associated with Black Hank Creek northwest of the analysis area in the proposed Area F permit area.

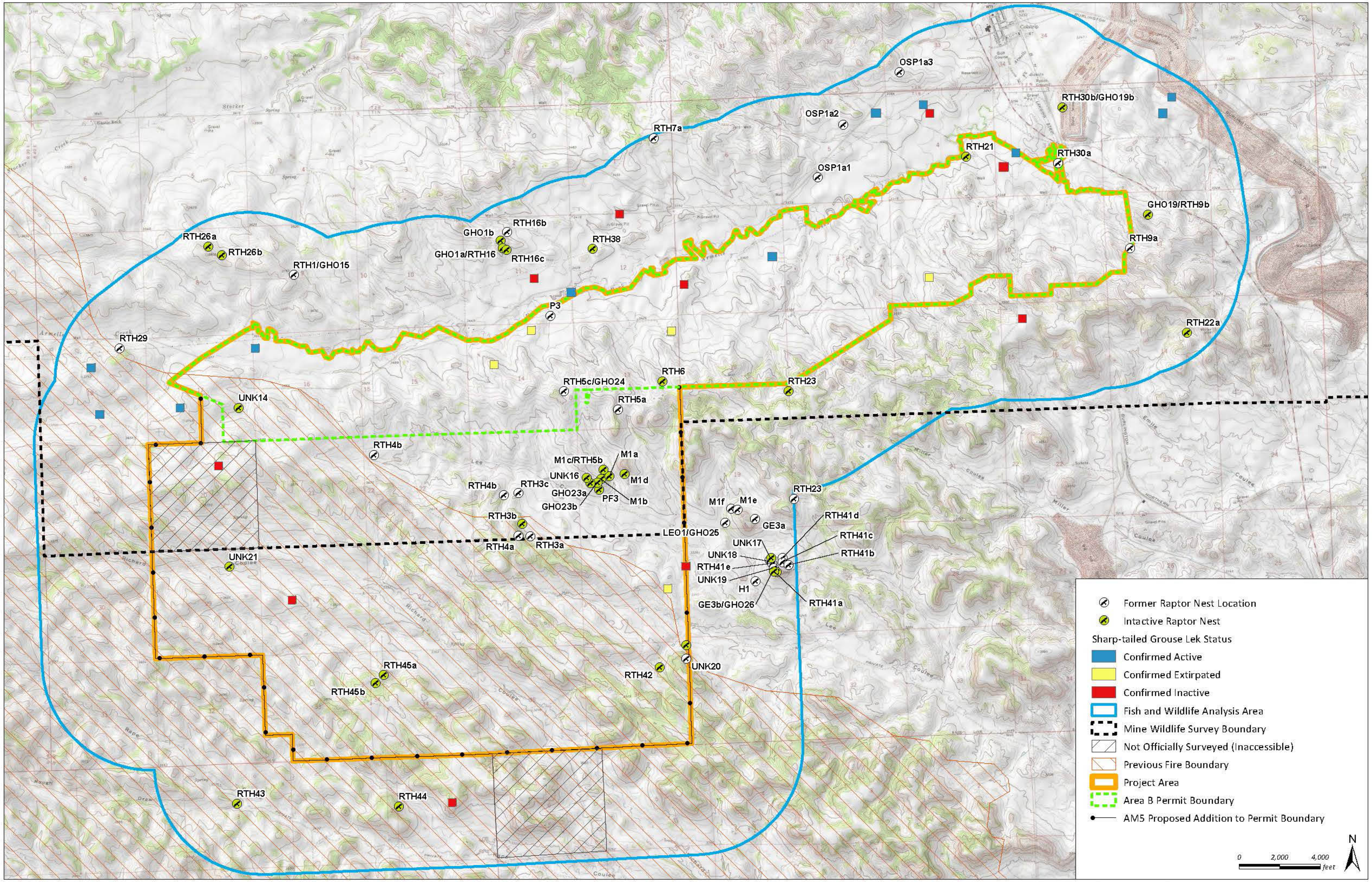

Figure 57. Sharp-Tailed Grouse Leks and Raptor Nests in the Analysis Area.

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Migratory Birds

Bird species use different habitat types in the analysis area for shelter, breeding, wintering, and foraging at various times of the year. The entire analysis area contains habitat for migratory birds. Baseline assessments conducted between 1972 and 2013 identified 175 avian species migrating through, breeding, or residing in some portion of the Rosebud Mine. Point count surveys (a tally of birds identified by sight and sound from a fixed position during a specified period of time—e.g., 3 minutes)) conducted during baseline surveys in 2013 and 2014 in the analysis area documented 59 avian species.

The most common songbirds documented in the analysis area during baseline assessments between 2013 and 2015 were western meadowlark, American robin, Brewer's blackbird, red-winged blackbird, house wren, vesper sparrow, mourning dove, chipping sparrow, brown-headed cowbird, and lark sparrow (ICF 2016). Of the 59 avian species documented during the 2013 and 2014 baseline assessments, 12 were documented in all habitat types in the analysis area. Species found in each habitat type are western meadowlark, American robin, lark sparrow, Brewer's blackbird, mourning dove, Bullock's oriole, cliff swallow, Cassin's kingbird, black-billed magpie, northern flicker, western kingbird, and chipping sparrow.

Species likely to nest among trees in grassland or agricultural habitats in the analysis area include mourning dove, eastern kingbird, and barn swallow. Species likely in lowland riparian areas or conifer/sumac woodlands include yellow warbler, western wood peewee, black-capped chickadee, brown thrasher, and black-headed grosbeak (ICF 2016). Three SOC were observed during the 2013 and 2014 surveys. The brown creeper and Brewer's sparrow were documented in the analysis area in 2013, and the red-headed woodpecker was observed in 2014. SOC are listed in **Table 76** and discussed in **Section 3.10.2.7, Special Status Species** below.

Shorebirds and Waterfowl

Shorebirds and waterfowl documented in the analysis area during the 2013 through 2015 surveys include long-billed curlew (an SOC), upland sandpiper, killdeer, Canada goose, and blue-winged teal. Most of the shorebirds and waterfowl listed above have wide distributions in Montana and potentially occur throughout the analysis area where habitat is available (MNHP 2018a). For information on MNHP shorebirds and waterfowl SOC, see **Section 3.10.2.7, Special Status Species**.

Raptors

Raptors frequently return to the same nest each year or build two or more alternate nest sites that they use in different years. Raptors also may build new nests and abandon existing nests over time. Raptor species documented nesting at the Rosebud Mine during long-term monitoring between 2003 and 2015 include red-tailed hawks (**Figure 58**), great horned owl, long-eared owl, burrowing owl, merlin, Cooper's hawk, prairie falcon, osprey, golden eagle, and northern goshawk. A total of eight species of raptors have nested in the analysis area during the long-term monitoring period at the Rosebud Mine. Species observed nesting include red-tailed hawk, great horned owl, merlin, osprey, northern harrier, long-eared owl, golden eagle, and prairie falcon. Nesting locations are shown on **Figure 57** (MNHP 2018c). Since 2012, only great horned owl, red-tailed hawk, and osprey have attempted to nest in

Figure 58. Red-tailed Hawk
(Nathan DeBoer MNHP)

the analysis area. One golden eagle (an SOC) nest has been documented in the analysis area but was destroyed in 2006 from natural causes (see **Section 3.10.2.7, Special Status Species**).

Monitoring efforts between 2003 and 2015 documented 110 known raptor nests on the entire Rosebud Mine, including the analysis area. In 2015 it was determined that a total of 61 raptor nests have been documented between 2003 and 2015 in the analysis area. This includes 12 new nests that were documented in Area B as of 2015 (ICF 2016). Out of the 61 identified nests between 2003 and 2015, 33 nests were intact in 2015 (not all were active, however). The majority of active nests documented during the 2015 wildlife survey in the analysis area were those of red-tailed hawks (4) and great horned owls (4). Additionally, one osprey pair attempted to nest on a mitigation platform that was constructed on the mine, but the nest failed (ICF 2016).

Nesting success varied between 2003 and 2015. In 2015 the raptor productivity average was 2.3 young per active nest in the analysis area, which is the highest average between 2013 and 2015. In 2013 raptor productivity in was the lowest ever recorded, with 0.0 young per nest in the analysis area (0.2 young per active nest throughout the entire Rosebud Mine) (ICF 2016). Severe weather conditions during the spring of 2013 may have contributed to the lower success rate.

3.10.2.4 Reptiles and Amphibians

Reptiles

Two species of reptile were observed in the analysis area during the 2013 through 2015 surveys. One prairie rattlesnake was observed in a revegetation area, and several painted turtles were observed near the shoreline of the reservoir in the southeast portion of the analysis area. The prairie rattlesnake is more frequent in grasslands, shrublands, and areas containing rocky outcrops, but can be found in almost any habitat type. The western painted turtle occurs in larger waterbodies including ponds and impoundments, and nests in adjacent uplands. Additionally, short-horned lizard, a SOC, has been previously documented in the analysis area (see **Section 3.10.2.7, Special Status Species**).

Four additional species have been observed in other areas of the Rosebud Mine. Reptiles documented in other areas of the Rosebud Mine are assumed to also occur in the analysis area. Additional species observed in other areas of the Rosebud Mine and that potentially occur in the analysis area include eastern yellowbelly racer, western plains garter snake, sagebrush lizard bullsnake, and milksnake.

The western plains garter snake is one of the most common snakes in other portions of the mine. This is due to its biology (a habitat and prey generalist), tolerance for cold temperature extremes, and widespread hibernacula availability. Eastern yellowbelly racers and short-horned lizards occur in grassland, shrubland, and agricultural habitats. Snakes and lizards such as the eastern yellowbelly racer, bullsnake, common gartersnake, western terrestrial garter snake, and sagebrush lizard potentially occur throughout analysis area.

Amphibians

Call surveys (a method to ID amphibians by sound from a fixed point during a specified period of time [1–2 minutes]—usually conducted in evenings or nighttime hours) conducted during baseline surveys in 2013 and 2014 in the analysis area recorded detections of five amphibian species: boreal chorus frog, northern leopard frog, Great Plains toad, plains spadefoot toad, and Woodhouse's toad (ICF 2016). Surveys were conducted at nine locations. The points were along creek sites and impoundment areas in native and reclaimed habitat. The boreal chorus frog was the most widespread and common amphibian that was detected. Woodhouse's toads were also fairly abundant and widespread. Boreal chorus frogs

were identified at every survey point; Woodhouse's toad was detected at seven out of nine survey points (ICF 2016).

The northern leopard frog, Great Plains toad, and plains spadefoot toad are SOC and are addressed in **Section 3.10.2.7, Special Status Species**.

3.10.2.5 Invertebrates

The majority of common invertebrates that occur within the analysis area are insects, arthropods, worms, and mollusks (snails). Which species occur within the analysis area is unknown. Soil invertebrates such as earthworms and burrowing arthropods and insects likely occur throughout the entire analysis area.

3.10.2.6 Aquatic Species

Aquatic Macroinvertebrates

An aquatic habitat assessment and benthic community survey were conducted in Area B in 2015 and 2016 and adjacent to Areas A, B, and C of the Rosebud Mine in 2014 (ERM 2016a, 2016b). All wetlands in the AM5 permit boundary were surveyed during the 2015 and 2016 surveys. In 2014, the assessment and survey were conducted on East Fork Armells Creek on October 9, 2014. The 2014 assessment and survey did not include the AM5 expansion area. The 2015 and 2016 surveys identified 29 taxa of macroinvertebrate species. The 2014 survey identified 25 taxa of macroinvertebrate species. The predominant taxonomic groups identified during all surveys were aquatic worms, snails, damselflies, caddisflies, beetles, midges, and fly larvae (see also **Section 2.4.8.3, Aquatic Macroinvertebrate Surveys**).

Fish

No fish surveys have been conducted in the analysis area. Open water areas in the analysis area may periodically harbor notropids (minnows and chubs) that become established under favorable conditions through bird dispersion. This occurrence is rare and ephemeral due to winter kill and to high temperatures and low oxygen during summer. Lee Coulee and Richard Coulee, which drain into Rosebud Creek and a portion of West Fork Armells Creek, which drains to Armells Creek (all of which drain into the Yellowstone River), occur in portions of the analysis area. The Yellowstone River contains permanent fish communities. However, aquatic species habitat is limited in the analysis area due to the ephemeral or intermittent nature of drainages and isolated stock ponds. The nearest permanent fish communities occur in the watershed areas east of the analysis area in Rosebud Creek and west in the Sarpy Creek drainage. One aquatic fish species of concern, the sauger, potentially occurs in Rosebud Creek and is addressed under **Section 3.10.2.7, Special Status Species**.

3.10.2.7 Special Status Species

Threatened, Endangered, and Candidate Species

According to the USFWS Information, Planning, and Conservation System (IPaC), three federally endangered species may be found in Rosebud County, specifically within the analysis area (**Table 75**). The IPaC system is consistent with the USFWS Ecological Services Montana Field Office's county list of threatened and endangered species.

Table 75. Federally Endangered Species Potentially Occurring in Rosebud, Treasure, Big Horn, and Powder River Counties.

Common Name	Scientific Name	Status* Federal/State	General Habitat Affinity	Habitat in Analysis Area
Birds				
Whooping crane	*Grus americana*	E	Wet meadows and marshes	None
Mammals				
Black-footed ferret	*Mustela nigripes*	E	Active prairie dog towns or complexes >80 acres in size	None
Fish				
Pallid sturgeon	*Scaphirhynchus albus*	E	Slow-moving, large rivers	None

Source: USFWS 2018.
*E = Endangered; T = Threatened.

Whooping Crane

The whooping crane was listed as an endangered species in 1967 when the population was down to less than 100 individuals. The whooping crane is the tallest bird in North America and can reach nearly 1.5 meters (4.9 feet) in height (USFWS 2012). Adults are white with a patch of black feathering on the nape and red or crimson feathers extending down across the throat. Whooping cranes can be confused with sandhill cranes, although sandhill cranes are generally dominated by gray plumage. Whooping cranes have been known to forage in croplands and along wetlands where they feed on a variety of small insects, fish, and berries (MNHP 2018b).

The whooping crane is endemic to North America and historically ranged from the Arctic Sea to Central Mexico and from Utah to the eastern seaboard. Currently there are three wild populations remaining. Only one wild population is self-sustaining, which is the population that migrates between Aransas, Texas, and Wood Buffalo National Park in Canada (USFWS 2012). Experimental reintroductions have been attempted in the Rocky Mountain region without success. The whooping crane is a passing migrant and has occasionally been observed in eastern Montana during the spring and fall migrations between northern Canada and southern Texas. No breeding of this species has been documented in Montana, and observations are generally incidental near the analysis area.

Black-Footed Ferret

The ferret was listed as endangered in 1967 under a precursor to the ESA of 1973. USFWS has not designated any critical habitat for the ferret. In Montana, all known black-footed ferret populations are those that have been reintroduced. The black-footed ferret historically inhabited areas of the Great Plains and intermountain west. Except for reintroduced populations, the black-footed ferret has been extirpated from the majority of its range. This species depends on prairie dogs (*Cynomys* spp.) for food and uses prairie dog burrows for shelter. Over the past century, prairie dog distribution has been substantially reduced due to habitat loss, plague, and prairie dog control efforts (USFWS 1993).

Black-footed ferrets feed almost exclusively on prairie dogs, although other small animals may be eaten opportunistically. This species feeds on its prey underground and has been known to drag prey more than 1,000 feet during the winter (MNHP 2018b). Black-footed ferrets do not inhabit single burrows but are nomadic and travel from burrow to burrow (MNHP 2018b).

In Montana, ferret populations are those that have been reintroduced and are monitored (MNHP 2018b). Known black-footed ferrets coincide with black-tailed prairie dog (*C. ludovicianus*) colonies. Black-tailed prairie dogs occur throughout eastern Montana and are considered a SOC due to their value to prairie ecosystems. USFWS encourages conservation of black-tailed prairie dog colonies because of their value

to prairie ecosystems and potential for black-footed ferret reintroductions. No black-tailed prairie dog colonies suitable for black-footed ferrets (greater than 80 acres in size) are present in the analysis area. Additionally, no black-footed ferrets have been reintroduced into the analysis area (MNHP 2018b). The nearest black-footed ferret reintroduction site is on the Crow Indian Reservation 66 kilometers (46 miles) southwest of the analysis area. Since the black-footed ferret is unlikely to occur within the analysis area, this species will not be discussed further in this document.

Pallid Sturgeon

The pallid sturgeon is listed as endangered throughout all of its known range. This species formerly inhabited the Missouri and Mississippi River systems from Montana to Louisiana. Its decline is due to habitat loss from damming of the Missouri River.

This species is a large fish characterized by its pale gray-whitish color and bony scutes (bony plate) on its back, head, and sides (MNHP 2018b). It inhabits large, slow, turbid waters with sandy bottoms. In Montana, this species is known to occur in the Missouri and Yellowstone Rivers. The diet of the pallid sturgeon is thought to consist of aquatic insects and small fish (MNHP 2018b).

The nearest known occurrences of this species to the Rosebud Mine, including the analysis area, are 60 miles away along lower reaches of the Yellowstone River, northeast of Miles City, which it may inhabit during the summer months. Sturgeons use the Missouri River below the confluence of the Yellowstone River during the spring, winter, and fall (MNHP 2018b). No habitat (large, turbid rivers) for pallid sturgeon exists within the analysis area. Since the pallid sturgeon is unlikely to occur within the analysis area, this species will not be discussed further in this document.

Montana Natural Heritage Program Species of Concern

According to MNHP and FWP, 44 SOC potentially occur in Rosebud County (MNHP 2018b). SOC in the county include 8 mammal, 25 bird, 2 fish, 6 reptile, and 3 amphibian species.

Table 76 identifies MNHP SOC and their preferred habitats that have been documented in the analysis area since 1973 (MNHP 2018c). Eight SOC (northern leopard frog, plains spadefoot toad, golden eagle, northern goshawk, great blue heron, long-billed curlew, McCown's longspur, and hoary bat) have been documented in the analysis area.

Figure 59 shows bird and mammal SOC, and **Figure 60** shows reptile and amphibian SOC at locations documented by MNHP within the analysis area (MNHP 2018c).

Table 76. MNHP Species of Concern Documented in the Direct Impacts Analysis Area.

Common Name	Scientific Name	Status	General Habitat Affinity	Likely to Occur in Analysis Area? (Y/N)
Amphibians				
Great Plains toad	*Anaxyrus cognatus*	S3	Grasslands, and shrublands with nearby water sources including wetlands, stock tanks, streams, springs, and stock ponds	Y
Northern leopard frog	*Lithobates (Rana) pipiens*	S1, S4[1]	Wetlands, stock tanks, streams, springs, and stock ponds	Y
Plains spadefoot toad	*Spea bombifrons*	S3	Grasslands, and shrublands with nearby water sources including wetlands, stock tanks, streams, springs, and stock ponds	Y
Birds				
Baird's sparrow	*Centronyx bairdii*	S3; B	Grasslands	Y
Black-backed woodpecker	*Picoides arcticus*	S3	Conifer forest burns	Y
Black-billed cuckoo	*Coccyzus erythropthalmus*	S3; B	Riparian woodlands	Y
Bobolink	*Dolichonyx oryzivorus*	S3; B	Moist grasslands	Y
Burrowing owl	*Athene cunicularia*	S3; B	Open grasslands with abandoned burrows dug by mammals	N
Brewer's sparrow	*Spizella breweri*	S3; B	Sagebrush shrublands	Y
Brown creeper	*Certhia americana*	S3	Moist conifer forests	Y
Cassin's finch	*Haemorhous cassinii*	S3	Dry, coniferous forest	Y
Chestnut-collared longspur	*Cakcaruys ornatus*	S2; B	Grasslands	Y
Common loon	*Gavia immer*	S3; B	Mountain lakes with emergent vegetation	N
Ferruginous hawk	*Buteo regalis*	S3; B	Shrub-grasslands, mixed-grass prairie, sagebrush grasslands, and sagebrush steppe	Y
Greater sage-grouse	*Centrocercus urophasianus*	S2	Shrub-grasslands, mixed-grass prairie, sagebrush grasslands, and sagebrush steppe	N
Golden eagle	*Aquila chrysaetos*	S3; BGEPA	Canyons, cliffs, and bluffs	Y
Great blue heron	*Ardea herodias*	S3	Riparian areas along major rivers and lakes	Y
Lewis's woodpecker	*Melanerpes lewis*	S2; B	Riparian woodlands	Y
Loggerhead shrike	*Lanius ludovicianus*	S3, B	Upland shrublands	Y
Long-billed curlew	*Numenius americanus*	S3, B	Mixed-grass prairie and moist meadows	Y
McCown's longspur	*Calcarius mccownii*	S3; B	Rangeland and shortgrass prairie	Y
Mountain plover	*Charadrius montanus*	S2: B	Grasslands	Y

Table 76. MNHP Species of Concern Documented in the Direct Impacts Analysis Area.

Common Name	Scientific Name	Status	General Habitat Affinity	Likely to Occur in Analysis Area? (Y/N)
Northern goshawk	*Accipiter gentilis*	S3; B	Mature or old-growth, coniferous, or mixed conifer/aspen forests with relatively open understories	Y
Pinyon jay	*Gymnorhinus cyanocephalus*	S3	Low-elevation ponderosa pine limber pine-juniper woodlands	Y
Red-headed woodpecker	*Melanerpes erythrocephalus*	S2; B	Riparian woodlands	Y
Sage thrasher	*Oreoscoptes montanus*	S3; B	Upland shrublands	Y
Sprague's pipit	*Anthus spragueii*	S3; B	Mixed-grass grasslands	N
Veery	*Catharus fuscenscens*	S3; B	Riparian forest	Y
Fish				
Paddlefish	*Polyodon spathula*	S2	Slow, quiet waters of large rivers or impoundments	N
Sauger	*Sander canadensis*	S2	Larger, turbid rivers; muddy shallows of lakes and reservoirs	N
Mammals				
Black-tailed prairie dog	*Cynomys ludovicianus*	S3	Shortgrass prairie, grasslands	N
Fringed myotis	*Myotis thysanodes*	S3	Riparian areas within coniferous woodlands, caves; typically roosts in rock crevices, caves, and abandoned buildings	Y
Hoary bat	*Lasiurus cinereus*	S3	Deciduous and occasionally coniferous woodlands; typically roosts in trees	Y
Little brown myotis	*Myotis lucifugus*	S3	Variety of habitats including buildings, woodlands, caves, and mines; forages over water	Y
Merriam's shrew	*Sorex merriami*	S3	Shrublands, grasslands, and agricultural lands dominated by pasture grasses	Y
Pallid bat	*Antrozous pallidus*	S3	Woodlands, including ponderosa forests and shrublands	Y
Spotted bat	*Euderma maculatum*	S3	Cliffs and rock crevices	Y
Townsend's big-eared bat	*Corynorhinus townsendii*	S3	Woodlands, rocky outcrops, caves, tunnels, and abandoned mines; occasionally roosts in tree cavities	Y

Table 76. MNHP Species of Concern Documented in the Direct Impacts Analysis Area.

Common Name	Scientific Name	Status	General Habitat Affinity	Likely to Occur in Analysis Area? (Y/N)
Reptiles				
Plains hognose snake	*Heterodon nasicus*	S2	Sagebrush-grasslands and gravely and sandy soil	Y
Short-horned lizard	*Phyrnosoma herandesi*	S3	Sandy gravely soil	Y
Snapping turtle	*Chelydra serpentine*	S3	Prairie rivers and streams	N
Spiny softshell turtle	*Apalone spinifera*	S3	Prairie rivers and large streams	N
Western milksnake	*Lampropeltis triangulum*	S2	Rocky outcrops; shrublands; grasslands	Y
Western smooth greensnake	*Opheodrys vernalis*	S2	Wetlands; forested areas with open meadows	Y

Source: Adams and Hayes 2000; ICF 2016; MNHP 2018b, 2018c.
S1: At very high risk of extirpation in the state due to very restricted range, steep declines, severe threats, and other factors.
S2: At high risk of extinction or extirpation in the state due to very limited or declining numbers, range, or habitat or extirpation in the state.
S3: At risk of extinction or extirpation in the state due to very limited or declining numbers, range, or habitat, even though it may be abundant in some areas.
S4: At a fairly low risk of extirpation in the state due to an extensive range or many populations or occurrences but with possible cause for some concern.
B: Protected under the Migratory Bird Treaty Act (MBTA).
BGEPA: Protected under the Bald and Golden Eagle Protection Act.
[1] Critically imperiled in mountain areas in western Montana; apparently secure on the Great Plains in eastern Montana.

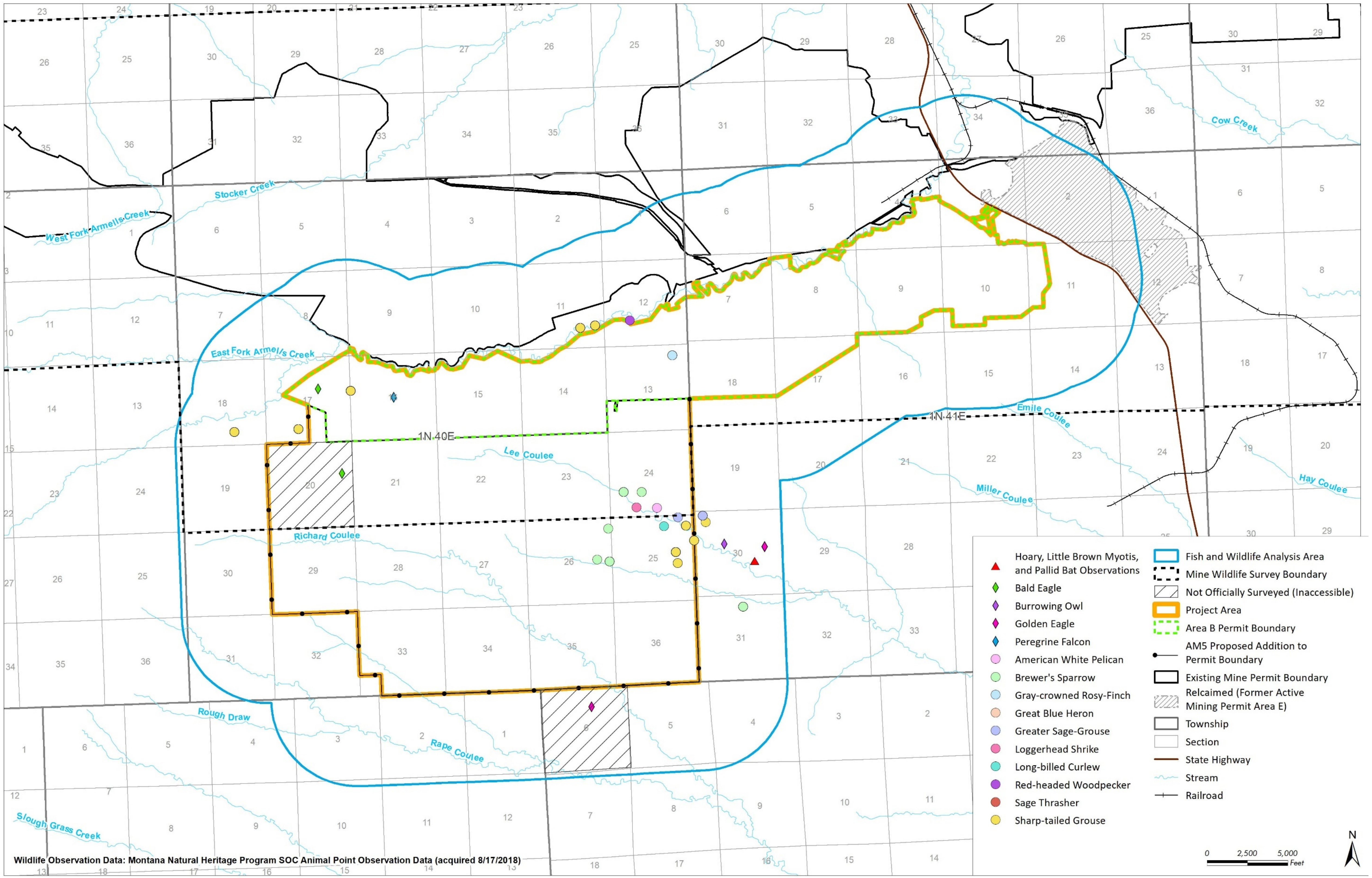

Figure 59. MNHP Bird and Mammal Species of Concern in the Analysis Area.

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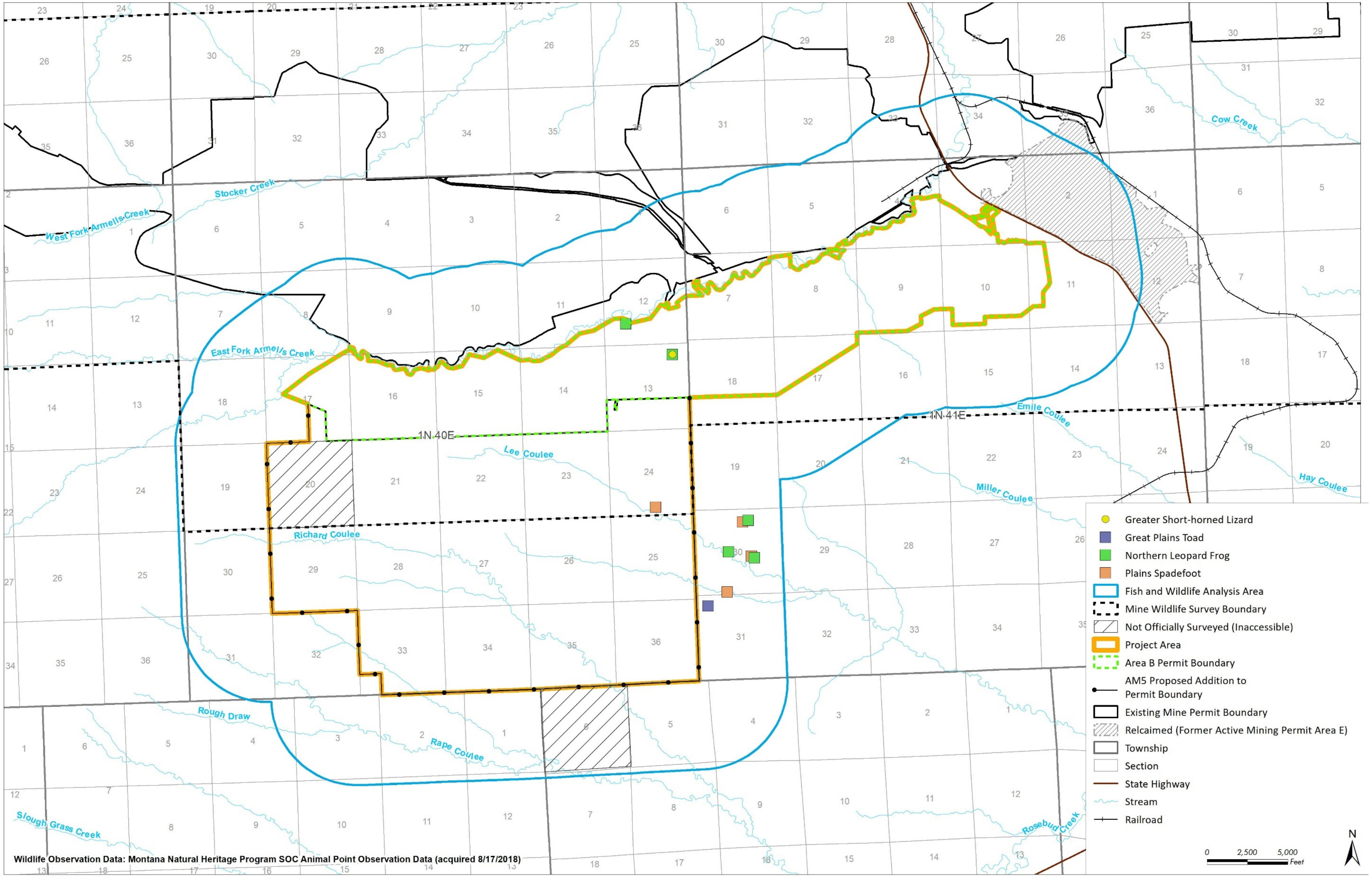

Figure 60. MNHP Reptile and Amphibian Species of Concern in the Analysis Area.

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Mammals

Bats

Bat surveys have been conducted in the analysis area (in the former Big Sky Mine permit area 0.7 mile east of the AM5 permit area. Eight bat species classified as either SOC or potential SOC were detected nearby during the 2011 and 2017 surveys for the Big Sky Mine and proposed permit Area F and are listed above in **Table 73**: Townsend's big-eared bat, little brown myotis, hoary bat, silver-haired bat, eastern red bat, pallid bat, spotted bat, and fringed myotis. In 2013, pallid, silver-haired, and hoary bats and little brown myotis were documented in Area C of the Rosebud Mine (MNHP 2018b). Additionally, during the spring and summer of 2014 and 2015, hoary bats, little brown myotis, and pallid bat were documented near Big Sky Mine Pond B-9 within the 1-mile buffer of the analysis area (ICF 2016; MNHP 2018b, 2018c; **Figure 59**).

Townsend's big-eared bat, which roosts in underground mines, tunnels, caves, and rock outcrops, could occur in existing rocky outcrops within the Project area. The little brown myotis is found in a variety of habitats including buildings, woodlands, caves, and underground mines and typically forages over water; it may be found foraging near water sources in the Project area. The hoary bat, eastern red bat, and silver-haired bat are found in deciduous and occasionally coniferous woodlands and typically roost in trees. The pallid bat and spotted bat are found in upland woodlands, including ponderosa forests, open meadows, and shrublands. The fringed myotis is found in riparian areas within coniferous woodlands or in caves and typically roosts in rock crevices, caves, and abandoned buildings.

Upland and Other Game Birds

Greater Sage-Grouse

The greater sage-grouse is listed as a SOC (**Figure 61**). The species was federally listed as a candidate species. However, in 2015 USFWS determined that the listing was "not warranted" and that the greater sage-grouse remains relatively abundant throughout its range (USFWS 2015). The greater sage-grouse potentially occurs in Rosebud County. It is the largest grouse species in North America and occurs throughout the northern portions of the intermountain west. Greater sage-grouse depend on a range of habitats within sagebrush shrublands throughout the west but require large, continuous tracts of open sagebrush for breeding, nesting, brood-rearing, and winter habitat. Each spring greater sage-grouse perform elaborate mating displays in areas that are known as leks. A lek usually consists of a clearing surrounded by sagebrush habitat (MSGWG 2005). Nesting season occurs from April until July.

Figure 61. Greater Sage-Grouse
(Bob Martinka MNHP)

No greater sage-grouse leks have been observed or documented within the greater sage-grouse analysis area (ICF 2016). According to FWP, greater sage-grouse have been documented west, northwest, and southeast of the proposed mine site; however, long-term monitoring for greater sage-grouse has been ongoing within the Rosebud Mine area since 1973, and no greater sage-grouse leks have been observed or

documented within the analysis area. In 1984 and 1985, two male greater sage-grouse were observed in a sharp-tailed grouse lek near the mine; no others have been reported since that time (ICF 2014).

The greater sage-grouse analysis area contains sagebrush habitat fragmented by forest and grassland. It is located within the overall range of the greater sage-grouse and in the general habitat area outlined in the EO. The analysis area is not in a designated core area or connectivity area. Additionally, the greater sage-grouse analysis area is not located within any priority habitat management areas identified in the BLM Miles City Resource Management Plan. The nearest core area is located north of Forsyth in Rosebud County (MDNRC 2018).

Migratory Birds

MNHP songbird SOC were documented in varying habitats throughout portions of the Rosebud Mine during the 2011 through 2016 surveys (ICF 2011, 2013, 2014, 2016, 2017). During point-count surveys in 2013 and 2014, a red-headed woodpecker, Brewer’s sparrow, and brown creeper were documented. The red-headed woodpecker was documented in an open woodland area in Area B in 2013 and 2014. In 2013, two Brewer’s sparrows were seen in sagebrush habitat. During that same period (June 2013), a brown creeper was seen in a pine stand (coniferous forest).

Three other SOC were incidentally observed during the 2013 and 2014 surveys: golden eagle (discussed below), long-billed curlew (discussed below), and pinyon jay. The pinyon jay was observed in pine forest habitat in October 2013. Other SOC have been documented historically in the analysis area including burrowing owl, loggerhead shrike, and sage thrasher (**Figure 59**; MNHP 2018c).

Shorebirds and Waterfowl

In 2012 a great blue heron was observed flying over the reclamation area of the Rosebud Mine, and in 2013 a long-billed curlew was observed in a pond in the analysis area (**Figure 59**; ICF 2016). Great blue herons have been documented in the analysis area and in Areas C and D of the Rosebud Mine in previous years (MNHP 2018c). Because aquatic habitat is limited in the direct impacts analysis area, herons, cranes, egrets, and other waterfowl have not been documented nesting in the area.

Raptors

Three golden eagles were observed during the 2013 surveys. Two eagles were observed flying over the analysis area in April 2013, and a juvenile was observed in October 2013. One golden eagle nest was documented in the analysis area before 2006 but was destroyed in 2006 by natural causes (**Figure 59**; ICF 2016).

Reptiles

One reptile SOC—short-horned lizard—has been documented in upland grassland in Area B (**Figure 62**). Other species including the western milksnake and plains hognose snake have been observed in other areas adjacent to the Rosebud Mine. The short-horned lizard occurs within the southern portion of the state, where suitable habitat exists (MNHP 2018b).

Figure 62. Short-Horned Lizard
(Paul Hendricks MNHP)

Amphibians

The northern leopard frog, Great Plains toad, and plains spadefoot toad have been documented on or near the mine (**Figure 60**). The three species were detected at various sites in the analysis area. The northern leopard frog was detected mostly in impoundment areas in native habitat and at creek sites. Great Plains toads were detected in impoundment areas in native and reclaimed habitat, and plains spadefoot toads were most prevalent near impoundment areas in reclaimed habitat. These species are also found in other permit areas of the Rosebud Mine (ICF 2016).

Fish

No fish SOC occur within the direct impacts analysis area. However, the sauger is a SOC that potentially occurs in Rosebud Creek directly downstream of the analysis area. The sauger is related to the walleye and is found most commonly in sections of the Missouri and Bighorn Rivers.

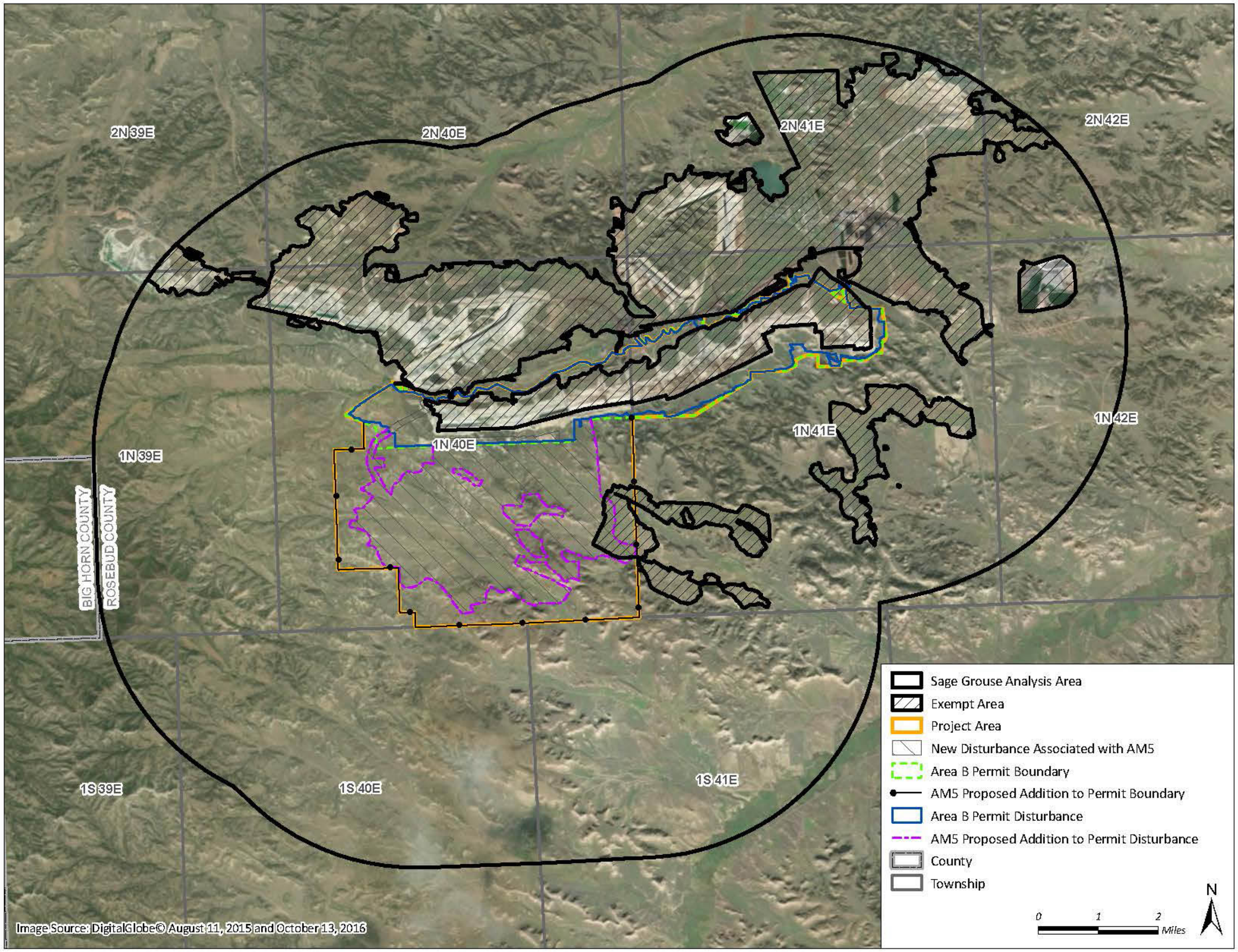

Figure 63. Greater Sage-Grouse Analysis Area.

3.10.3 Environmental Consequences

This section discloses the direct, secondary, and cumulative impacts that the No Action Alternative (Alternative 1) and the Proposed Action (Alternative 2) would have on fish and wildlife resources, including special status species. The analysis areas are described in **Section 3.10.1.2, Analysis Area and Methods**.

3.10.3.1 Alternative 1 – No Action

Under the No Action Alternative, the AM5 expansion area (proposed Project) would not be permitted. Westmoreland Rosebud would complete mining and reclamation in the Area B permit area according to its currently approved operating permit. Mining is permitted in Area B until 2030, and initial stages of reclamation would be completed within 2 years of the cessation of mining. There would be no Project impacts on fish and wildlife resources, as described in **Section 3.10.2, Affected Environment**, because any changes or ground disturbances associated with development of the Project area would not occur.

The No Action Alternative would not change the status of the existing Area B permit area or other permit areas, including Area F, of the Rosebud Mine (**Section 2.2, Existing Operating Permits, Disturbance, and Reclamation**), nor would it affect the federal coal lease MTM 80697 (tracts in Areas B and C) modification application, which is currently being evaluated by the BLM (**Section 3.1.4.2, Related Future Actions**). Wildlife use and habitat in the analysis area would remain unchanged, except as affected by ongoing mining activities and associated reclamation in the existing Area B permit area and other permit areas of the Rosebud Mine.

3.10.3.2 Alternative 2 – Proposed Action

Direct Impacts

Fish and Wildlife Species

Potential adverse impacts from the Proposed Action include loss of habitat due to expansion of Area B by 9,108 acres, and delay of reclamation of haul and ramp roads in the existing Area B permit area. A total of 5,711 acres of habitat would be disturbed in the analysis area. Additional adverse impacts would occur from surface disturbances that remove vegetation, result in direct mortality of or injury to wildlife, or cause behavioral shifts such as a change in movement or displacement to other areas due to increased human activity and noise from blasting and mining operations.

Wildlife species are closely tied to habitat and the plant communities that characterize these specific habitats. Thus, impacts on wildlife are generally related to impacts on the plant communities as described in **Section 3.8, Vegetation**, **Section 3.9, Wetlands**, and **Section 3.10.1.3, Fish and Wildlife Habitat Characteristics**. Reclamation of impacts on vegetation communities (at a 1:1 ratio based on acreage) would eventually offset some adverse wildlife impacts, although species composition and maturity of certain communities may take years, which may result in long-term adverse impacts or shifts in species composition. Mortality or injury to wildlife may occur from habitat removal (especially for less-mobile species including ground-nesting birds, small mammals, reptiles, and amphibians) and collisions with mine-related vehicles. Restricted movement of less-mobile species due to barriers such as construction fences, pits, and stockpiles is also possible during active mining. Animals that are displaced may move to less suitable habitat or suitable habitat occupied by predators or competitors, which could result in lower survival and reproduction rates.

Reclamation after mining would occur through various methods (i.e., grading and seeding areas); vegetation species composition and structure would take time to establish and mature. For example, reclaimed conifer areas may initially see an influx of early successional communities before a coniferous or deciduous overstory develops (Buehler and Percy 2012). Wildlife favoring early successional stages of plant growth would be the first to move into a reclaimed area. As vegetation matured, reclaimed mined areas would support a greater diversity of wildlife.

Because mining would be conducted in phases, surface disturbance and vegetation removal would occur incrementally over 30 years. Additionally, ramp roads in the existing Area B permit area would not be reclaimed for an additional 15 years due to development of the AM5 expansion area. Existing haul roads in the current Area B permit area would delay reclamation in those areas because they would continue to be used and expanded into the AM5 expansion area. Mined-out land of the existing Area B permit area would be reclaimed sooner. Initial stages of reclamation (grading, application of soil, and seeding) of disturbed lands would begin 2 years after the removal of coal and would occur in phases throughout the life of the mine until all disturbed lands were revegetated (see **Section 2.4.5, Reclamation Plan**). Land in the Project area that has been reclaimed and successfully revegetated, along with unmined land, would provide habitat for wildlife during mine operations.

Mammals

Small Mammals

The Proposed Action would result in short- and long-term, adverse impacts on small mammals. Direct losses of small mammals due to habitat loss would occur since mobility of small animals is limited and many use burrows for shelter. It is possible that localized small-mammal populations (mice, voles, shrews, and lagomorphs) would decline during land clearing. Some small mammals may be displaced to adjacent land, which could lead to increased competition.

Long-term impacts would depend on how quickly different habitat types established after reclamation, which would be delayed along ramp roads in the existing Area B permit area. Grasslands would mature more quickly than woodland and shrub-grassland habitat. Reclaimed areas would first be revegetated with early successional species, providing habitat for grassland-associated species. Habitat for small mammals adapted to woodland habitats would take longer to recover. Many small mammals (lagomorphs and rodents) would be able to quickly recolonize areas due to high reproductive rates. These species tend to adapt to reclaimed areas sooner. Generalist species such as deer mice and cottontail rabbits would establish more quickly than species with specialized habitat requirements.

Bats

Due to expanded surface disturbances and vegetation removal, mining in the analysis area would impact a variety of habitats used by bats. Vegetation removal would reduce available habitat for roosting and foraging. Common wide-ranging species such as big brown bat and long-eared myotis would be impacted by vegetation removal in all habitat types.

Other impacts on local bat populations would likely occur over the long term due to potential changes in habitat over time. Generalist species would likely recover more quickly due to adaptation to different habitats. Impacts on forest- and shrub-dwelling species such as the hoary bat, pallid bat, and Townsend's big-eared bat would last longer and could result in a decline in these species in the analysis area. However, these localized impacts would not likely affect bat populations outside of the analysis area.

Carnivores

The impacts on small carnivores from the Proposed Action are expected to be short-term due to relatively high reproductive rates and ability to adapt to human presence. Smaller carnivores such as skunk, raccoon, and weasel may decline in the analysis area due to habitat loss from mine-related surface disturbance. Most large carnivore sightings in the Project area have been incidental. Because larger carnivores are somewhat nomadic and pass through areas while foraging, impacts are expected to be adverse due to mining operations. Larger carnivores including coyote, black bear, and mountain lion are mobile and would avoid active mine areas. Predatory species would likely return after reclamation and recolonization by prey species.

Big Game Animals

Mule Deer, Elk, and Pronghorn

Direct impacts on large game from mining in the analysis area would include loss of habitat due to mine-related surface disturbances and vegetation removal. Over the life of the mine, about 5,711 acres of grassland, shrub-grassland, conifer, and agricultural habitat would be directly impacted. Habitat loss, combined with other mine-related activity such as increased human activity and noise from blasting and mining operations, could result in behavioral changes in large game. Behavioral changes may affect movement patterns, resulting in displacement of large game to other areas.

Mule deer are the most abundant of the large game animals documented on the Rosebud Mine, including the analysis area. Mule deer are habitat generalists (populations have been documented in nearly every habitat type in the Rosebud Mine), and ample nearby suitable habitat is available for mule deer displaced by mining (**Table 74**). Relatively low numbers (compared to mule deer) of elk and pronghorn have been documented in the direct impacts analysis area (see **Section 3.10.2.2, Big Game**). Mining in the Project area may affect elk and pronghorn individuals but would not likely affect regional populations of either species because of the limited suitable habitat for these species in the Project area compared to surrounding areas. Monitoring of reclaimed habitat near active portions of the Rosebud Mine, including the existing Area B permit area, indicates that large game animals have continued to inhabit areas adjacent to active mining areas throughout the duration of mining activities (ICF 2011, 2013, 2014, 2016).

Large game animals are highly mobile and able to move to undisturbed areas relatively readily; however, mine-related disturbance may not preclude big game animals from using active mine areas. Annual monitoring reports from the Rosebud Mine indicate that large game animals do use active mine areas, including soil stockpiles, spoil piles, and areas in the process of reclamation (ICF 2013, 2016).

Movement through the Project area is already somewhat restricted in the existing Area B permit area where mining is occurring and would become restricted in the AM5 expansion area due to placement of open pits, roads, stockpiles, and staging areas associated with mining activities, as well as additional fencing (if needed). Pronghorn seem to be most susceptible to such barriers (Sawyer et al. 2005). Delayed reclamation of ramp roads in the existing Area B permit area, along with extension of the roads into the AM5 expansion area, would result in an increase in such barriers within the analysis area. Although no big game movement corridors have been identified in the Project area, mining activities could shift big game movement patterns.

Eventual postmine reclamation would establish vegetation communities similar to pre-mine conditions. It is likely to take several years after reclamation for vegetation communities to mature and return to comparable wildlife carrying capacity that pre-mine conditions provided. Eventual development of

mature vegetation in reclaimed areas is anticipated to support large game animals in similar numbers as pre-mining. Since it would be several years before mined areas in the analysis area were reclaimed, impacts are anticipated to be long-term.

Other Big Game Species

White-tailed deer, bighorn sheep, and moose have not been documented in the analysis area, although limited suitable habitat for these species is available. Given the lack of documented use of the analysis area by these species, impacts are likely to be negligible.

Birds

Upland Game Bird Species

Mining operations in the analysis area would impact habitat used by upland game birds. Wild turkey, sharp-tailed grouse, and ring-necked pheasant are all associated with various habitats in the analysis area. Mining activities would likely displace upland game birds from active mining areas within the analysis area to other areas. Each of the species listed above is somewhat mobile and is likely to avoid areas of active mining and disturbed habitat in the Project area.

A total of 14 active sharp-tailed grouse leks were identified in in the analysis area in 2015 (**Figure 57**; ICF 2016). Additional leks occur near the Project area boundary. Previous annual monitoring from other permit areas of the Rosebud Mine, and studies from the Absaloka Mine to the west, show that impacts from mining activities on sharp-tailed grouse appear to be short-term. Sharp-tailed grouse returned to reclaimed portions of Area C of the Rosebud Mine 2 years after active mining ceased and reclamation was implemented (Yde 2015). Similar results may occur for sharp-tailed grouse and perhaps other game birds in the analysis area, although a delay in reclamation of active roads in the existing Area B permit area would result in long-term impacts. Mitigation and minimization measures such as soil salvaging outside of the spring months, phasing mine development areas, and establishing vegetation after mining would reduce overall impacts on sharp-tailed grouse. Planned eventual reclamation after mining disturbance would establish similar habitats to those currently used by all game birds. Reclamation would begin in portions of the existing Area B permit area that have been mined out in the short term, allowing some repopulation by upland game birds. However, existing ramp roads in the existing permit area and portions of the AM5 expansion area would be actively mined for several years, resulting in overall long-term adverse impacts on upland game birds.

Migratory Birds

Mining activities could cause abandonment or direct removal of nests if land-clearing activities occur during the breeding season. Bird use of undisturbed lands in the Project area or adjacent lands in the analysis area could also be displaced as a result of human activity and noise from mining and vehicle travel.

Mining in the analysis area would impact a variety of habitats used by migratory birds. Vegetation removal would reduce available habitat for breeding, roosting, and foraging songbirds and other avian species. Common wide-ranging species such as meadowlark, American robin, and lark sparrow would be impacted by vegetation removal in all habitat types. Vesper sparrow, Brewer’s sparrow, eastern kingbird, and similar species would be impacted by the loss of grassland and shrub-grassland. Forest-dwelling species such as Bullock’s oriole, black-capped chickadee, and black-headed grosbeak would be impacted by the loss of conifer and deciduous tree/shrub habitat. Waterfowl, (ducks, geese, and shorebirds) and birds that depend on wetland and adjacent riparian habitat would be impacted by the loss of wetlands.

Habitat loss would be short-term for species that are adapted to a variety of habitats (generalists) and those adapted to open grasslands or agricultural areas (such as western meadowlark, American crow, and black-billed magpie). Long-term impacts would occur on those species that depend on shrubland or forested habitats (loggerhead shrike and woodpecker), as these habitats may take decades to become mature. Reclamation of disturbed land after coal extraction would occur concurrently with mining of new sections and would provide habitat for avian species that use grassland and cropland habitats. Impacts on migratory birds would likely be adverse in the short term, or may be long-term depending on species.

Shorebirds and Waterfowl

Waterfowl and shorebird species that have been documented in the direct impacts analysis area are discussed in **Section 3.10.2.3, Birds**. Open water and aquatic habitat is limited in the Project area, and most waterfowl observations have been incidental. The Proposed Action would have a direct impact on 12.27 acres of wetlands. Long-term impacts on wetlands would be mitigated either within the Project area or within the same watershed during reclamation (see also **Section 3.7, Water Resources – Surface Water** and **Section 3.11, Wetlands**). Therefore, impacts are expected to be significant during the short term but are anticipated to diminish in the long term as areas are reclaimed.

Activities associated with mining could deter shorebirds and waterfowl from using the Project area as foraging habitat, but surrounding undisturbed areas and reclaimed areas would provide habitat. Development of sediment ponds may attract some species. Mining in the analysis area would not likely affect breeding pairs of aquatic birds because no shorebird or waterfowl breeding has been documented in the Project area, and breeding pairs would likely continue to nest in suitable habitat outside of the analysis area.

Raptors

Raptor tolerance of disturbance varies among species and individuals within the same species (Whittington and Allen 2008). Generally, species such as golden eagle respond to disturbance associated with human activity at greater distances than some other hawk species, such as Cooper's hawk. USFWS has recommended spatial nest buffers for various raptor species that occur within the western United States. The purpose of a spatial buffer is to serve as a guideline for reducing the likelihood of raptor abandonment of nests (roosting or breeding) due to human-related disturbance (e.g., construction activity). Recommended buffers for species documented in the analysis area are shown in **Table 77**. **Figure 64** shows documented raptor nests within or adjacent to the analysis area and the recommended buffers for each. Mining and associated activities within these buffers may result in nest abandonment or unsuccessful breeding.

Table 77. Raptor Species Documented in the Analysis Area and USFWS Recommended Nest Buffers.

Species	Scientific Name	Recommended Buffer (Miles)	Recommended Buffer (Meters)
Species Documented on the Rosebud Mine (including the Project Area)			
Cooper's hawk	*Accipiter cooperii*	0.25	400
Golden eagle	*Aquila chrysaetos*	0.50	800
Burrowing owl	*Athene cunicularia*	0.25	400
Great horned owl	*Bubo virginianus*	0.125	200
Red-tailed hawk	*Buteo jamaicensis*	0.33	530
Merlin	*Falco columbarius*	0.25	400
Prairie falcon	*Falco mexicanus*	0.50	800
Osprey	*Pandion haliaetus*	0.25	400
Additional Species Documented in the Analysis Area			
Northern goshawk	*Accipiter gentilis*	0.50	800
Ferruginous hawk	*Buteo regalis*	1.00	1,600
Peregrine falcon	*Falco peregrinus*	1.00	1,600

Source: Whittington and Allen 2008.

Annual monitoring on the Rosebud Mine, including the analysis area, has documented successful raptor nesting in close proximity to active mining, indicating that some species may have become adapted to gradual encroachment of mining and may have benefitted from mitigation efforts such as erection of nesting poles in other areas of the mine. Studies near Wyoming coal mines in the Powder River Basin have documented nesting raptors near active mines (WWC Engineering 2010). Similarly, red-tailed hawks and great horned owls have bred successfully around the periphery of active portions of the Rosebud Mine between 2009 and 2013 (ICF 2014).

Although mining in the analysis area would not likely affect regional raptor populations, mining activities could disrupt normal activities of individual raptors or breeding pairs. Mining could result in the loss of nests that occur in the analysis area. Long-term impacts on tree-nesting species including red-tailed hawk and great horned owl are possible with removal of 1,162 acres of conifer and 59 acres of deciduous tree/shrub areas. Ground-nesting species may be impacted during active mining but would likely return to the area after reclamation. Mining activities in the AM5 expansion area along with ongoing activity on the existing Area B permit area ramp roads would result in short- and long-term adverse impacts on nesting raptors, depending on the species.

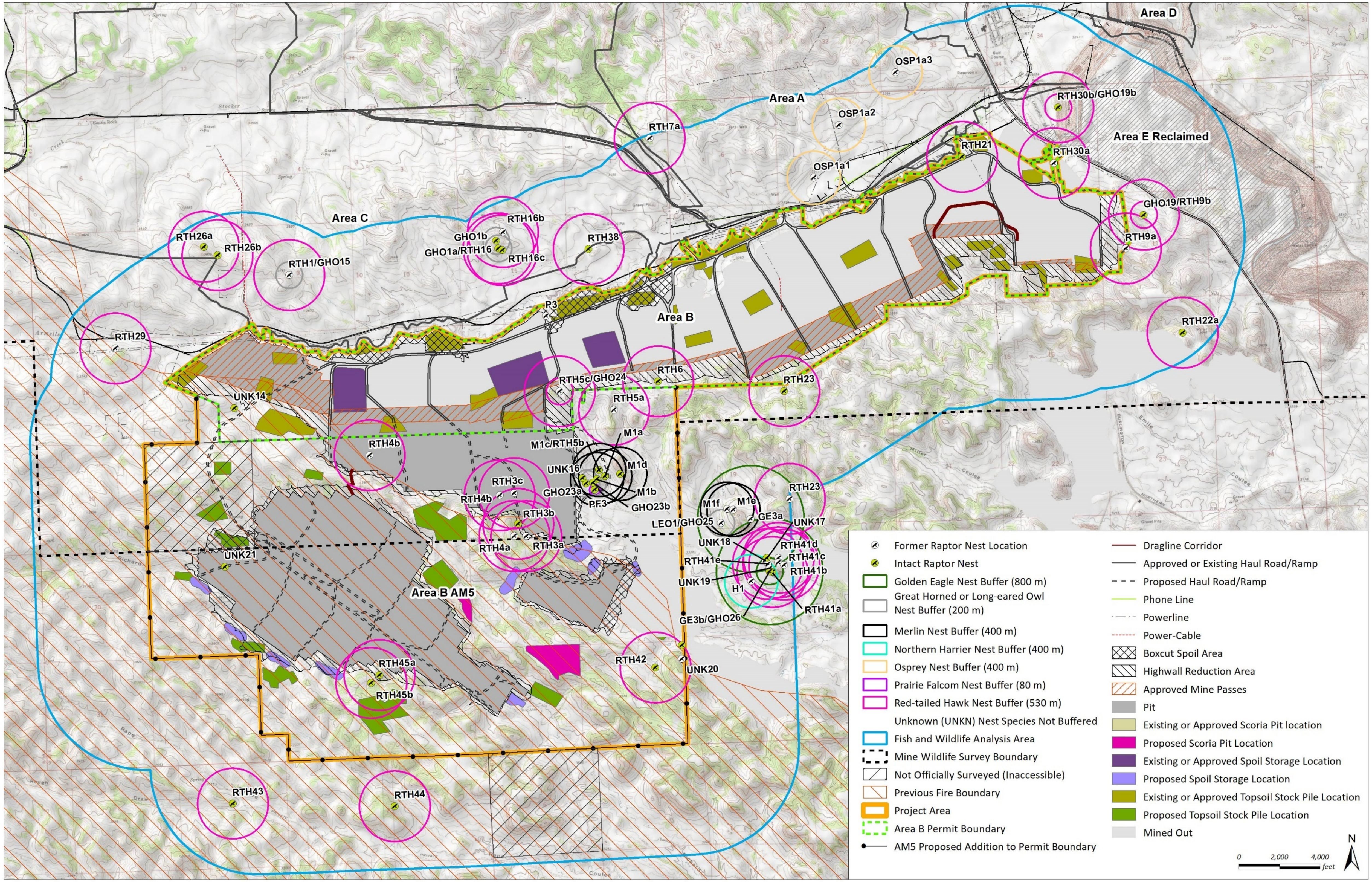

Figure 64. Known Raptor Nests and USFWS Recommended Buffers in the Analysis Area.

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Amphibians and Reptiles

Under the Proposed Action, mining activities would adversely affect amphibians and reptiles due to habitat loss. Direct impacts on amphibians and reptiles would occur during land clearing due to limited mobility and the need for fairly specialized habitat. Impacts on amphibians and reptiles would possibly be long-term because these species' reproductive rates are relatively low and vary seasonally. After reclamation and wetland mitigation, it is likely that amphibians and reptiles would slowly return to the area, although some aquatic habitats may be permanently altered (**Section 3.7, Water Resources – Surface Water** and **Section 3.11, Wetlands**). Adverse, long-term impacts on amphibians and reptiles would likely occur from surface-mining activities.

Aquatic Species

Habitat for aquatic species is limited and generally poor in the analysis area. East Fork Armells Creek is located in the northwestern portion of the analysis area. Additionally, Richard Coulee and Lee Coulee cross the southeastern portion of the Project area before merging with Rosebud Creek outside of the analysis area. A total of 12.27 acres of wetlands would be directly impacted by the Proposed Action. Impacts would also occur on ephemeral and intermittent drainages (East Fork Armells Creek and Richard and Lee Coulees). It is possible that some aquatic habitat may be created through use of water management structures that are implemented during mine operations. However, the Proposed Action could adversely impact local populations of macroinvertebrates and notropids that may occur in impacted stock ponds, springs, and perennial and intermittent streams if water management structures are not constructed.

Special Status Species

Federally Listed Threatened, Endangered, and Candidate Species

Table 75 lists federally threatened, endangered, and candidate species that potentially occur in Rosebud County. Based on the best current data and scientific information available, direct impacts of expansion of mining in the analysis area would not result in adverse impacts on federally listed threatened, endangered, or candidate species or any designated critical habitat. Impacts determinations for these species are described below.

Whooping Crane

The Proposed Action would have no impact on the whooping crane because the analysis area does not provide the wetland and marsh habitat along large rivers, lakes, and reservoirs that cranes typically use. The small ponds and streams in the analysis area do not provide suitable habitat. Additionally, the whooping crane is migratory through Montana and has not been known to breed in the state. **There is no known use of the analysis area by whooping crane.**

Black-Footed Ferret

The Proposed Action would have no impact on the black-footed ferret in the analysis area because this species depends on prairie dogs for food and uses prairie dog burrows for shelter, and no prairie dog colonies are present in the analysis area. In Montana, ferret populations coincide with black-tailed prairie dog colonies, generally over 80 acres in size. Black-tailed prairie dogs occur throughout eastern Montana, but none are present in the analysis area. Because no black-footed ferret habitat exists in the analysis area, the proposed mining and reclamation activities would have no impact on this species.

Pallid Sturgeon

The Proposed Action would have no impact on the pallid sturgeon because there is no suitable habitat in the analysis area. Pallid sturgeons are found in large, slow-moving rivers. The pallid sturgeon is rare but is known to occur in portions of the Yellowstone, Missouri, and Mississippi Rivers. The small streams in the analysis area do not provide suitable habitat for pallid sturgeon; therefore, the proposed Project would have no impact on this species.

Montana Natural Heritage Program Species of Concern

Table 76 in **Section 3.10.2.7, Special Status Species** lists MNHP SOC that have been documented within 1 mile of the analysis area and potentially occur in the Project area. Several species in **Table 76** have potential to occur in the analysis area based on the presence of suitable habitat. Direct disturbance to wildlife habitat on 5,711 acres may impact several MNHP SOC.

Figure 65. Long-Billed Curlew
(Nathan DeBoer MNHP)

Species that inhabit forested areas such as pinyon jay and silver-haired bat could be affected by the loss of about 1,162 acres of conifer habitat. Disturbance to a total of 4,108 acres of shrub and grassland habitat could impact Brewer's sparrow, long-billed curlew (**Figure 65**), loggerhead shrike, and short-horned lizard. The loss of about 3,269 acres of grassland could impact sage thrasher, plains spadefoot toad, and short-horned lizard. Because mining disturbance would impact riparian and wetland areas, there would be direct impacts on habitat for species such as red-headed woodpecker, great blue heron, and fringed myotis. However, avian use of riparian habitats could decrease from the noise and disturbance associated with nearby mine operations. Little brown myotis, pallid bat, and Townsend's big-eared bat could be impacted by the loss of woodland habitat. Secondary impacts may occur in Lee and Richard Coulees from changes to surface water or ground water flow quantities due to mining activities (as described for Surface Water in **Section 3.5.3.2** under **Direct and Secondary Impacts**), but would not affect downstream rivers and tributaries or fish SOC such as the sauger, which may occur in Rosebud Creek. Overall, direct impacts on SOC would be considered moderate due to the permanent loss or modification of habitat.

Planned reclamation after mining would establish wildlife habitat with species similar to pre-mining conditions. Establishment of wildlife habitat would vary depending on the habitat types. Because conifer habitat would take longer to establish than grasslands, species like Clark's nutcracker that inhabit coniferous forest would be affected longer than grassland-associated species such as McCown's longspur.

Greater Sage-Grouse

As previously described, no greater sage-grouse leks or core habitat are present in the greater sage-grouse analysis area. The greater sage-grouse analysis area is located entirely within general habitat for greater sage-grouse, as defined in EO 12-2015 (ICF 2018). Delineated general habitat is important for maintaining the abundance and distribution of greater sage-grouse in Montana, but does not include areas identified as core or connectivity areas. No leks or core habitat occur in the greater sage-grouse analysis area. However, impacts on the greater sage-grouse would result from impacts on general habitat over the life of the Project.

Although greater sage-grouse are not known to occur in the analysis area, mining activities would displace any greater sage-grouse that did occur from active mining areas within the analysis area to other areas and would remove general habitat. Mitigation and minimization measures, such as phasing mine development areas and establishing vegetation after mining, would reduce overall impacts. Planned eventual reclamation after mining disturbance would establish general habitat.

The Montana Sage Grouse Habitat Conservation Program and Western Energy (predecessor to Westmoreland Rosebud) evaluated the Project using the Montana Mitigation System Habitat Quantification Tool Technical Manual for Greater Sage-Grouse (HQT) and developed a mitigation plan for the greater sage-grouse (ICF 2018; see **Appendix C**). The HQT is an objective scientific method used to evaluate vegetation and environmental conditions related to the quality and quantity of greater sage-grouse habitat and to quantify and calculate the value of credits and debits in a mitigation marketplace setting such as a habitat exchange. The HQT model calculated that 3,137.72 functional acres of general greater sage-grouse habitat would be lost due to the direct and indirect impacts of the Project. To meet their compensatory mitigation obligations for these impacts, Western Energy elected to make a financial contribution of $36,522.91 to the greater sage-grouse Stewardship Account (ICF 2018; see **Section 2.4.9.3, Greater Sage-Grouse Compensatory Mitigation** and **Appendix C**). With implementation of compensatory mitigation and the greater sage-grouse mitigation plan, the Project would be fully consistent with EO 12-2015.

Secondary Impacts

The majority of secondary impacts on fish and wildlife would consist of displacement and changes in behavior. Delayed reclamation of ramp roads in the existing Area B permit area would result in potential long-term barriers to wildlife movement, which may affect species more sensitive to such barriers (e.g., upland game birds and pronghorn). Increased human activity and noise may displace wildlife to areas farther out of the existing Area B permit area and AM5 expansion area. For example, bat foraging behavior could be affected by increased human presence and mine-related noise, because such impacts may cause bats to avoid suitable foraging habitat. Studies conducted in the analysis area have determined that most bats were detected foraging near water or riparian areas. Because riparian areas would be impacted by mining activities, bats would be adversely affected in these areas. Additionally, removal of roosting habitat could result in an overall lower number of bats. Small carnivores may respond to such disturbance by moving to other nearby habitat. Displacement could result in lower production or survival of local populations in the analysis area depending on the level of competition in other nearby habitats and abundance of food sources. Mining activities could also cause breeding raptors to abandon nests that are located close to disturbance. Additionally, prey availability in the analysis area during mining may decrease, potentially impacting raptor foraging. Raptors currently nesting in the analysis area would be displaced by removal of habitat, possibly resulting in increased competition in surrounding areas. Aquatic habitat could be secondarily impacted by changes in streamflow or water quality due to mining. A total of 1.19 acres of wetland habitat along Lee Coulee would be secondarily impacted by change in flow regime. Eventual mitigation of wetlands and action to maintain the hydrologic balance may allow repopulation of some species (including amphibians). Impacts on surface water and wetland resources are explained in more detail in **Section 3.7, Water Resources – Surface Water** and **Section 3.11, Wetlands**. Secondary impacts on lands surrounding mining areas from noise and Project-related activity could adversely impact several MNHP SOC.

3.10.3.3 Cumulative Impacts

The analysis area for evaluation of cumulative impacts on fish and wildlife (including special status species) includes all permit areas of the Rosebud Mine and the region surrounding the Rosebud Mine.

Related, past, present, and futures actions under concurrent consideration that have impacted or may impact wildlife in the region include:

- Agriculture operations
- Construction of the airport
- Air pollutant sources and emissions
- Past, ongoing, and future permitted mining at the Rosebud Mine and other coal-mining operations
- Past and ongoing gravel quarrying
- Past and ongoing actions by federal land management agencies
- Municipal, industrial, and existing permit discharges
- Wildland fire

Agricultural development in the area consists mostly of cropland, pastureland, and grazing lands. Continued agricultural development would alter habitat in areas adjacent to the mine. Wildlife are often displaced when native habitat is converted to cropland or pastureland. Grazing also affects wildlife habitat because livestock compete with native herbivores such as deer and elk. Loss of wildlife habitat and displacement of wildlife due to mining operations in the Project area would contribute to regional cumulative impacts on wildlife habitat and populations.

BLM-authorized actions in the near vicinity of the Project area, such as rights-of-way for powerlines and pipelines, coal leases, mineral material sites, land withdrawals, and land sales and exchanges, may have resulted in habitat loss and fragmentation from new infrastructure development. However, BLM's ARMP also includes implementation of conservation and habitat protection of wetland and riparian areas. Displacement of wildlife from ongoing energy and mineral development and other actions on federally managed lands in the analysis area in combination with the Proposed Action may increase competition in available habitat containing sensitive resources.

Road construction, airport construction, power plant operation (coal combustion), and mining and rail transport have resulted in habitat loss or fragmentation due to land disturbances. Future mining in existing Rosebud Mine permit areas would also contribute to habitat loss from land-clearing activities and surface disturbance. Infrastructure associated with mining, including roads and fencing, further divide habitat and create barriers to wildlife movement. Loss of wildlife habitat and displacement of wildlife due to mining operations in the Project area would contribute to habitat losses and displacement impacts from past and future land disturbance associated with construction of infrastructure.

Mine drainage and power plant water are discharged into East Fork Armells Creek, Stocker Creek, Lee Coulee, West Fork Armells Creek, Black Hank Creek, Donley Creek, Cow Creek, Spring Creek, and Pony Creek. Discharges of mine drainage and industrial water into creeks change the water level and may affect water quality. Changes in water levels may result in changes to habitat along creek banks. Water quality changes may affect abundance and diversity of aquatic organisms.

Fire affects wildlife mainly through alteration of habitat. In 2012 the McClure Creek and Donnely Creek fires burned 221 acres and resulted in impacts on wildlife habitat along the southern boundary of the Rosebud Mine Areas B, C, and proposed Area F permit area. The severity of the impacts on wildlife depends on the extent of habitat change from fire. Fires in forested areas usually cause more drastic alterations to habitat and associated fauna than those that occur in grasslands (Smith 2000). Certain studies suggest that direct mortality from fires is relatively low. Large, mobile animals and birds are capable of fleeing rather quickly. Smaller species may seek refuge under debris or in burrows (Kennedy and Fontaine 2009). Smith (2000) suggests that fire "reorganizes" animal communities because of alteration of habitat. After some fires, generalized species may recolonize the burn area or move to

adjacent unburned habitats. Generalist species may simply move to another habitat type that was not affected (e.g., breeding shrubland birds may move to grassland habitat) (Smith 2000). Some predators and raptors may benefit from fires by exposing potential prey. Past wildland fires likely changed or eliminated habitat components in the burn areas and may have prevented or altered use by certain species.

3.10.3.4 Unavoidable Adverse Impacts

An unavoidable loss of native species habitat and species composition would occur during mining operations. Reclamation of disturbed areas after mining would revegetate most areas to pre-mining vegetation production over the long term. However, most vegetation communities would be altered, and not all native species would reestablish. Additionally, some habitat types (e.g., conifer forests) would take longer to establish and mature, resulting in shifts in species abundance and diversity. Introduced nonnative plant species also have the potential to increase, resulting in repopulation by wildlife species that adapt more readily to this type of habitat and a long-term loss of more specialized species.

3.10.3.5 Irreversible and Irretrievable Impacts

The action alternatives would disturb wildlife species individuals and local populations. The action alternatives would likely result in shifts in species composition from wildlife that is less tolerant of disturbance to species that are able to adapt more readily to disturbance and increased human presence. As revegetation and reclamation of disturbed areas occurred, it is likely that species composition diversity would eventually increase, but not to the levels of predisturbance diversity due to an anticipated reduction in overall vegetation diversity. The temporary loss of native wildlife habitat under the action alternatives would be an irreversible resource commitment.

There would be no irreversible or irretrievable commitment of resources for federally listed threatened or endangered species. The action alternatives may disturb wildlife SOC individuals and local populations.

3.11 CULTURAL AND HISTORIC RESOURCES

3.11.1 Introduction

This section describes the affected environment with respect to cultural resources, including the regulatory framework to protect those resources, the cultural context and background, and a description of the documented cultural resources within the analysis area. The analysis area is defined below in **Section 3.11.1.2, Analysis Area and Methods**. The locations of cultural resources are exempt from public disclosure under Public Laws 96-95 and 89-665 to protect resources from potential vandalism and to retain confidentiality of those resources culturally significant to American Indian tribes. Thus, specific cultural resource locations are not included in the discussion.

This section also analyzes the environmental consequences, including direct, secondary, and cumulative impacts, of the No Action Alternative (Alternative 1) and the Proposed Action (Alternative 2) with respect to historic properties.

3.11.1.1 Regulatory Framework

Federal Requirements

Please see discussion below under **State Requirements**.

State Requirements

MSUMRA and associated administrative rules require applicants to consider potential impacts on historic properties from their actions similar to those imposed by Section 106 of the National Historic Preservation Act (NHPA) and its implementing rules under 36 CFR 800, including consultation with the Montana State Historic Preservation Officer (SHPO). DEQ's administrative rules applicable to cultural resources are summarized in **Table 78**. The Montana State Antiquities Act is also applicable to state lands (ARM 10.121.901 through 10.121.916).

Under MSUMRA and associated administrative rules, DEQ may not approve an application for surface mining when the area of land described in the application has special, exceptional, critical, or unique characteristics (including cultural resources with archeological or cultural significance, collectively referred to as historic properties) or when mining on such land would adversely affect the use, enjoyment, or fundamental character of neighboring land with special, exceptional, critical, or unique archaeological or cultural significance, with particular attention being paid to the preservation of Plains Indian history and culture (82-4-227(2), MCA). An application for a surface mine permit must include a listing, location, and description of the archaeological, cultural, and other values of the land to be affected by the proposed mining operation (ARM 17.24.1807(8)).

Table 78. Administrative Rules of Montana Applicable to Cultural Resources under MSUMRA and Other State Regulations.

Administrative Rules of Montana (ARM)	Summary of Requirement
17.24.304(1)(b)	Includes the requirements for baseline information in the permit application; specifically, it must include a listing, location, and description of all archeological, historical, ethnological, and cultural resources and values of the proposed mine plan and adjacent area. Sites listed on, eligible for, or potentially eligible for the National Register of Historic Places (NRHP) must be so identified.
17.24.305(1)(h)	Contains mapping requirements for the permit application; the application must contain locations of any cultural or historical resources listed or eligible for listing in the NRHP.
17.24.318	Contains requirements for the permit application; specifically, the application must contain information on the protection of public parks and historic places and must include plans to minimize or prevent impacts on these resources.
17.24.1131	Contains requirements that prohibit surface or underground mining projects from using parks, historic sites, and places listed in the NRHP unless approved jointly by the department and the federal, state, or local agency with jurisdiction over the park or historic site.
17.24.1132(1)(e)	Prohibits coal mining from impacting a “community or institutional building…that functions as an educational, cultural, historic, religious, [or] scientific…facility.”
2.65.101-401	Establishes a burial preservation board that ensures that burials discovered on state and private lands are accorded equal treatment, establishes procedures for the protection of burial discoveries, and establishes repatriation procedures.
22.3.421-442	Establishes the requirements and responsibilities regarding historic and prehistoric sites on state-owned lands.
22.3.805	Establishes reporting requirements and field review for discovery of human skeletal remains during archeological excavation or by agricultural, mining, construction, or other ground-disturbing activities.

Local Requirements

There are no local requirements related to cultural and historic resources that would apply to the analysis area.

3.11.1.2 Analysis Area and Methods

Analysis Area

The direct and secondary impacts analysis area for cultural resources focuses on the area where new Project-related disturbance would occur. This includes the 5,711-acre disturbance area associated with the Project activities (**Figure 66**). The area of potential effects (APE) is defined as the 15,153-acre Project area, which includes the AM5 expansion area and a portion of the existing Area B permit area. The APE is the analysis area for cumulative impacts and includes both disturbance that has already been permitted and new disturbance that would occur as part of the proposed Project. For example, extensive ground disturbance has occurred on about 4,601 acres in the existing Area B permit area from permitted mining and associated activities. This disturbance, which is part of the APE, is not included in the analysis area for direct and secondary impacts but is considered in the analysis of cumulative impacts.

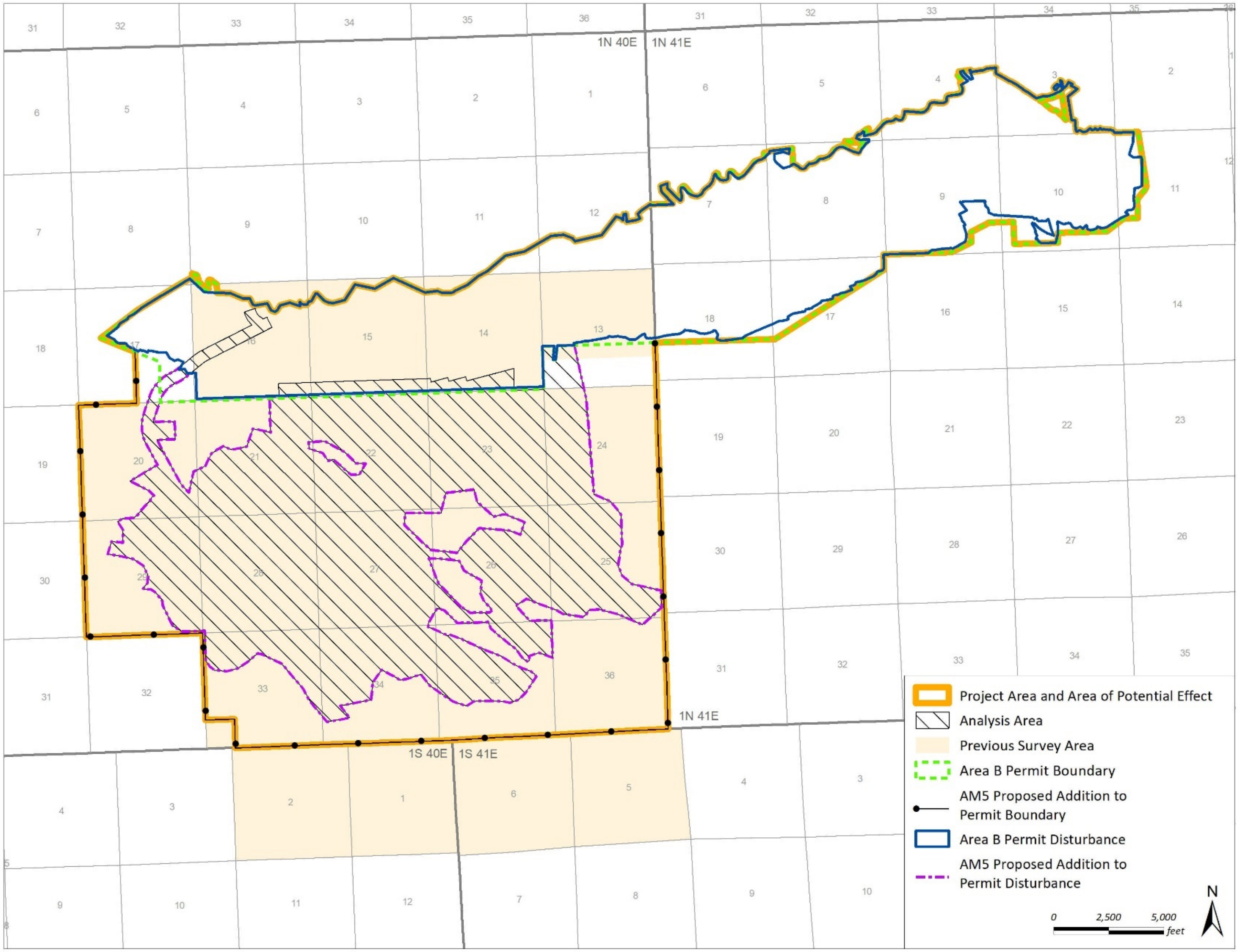

Figure 66. Cultural Resource Analysis Area and APE.

Analysis Methods

GCM Services (GCM) surveyed the AM5 expansion area for cultural resources in 2010, 2014, and 2016 (Meyer et al. 2017; Appendix A). The total area surveyed by GCM was 8,960 acres, including 640 acres of state land; 85 acres in the northern portion of the analysis area in Sections 13 and 17, Township 1 North, Range 40 East were not surveyed, which represents a data gap that will need to be resolved through future pedestrian survey. Previous survey, testing, and mitigation conducted in the 1980s and 1990s covered these gaps; however, these surveys would not meet current standards. Data from previous survey work in the existing Area B permit area is summarized in **Section 3.11.2.2, Documented Cultural Resources**. In addition to previous pedestrian survey, the mine is currently conducting an ethnographic study as part of ARM 17.24.304(1)(b) to identify any other potential historical properties or traditional cultural properties (TCPs) important to consulting tribal parties.

Intensive cultural resource inventories are intended to locate, document, and evaluate all known cultural resources within the APE. The method employed during the identification of potential historic properties in the APE used the 50-year age criterion established by the National Park Service (NPS). Identified cultural resources were evaluated for significance by their eligibility to be listed on the National Register of Historic Places (NRHP) using criteria codified under 36 CFR 60.4 of the NHPA. The most common significance criterion applied to archeological properties in the APE is Criterion D, which identifies an archeological site as containing information important to the interpretation of history or prehistory. Other applicable criteria include cultural resources that are associated with events that have made a significant contribution to history (Criterion A); those associated with the lives of significant persons (Criterion B); and those that embody distinctive characteristics of a type, period, or method of construction (Criterion C).

Once a cultural resource is determined eligible for listing in the NRHP after consultation with the SHPO, it is considered a historic property and requires consideration of Project effects. Unevaluated sites are those that may meet eligibility criteria but require further work to determine significance and are treated as potentially eligible. Resources that were determined ineligible for inclusion in the NRHP do not meet sufficient eligibility criteria or have lost physical integrity.

3.11.2 Affected Environment

Cultural resources are aspects of the human environment that include buildings, structures, objects, historic and prehistoric archeological sites, landscapes, and districts. Districts are groups of buildings, structures, or sites that are associated by shared cultural significance such as mining or homesteading and are further related in both time and space. Cultural landscapes have been affected, influenced, or shaped by human involvement and can be associated with persons or events. Sites are typically meant to include historic or prehistoric archeological sites. TCPs include “traditions, beliefs, practices, lifeways, arts, crafts, and social institutions of any community, be it an Indian tribe, a local ethnic group, or the people of the nation as a whole” (NPS 1998).

3.11.2.1 Cultural Context

The cultural context that follows is provided for a better understanding of the cultural and historical context of the analysis area. A summary of the cultural history of eastern Montana is also provided by Aaberg and others (Aaberg et al. 2006).

Occupation of the Pine Breaks area, which encompasses the analysis area, began during the Paleo-Indian period (12000 to 8500 BP [before present]/10000 to 6500 BC). This period is characterized by the use of

large, well-made lanceolate spear points and the hunting of large mammals including now-extinct bison and mammoth species. By the end of this period, subsistence strategies had changed to a broad-spectrum hunting and plant-gathering economy.

The Archaic stage (8500 to 1500 BP/6500 BC to AD 500) is divided into three periods, marked by changes in settlement strategies and material culture. Few sites are known in the Pine Breaks and adjacent areas that date to the Early Archaic, which is characterized primarily by a change in projectile-point style and increased emphasis on plant gathering (Frison 1991). As the climate stabilized around 3500 BC, the McKean complex became the dominant archeological manifestation of the Middle Archaic period characterized by the co-occurrence of several projectile-point types and an increase in ground-stone technology. The number of archeological sites increased dramatically during the Late Archaic period. The dominant material culture change was a shift to larger corner-notched projectile points, and by the end of this period, bow-and-arrow and ceramic technologies were introduced.

The Late Prehistoric period (AD 500 to 1600) is associated with the common use of the bow and arrow and the full adoption of ceramic technology. The population continued to increase during this time. Characteristic material culture included the shift from small corner-notched arrow points to small side-notched forms, and stylistic changes in pottery traditions (Kornfeld et al. 2010). Ethnohistoric information suggests the presence of several modern tribes in the area by this period including the Shoshone, Crow, Northern Cheyenne, Kiowa, and Kiowa-Apache (Reher 1979).

The first well-documented Euroamericans in the region were members of the Lewis and Clark Expedition of 1804–1806. However, the effects of horses, firearms, and disease were felt long before Euroamericans established a permanent presence. Disease had a significant effect on Native American populations in the region. Major tribes that occupied the region during the Historic period included the Crow, Shoshone, Lakota (western, or Teton Sioux), Nakota (central, or Yanktonai Sioux), Cheyenne, Blackfeet, Gros Ventre, Arapaho, and Kiowa, among others (Waldman 1985; Kooistra-Manning et al. 1993). The Crow and Northern Cheyenne Reservations are nearest the analysis area.

During the first three-quarters of the 19th century, small numbers of Euroamericans passed through the region including fur traders, government explorers, military expeditions, hunting parties, and cattle drives. The first heavily traveled routes were in Wyoming along the south and west edges of the Powder River Basin. Starting in the 1840s, westbound emigrants used the Oregon-California Trail to the south, along the North Platte River (Larson 1978). By the 1860s, the Bozeman Trail ran along the eastern edge of the Big Horn Mountains. Both the Crow and the Northern Cheyenne signed the Friendship Treaty with the United States in 1825. The first Fort Laramie Treaty was signed in 1851 giving the Crow 33 million acres of land in Montana, Wyoming, and Dakota Territories. The second Fort Laramie Treaty reduced Crow lands to 8 million acres in south central Montana Territory. By 1905, Crow lands had been further reduced to three million acres. The division of the Cheyenne into Northern and Southern tribes was recognized in the first Fort Laramie Treaty. The Northern Cheyenne participated in the Battle of Little Bighorn in 1876 and were exiled to Oklahoma in 1877. The Tongue River Indian Reservation was established in 1884 for the Northern Cheyenne although existing white settlements were allowed to remain. Conflict between the white settlers and the Northern Cheyenne led to Congress buying out the settlers in 1900 (Division of Indian Education 2018). In 1876, the U.S. government terminated all Native American claims to the Powder River country, which opened the region to large-scale Euroamerican settlement (Larson 1978).

After the Civil War, homesteading associated primarily with the cattle industry expanded into the region, facilitated by the concomitant expansion of the railroad that enabled the movement of goods and products to market (Fletcher 1960). Homesteading, regardless of the economic driver, was boom and bust, affected by climate and precipitation patterns.

The presence of coal in the region was recognized very early. Small-scale coal mining began as private enterprise but slowly expanded to industry. The Northern Pacific Railway Company attempted to develop the coal deposits at the head of Keogh Flat, a few miles north of Miles City, and even built the small community of Lignite near the mine. However, the coal was not suitable for use in locomotives, and the mine and village were abandoned.

In 1913 the Northern Pacific Railroad surveyed coal resources near its lines and made an extensive study of the Rosebud Field in the present-day Colstrip area. Construction of a branch line and opening of the field at Colstrip marked the beginning of the first large-scale coal operation in the Yellowstone Valley area. The Foley Brothers Company of Minnesota began construction on the mine in 1924; by 1930, the mine was producing 40 percent of Montana's coal. The mine's output peaked during World War II when it reached 2.5 million tons (over half the entire state's total) in 1943 (Chadwick 1973). The Rosebud Mine was the first completely electrified surface coal mine in the country. The original city of Colstrip was also constructed at this time.

3.11.2.2 Documented Cultural Resources

Surveys conducted by GCM within the AM5 expansion area documented 117 resources (Meyer et al. 2017); 78 of these resources are located within the analysis area where disturbance would occur. Prehistoric site types include lithic scatters, lithic source locations, camps, a human burial, and rock-art locations. Lithic scatters and sources refer to sites where stone-tool manufacturing primarily took place, whereas camps refer to sites where habitation took place. The historic-period sites include the remains of homesteads, cabins, rock art/graffiti, a trash dump, and cairns. Additionally, multicomponent historic and prehistoric period sites exist within the analysis area, which include primarily rock art/graffiti locations that generally date to both periods and historic homesteads with underlying prehistoric components. A total of 95 isolated finds were also documented. Generally, isolated finds are not eligible for inclusion in the NRHP and are dismissed from further consideration. A human burial was identified during the 2014 survey but has since been disinterred and reburied following Montana's Human Skeletal Remains and Burial Site Protection Act of 1991 and with assistance from the Northern Cheyenne.

In addition to the surveys, several evaluative testing and mitigation projects have occurred within and adjacent to the analysis area in the Big Sky Mine Area B that overlaps the Project area: evaluative testing in the Lee Coulee study area (Munson 1991a; 1991b), data recovery at a rock art site (Munson 1989), mitigation of two prehistoric camps (Munson 1991b; Meyer and Munson 1998), and mitigation of the Windmill Site (Munson and Ferguson 1994).

Of the 117 sites documented during the most recent surveys, 83 have been evaluated as not eligible for listing in the NRHP. Twenty-six sites are recommended eligible for listing in the NRHP, primarily under Criterion D, for their potential to provide information significant to the interpretation of history or prehistory. All of these are within or overlapping the analysis area. Eligible sites consist primarily of unknown prehistoric camps or lithic scatters, Late Archaic camps or lithic scatters, prehistoric camps with rock art, and multicomponent sites with both prehistoric and historic components. Seven sites remain unevaluated pending further investigation; two of these straddled the GCM survey boundary and could not be fully evaluated due to access issues. Additional work at these sites to determine NRHP eligibility may be required.

One historic district intersects the APE—the Lee Community Historic District (24RB2053) overlaps the northern and western sections of the APE. The district includes the entire Lee School District 8 (later District 19) and is recommended eligible for the NRHP under Criterion A for its association with the development of homesteading in the region. The district is a community of homesteads founded in the early 20th century, which share common historical developments and a bounded geographic area.

Individual historic sites are evaluated for their NRHP significance and to determine whether they contribute to the period of significance and are located within the geographic boundary that defines the district. Eleven homesteads within the analysis area are within or near the Lee Community Historic District.

In summary, based on the survey report and GIS spatial data provided to ERO (Meyer et al. 2017), 31 potential historic properties are within or overlapping the analysis area, including the Lee Community Historic District, 5 multicomponent sites and 25 prehistoric camps or lithic scatters (**Table 79**).

Table 79. Potential Historic Properties Within or Overlapping the Analysis Area.

Smith. No.	Site Name	Site Type	Criteria
24RB284	River	Prehistoric Camp	Eligible - D
24RB304	Pedestal Point	Prehistoric Camp	Eligible - D
24RB1607	Two Track	Prehistoric Camp	Eligible - D
24RB1611	3:30 PM	Prehistoric Camp	Eligible - D
24RB1612 / (24RB1914)	Boggess Homestead	Prehistoric Camp/Historic Homestead	Unevaluated
24RB2053	Lee Comm. Hist. Dist.	Historic District	Eligible - A
24RB2390	Chop-a-Lot	Prehistoric Camp	Eligible - D
24RB2406	Poor Rich., King Richard, All Rings	Prehistoric Camp	Eligible - D
24RB2498	V32	Prehistoric Lithic Scatter	Eligible - D
24RB2505	Neill	Prehistoric Grave/Historic Graffiti	Eligible - D
24RB2507	M30	Prehistoric Lithic Scatter	Eligible - D
24RB2519	Badger Rock	Prehistoric Camp	Eligible - D
24RB2520	Bonhomme Richard	Prehistoric Occupation	Eligible - D
24RB2521	8 Birds	Prehistoric Occupation	Eligible - C and D
24RB2522	Rattlesnake	Prehistoric Lithic Scatter	Eligible - D
24RB2529	Richard Petty	Prehistoric Camp	Eligible - D
24RB2533	Richard's Castle	Prehistoric Camp	Eligible - D
24RB2732	Grasshoper Bend	Prehistoric Camp	Eligible - D
24RB2737	Richard Burton	Prehistoric Camp	Eligible - D
24RB2749	D16	Prehistoric Camp/Historic Debris	Eligible - D
24RB2750	D23	Prehistoric Camp/Historic Debris	Eligible - D
24RB2754	Dick Butkus	Prehistoric Camp/Historic Debris	Eligible - D
24RB2756	GX2	Prehistoric Lithic Scatter	Unevaluated
27RB2757	GX3	Prehistoric Camp	Eligible - D
24RB2759	GX5	Prehistoric Camp	Unevaluated
24RB2762	Richard Harris	Prehistoric Camp/Historic Isolate	Eligible - D
24RB2763	Richard Byrd	Prehistoric Camp	Eligible - D
24RB2765	Dick Clark	Prehistoric Camp	Eligible - D
24RB2766	Richard Hugo	Prehistoric Camp	Eligible - D
24RB2767	Richard Daley	Prehistoric Camp	Eligible - D
24RB2768	Richard Widmark	Prehistoric Camp	Eligible - D

3.11.2.3 Tribal Consultation

DEQ has initiated tribal consultation with the Blackfeet Nation Tribe, Chippewa Cree Tribe, Confederated Salish & Kootenai Tribes of the Flathead Reservation, Crow Nation, Northern Cheyenne Tribe, Fort Peck Assiniboine and Sioux Tribes, Nakoda and Aaniiih Nations, Little Shell Chippewa Tribe, Fort Belknap Indian Community, and Crow Tribe regarding the identification and effects on TCPs and archeological sites of significance to the tribes (see **Section 5.1.3, Tribal Consultation Process**).

3.11.2.4 Resolution of Adverse Effects

Impacts on historic properties are usually addressed through the implementation of either a treatment plan or a mitigation plan. Treatment plans are used when a site can be avoided through physical avoidance or project adjustment so that no adverse effects occur. Mitigation plans are reserved for sites that cannot be avoided by other means and adverse impacts will occur or have already occurred. These plans may include an archaeological excavation and site-specific data recovery used to resolve adverse effects by recovering information important to history or prehistory. Generally, historic properties that cannot be avoided during mining activities would result in irreversible adverse effects. To minimize adverse effects, each site would require a site-specific data recovery or mitigation plan that would be developed by Westmoreland Rosebud, submitted to DEQ, and approved by DEQ in coordination with the SHPO prior to disturbance. To avoid unnecessary mitigations in advance of mining, mitigation plans would be developed for each historic property as the mine develops.

3.11.3 Environmental Consequences

3.11.3.1 Alternative 1 – No Action

Under the No Action Alternative, the AM5 amendment (proposed Project) would not be permitted. Westmoreland Rosebud would complete mining and reclamation in the Area B permit area according to its currently approved operating permit. Mining is permitted in Area B until 2030, and initial stages of reclamation would be completed within 2 years of the cessation of mining. There would be no Project-related ground disturbance within the analysis area, and therefore no potential for adverse effects on cultural resources described above in **Section 3.11.2, Affected Environment**. However, continued natural degradation of historic properties may result in a loss of information that would otherwise be preserved through mitigation.

The No Action Alternative would not change the status of the existing Area B permit area or other permit areas, including Area F, of the Rosebud Mine (**Section 2.2, Existing Operating Permits, Disturbance, and Reclamation**), nor would it affect the federal coal lease MTM 80697 (tracts in Areas B and C) modification application, which is currently being evaluated by the Bureau of Land Management (**Section 3.1.4.2, Related Future Actions**). Impacts on cultural resources due to current and future mining and reclamation in the existing Area B permit area and other permit areas of the Rosebud Mine would continue.

3.11.3.2 Alternative 2 – Proposed Action

Direct Impacts

Under the Proposed Action, 31 potential historic properties would be adversely affected by ground-disturbing activity within the 5,711-acre analysis area over the life of the Project, including 27 properties determined eligible for listing in the NRHP, 3 that remain unevaluated for listing in the NRHP, and 1 historic district. Adverse impacts on the potential historic properties would be resolved through a treatment plan, to be developed by Westmoreland Rosebud. In addition, any potential historic properties or TCPs identified during the ethnographic study would be evaluated for eligibility to the NRHP through consultation with the SHPO and tribes. Any of these properties determined eligible would also require avoidance or mitigation.

Secondary Impacts

There would be no secondary impacts on cultural resources within the analysis area.

3.11.3.3 Cumulative Impacts

The analysis area for evaluation of cumulative impacts for cultural resources includes all permit areas of the Rosebud Mine, including past and ongoing mining areas. Any activities that require surface and subsurface disturbance of intact areas have the potential to adversely impact historic properties. Past, present, and related future actions under concurrent consideration that have adversely affected or could adversely affect historic properties in the vicinity of the analysis area include:

- Past, ongoing, and future permitted mining at the Rosebud Mine and other coal-mining operations
- Past and ongoing gravel quarrying
- Past and ongoing actions by federal land management agencies
- Agricultural operations

Past and ongoing mining at the Big Sky Mine and the Rosebud Mine has resulted in cumulative adverse impacts on historic properties. Surface mining results in destruction of historic properties. Mining in the Project area and future mining in other permit area at the Rosebud Mine could result in additional long-term cumulative adverse impacts on historic properties.

Past and ongoing gravel quarrying has potentially adversely impacted historic properties within the quarried areas.

BLM has authorized actions in the vicinity of the analysis area, such as rights-of-ways for powerlines and pipelines, coal leases, mineral material sites, land withdrawals, oil and gas leases, and land sales/exchanges. Many of these activities involve surface disturbance and have the potential to impact the physical integrity of historic properties.

Cumulative impacts from agricultural operations on cultural resources stem from plowing of the soil and the soil erosion that often follows. These actions can disturb intact cultural deposits and have the potential to adversely impact historic properties. Future agricultural activities will also adversely impact historic properties.

3.11.3.4 Unavoidable Adverse Impacts

All potential adverse impacts on historic properties within the analysis area would be resolved through measures outlined in a mitigation plan prior to any disturbance. Because avoidance and minimization of effects are not feasible for historic properties within the analysis area, evaluative testing and archaeological excavation are accepted methods to resolve adverse effects by recovering information important to the interpretation of history or prehistory, but these mitigation measures are not the only available option.

3.11.3.5 Irreversible and Irretrievable Impacts

Adverse effects on historic properties in the analysis area would be resolved through a mitigation plan for each of the affected properties (see **Section 2.4.9, Mitigations**); however, some mitigation strategies would represent an irreversible and irretrievable impact on historic properties. Archaeological excavation of a historic property effectively destroys the property, resulting in an irreversible and irretrievable impact. Accidental destruction of presently unknown cultural resources, including resources with Native

American significance, would also constitute irreversible and irretrievable losses. If any cultural resources are inadvertently unearthed or otherwise encountered during mining activities, work would cease in the area of the discovery until the resources can be identified and appropriate resource protection measures can be implemented.

3.12 SOCIOECONOMICS

3.12.1 Introduction

Socioeconomics describes a combination of the economic and social level of a specific population of people based on income, education, demographics, and occupation. The economic and social position of an individual or family, in relation to others, is considered when describing socioeconomics. This section discusses the current socioeconomic conditions within and near the analysis area, as well as the regulatory framework. The analysis area for socioeconomic conditions is defined below in **Section 3.12.1.2, Analysis Area and Methods**.

This section also analyzes the environmental consequences related to socioeconomics, including direct, indirect, and induced effects (see description in **Impact Analysis Method** below), of the No Action Alternative (Alternative 1) and the Proposed Action (Alternative 2).

3.12.1.1 Regulatory Framework

Federal Requirements

There are no federal requirements that apply to the socioeconomic environment as it relates to the Proposed Action.

State Requirements

Federal Mineral Royalties

Twenty-five percent of the revenue received by the state for federal mineral royalties is given to local governments. It is distributed based on mineral production in each county (17-3-240, MCA).

State of Montana Coal Severance Tax

Coal mines in Montana pay a severance tax based on the value of coal produced (15-35-103, MCA). The value of coal represents the contract sales price, which is either the price of the severed coal or the price of coal as computed by the Montana Department of Revenue. The tax rate on coal varies with the heat content of the coal and the type of mine (open-pit or underground). Each producer is exempt from tax on 20,000 tons per year, and mines producing less than 50,000 tons per year are exempt from the tax.

Coal severance taxes are distributed to several funds. Montana’s coal tax collections for fiscal year 2018 was $60.1 million. With the passage of Senate Bill 260 and beginning in fiscal year 2018, 50 percent ($30.05 million) of coal tax revenues will go to the coal tax bond fund, which supports special state revenue funds for water infrastructure development, school facilities, economic development, subsidized loans for renewable resource development, and the state treasury endowment fund (Montana Legislative Fiscal Division 2018). The remaining funds are distributed to the Long-Range Building Program Account (12 percent), Coal Natural Resource Account (5.8 percent), Parks Trust Fund (1.27 percent), local conservation districts (3.89 percent), Montana Growth Through Agriculture Fund (0.72 percent), Library Services account (0.85 percent), renewable resources debt servicing (0.95), and the Cultural Trust (0.63 percent). In addition, $250,000 each fiscal year is appropriated to the Coal and Uranium Program. The remainder of the funds is distributed to the General Fund. In 2018, the General Fund will receive 24.89 percent ($14.95 million) from Montana’s coal tax revenues.

State of Montana Coal Gross Proceeds Tax

Although no actual property tax is levied on coal real property in Montana, the coal gross proceeds tax is implemented in lieu. The coal gross proceeds tax is equal to 5 percent of the coal's value (15-23-703, MCA). The value of coal is determined by considering the contract sales price, which represents either the price of coal when extracted or a price imposed by the Montana Department of Revenue. The price may be imposed by the Montana Department of Revenue if any of the following apply:

- The extracted coal is used by the operator in a manufacturing process;
- The coal is refined to improve quality through drying, cleaning, or additional processing;
- The coal is sold through a contract, and that contract is not an arm's-length agreement; or
- The gross yield statement for a mine is not filed.

The local county treasurer collects the tax. The revenue is proportionally distributed to the appropriate taxing jurisdictions in which production occurred based on the total number of mills levied in fiscal year 1990, per 15-23-703, MCA. No tax is levied on reserve coal property in Montana.

Business Equipment Tax

Coal-related personal property (business equipment) owned by coal companies in Montana such as machinery, fixtures, and equipment is classified as Class 8 property. The first $100,000 of market value is exempt. From $100,000 to $6 million of market value, Class 8 property is taxed at 1.5 percent. Above $6 million, Class 8 property is taxed at 3 percent.

State of Montana Coal Board Grants

The governing body of a city, town, county, or school district; any other local or state governmental unit or agency; or the governing body of a federally recognized tribe may apply for a Coal Board Impact Grant to enable it to provide governmental services that are needed as a direct consequence of an increase or decrease in coal development or of an increase or decrease in the consumption of coal by a coal-using energy complex (90-6-208, MCA).

Local Requirements

There are no local requirements that apply to the socioeconomic environment as it relates to the Proposed Action.

3.12.1.2 Analysis Area and Methods

Analysis Area

The analysis area for socioeconomic effects is Rosebud, Treasure, and Big Horn Counties (**Figure 67**). Affected incorporated municipalities in the analysis area include Colstrip, Forsyth, Hysham, and Hardin.

The socioeconomic analysis area is based on a range of factors that may influence the location and magnitude of potential socioeconomic impacts. These factors include:

- The location of and access to the proposed permit area;
- The likely residence area for people working at the mine (existing residents and any in-migrating Project employees);

- The rate and magnitude of population and employee turnover, if any (including student population turnover in schools, employee turnover at the mine, and employee turnover from existing jobs to employment with Westmoreland Rosebud);
- The availability and location of existing housing and potential housing, and the capacity and condition of existing local services and facilities;
- The people directly or indirectly affected economically by the proposed mining operation (e.g., from wages and taxes); and
- The willingness and ability of community residents and local government personnel to deal with change.

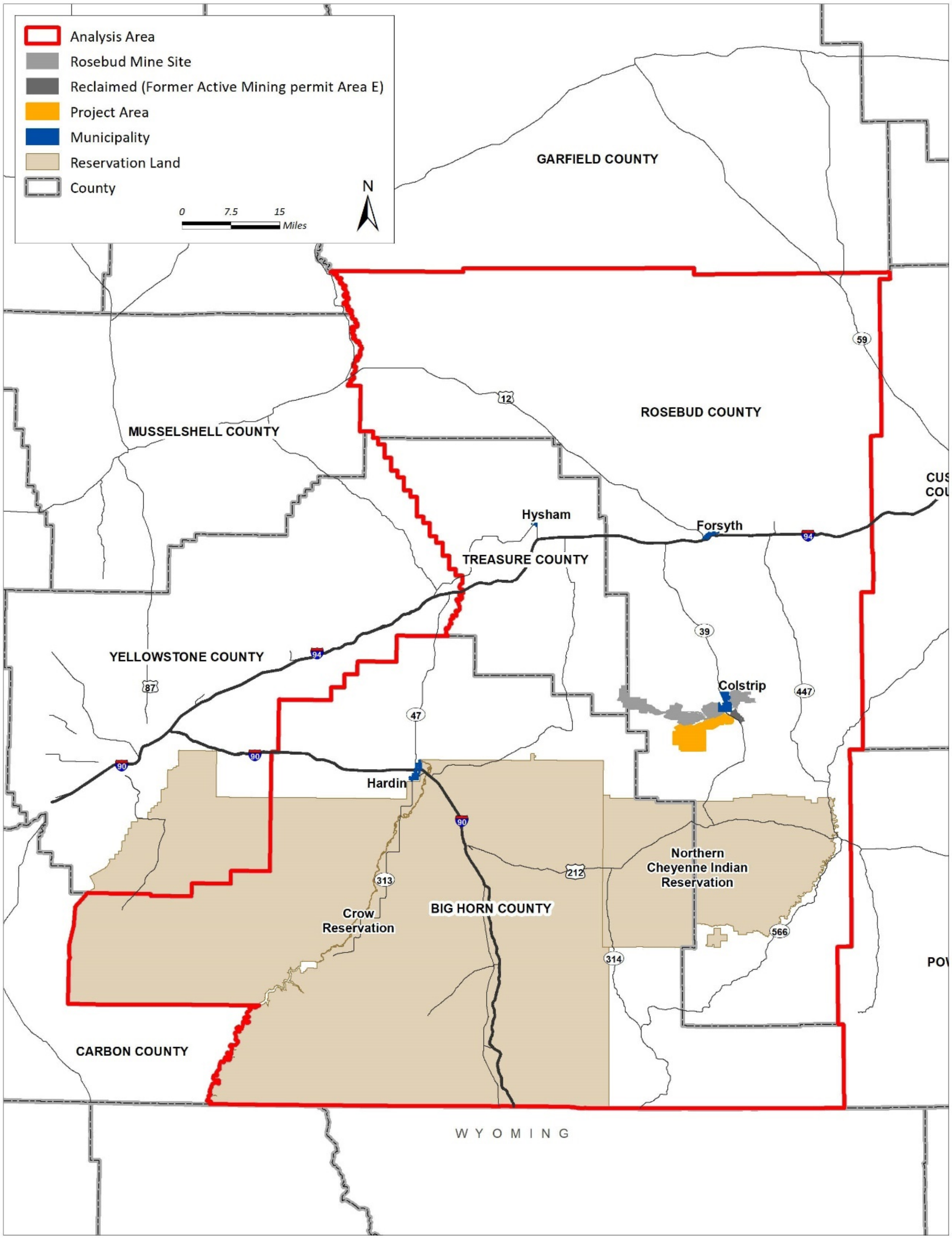

Figure 67. Socioeconomic Analysis Area.

Analysis Methods

Social Baseline Conditions

The analysis methods for describing the socioeconomic affected environment include accessing and processing data from reliable publicly available sources. Data sources include but are not limited to:

- U.S. Census Bureau (USCB) and other sources that publish and interpret USCB data
- U.S. Bureau of Labor Statistics (USBLS) and other sources that publish and interpret USBLS data
- Montana Department of Commerce
- Montana Department of Labor and Industry

The most current data available are used for each socioeconomic parameter. For USCB demographic data, complete USCB Decennial Census data are used for appropriate years (1970 through 2010), and five-year 2012–2016 USCB American Community Survey data are used for 2016.

Impact Analysis Method

The impact analysis focused on the current economic impacts of the entire Rosebud Mine operations, which are assumed to remain about the same through 2038, regardless of whether the proposed Project is permitted (see **Assumptions** below), compared to the longer-term impacts of operations of the Rosebud Mine, which is defined differently for each alternative. The analysis assumes that the Project would not result in an increase in Rosebud Mine's coal production annually. The socioeconomic impacts from the Project would be experienced through the extension of the mine's life of operations, which would be a continuation of current production and would sustain the current socioeconomic conditions. Westmoreland Rosebud estimates that 104.3 million tons of recoverable coal would be mined in the Project area if AM5 is approved.

The regional economic impacts of current (2020) and future Rosebud Mine operations were evaluated in an IMPLAN analysis conducted by BBC Research & Consulting (termed the "BBC Effects Analysis" in this section; BBC 2020). IMPLAN is an input-output model, originally developed by the U.S. Forest Service that is now widely used throughout the private and public sectors (BBC 2020); input-output analysis is further explained in the text below.

The IMPLAN model provides information on economic activity (employment, labor compensation, output, and other metrics) for the coal mining sector in Rosebud County in 2018. Employment and production at the Rosebud Mine vary from year to year (BBC 2020). Projected future employment and economic output were based on continued operation of the mine at 2020 levels (BBC 2020). Actual economic impacts and the duration of the mine life could fluctuate or vary from projections, depending on the resources applied by Westmoreland Rosebud at full-scale operations. Coal and input market conditions, as well as the fate of Colstrip Units 3 and 4, also could cause operations to be curtailed or shut down on short notice at any point during projected mine life.

Employment and income impacts were estimated in the BBC Effects Analysis using input-output analysis (IMPLAN model). Input-output analysis is a means of examining relationships within an economy among businesses, and among businesses and final consumers. Three types of economic impacts (effects) are identified in the analysis:

- *Direct effects* are associated with the immediate effects tied to mine activity (e.g., the payroll and the supplies, materials, and services purchased by the Rosebud Mine) and should not be confused with direct impacts as described in **Section 3.1.1, Definitions Used for Impacts Analyses**.
- *Indirect effects* are production changes resulting from spending during operations in industries that supply products and services to mine operations and should not be confused with secondary impacts as described in **Section 3.1.1, Definitions Used for Impacts Analyses**.
- *Induced effects* are changes in economic activity resulting from households spending income earned directly or indirectly as a result of mine operations.

Direct employment and labor income effects were estimated using information provided by Western Energy (predecessor to Westmoreland Rosebud). Indirect effects were estimated using nonlabor expenditure information provided by Western Energy and IMPLAN. Induced effects were estimated using IMPLAN. Other specific information on the methodological approach and assumptions used in the analysis presented below can be found in the BBC Effects Analysis report (BBC 2020). Projected employment and labor income effects identified in the BBC Effects Analysis are presented below.

In addition to the effects of mine operations on the two counties in the study area, the BBC Effects Analysis estimated the effects of mine operations on Big Horn County and on two nearby tribes. The Northern Cheyenne Indian Reservation is located primarily in Rosebud County, 8 miles south of the Project area. The Crow Reservation is located in Big Horn County, 11 miles southwest of the Project area (BBC 2020). Potential economic effects on the tribes were estimated by applying the overall economic effects on each major sector in the relevant county to the proportion of the county's economic sector estimated to be located within the reservation. For example, if mine operations were estimated to support 20 jobs in retail trade in Rosebud County and the Northern Cheyenne Indian Reservation were estimated to contain 30 percent of the retail trade jobs in Rosebud County, the estimated effect on retail trade within the Northern Cheyenne Indian Reservation would be 20 jobs multiplied by 30 percent, or 6 jobs (BBC 2020).

Because of the limited impacts in Big Horn County (described below), the economic effects within the Crow Reservation were assumed to be negligible and were not calculated (BBC 2020). The Northern Cheyenne Indian Reservation would be expected to experience greater economic effects because of its proximity and relationship to the mine.

Assumptions

This analysis assumed that if the Project were not permitted (as described in **Section 2.3, Alternative 1 – No Action**), then the operations and status of the other permit areas of the Rosebud Mine (including those currently in the permitting process) would be unaffected. In general, existing patterns and trends of population growth, employment, and income described in **Section 3.12.2, Affected Environment** would continue to drive the social structure and economy of the area. It also assumed that the Colstrip and Rosebud Power Plants would continue to operate as described in **Section 2.3, Alternative 1 – No Action**.

Retirement of Colstrip Units 1 and 2, which occurred on January 5, 2020, is an action considered under cumulative impacts. Colstrip Power Plant's production and annual electric generation was reduced by about 30 percent (Criswell 2017) due to the retirement. When Colstrip Units 1 and 2 were in operation, the annual electric generation was about 17,000 gigawatt hours.

This analysis is based on recent production rates as discussed in **Chapter 1, Introduction**. Currently, the Rosebud Mine's active permit areas supply the Colstrip Units 3 and 4; a small amount of waste coal goes to the Rosebud Power Plant as described in **Section 2.2, Rosebud Mine – Description of Past and**

Existing Mine Operations and Reclamation. As stated in **Section 1.1, Introduction**, it is assumed that Project area coal would be used in the Rosebud Power Plant and Colstrip Units 3 and 4.

During 2019, a total of 349 people worked at the Rosebud Mine for some portion of the year. As the mine has adjusted to the closure of Colstrip Units 1 and 2, employment in 2020 and 2021 is expected to decline to 316 workers (BBC 2020). Given the impossibility of accurately forecasting year-to-year variability in mine employment, analyses in this EIS assumed constant employment of 316 workers to the end of production at the mine.

3.12.2 Affected Environment

3.12.2.1 Population and Demographics

Historical Population Trends and Characteristics

The analysis area's population numbers from 1970 to 2016 are shown in **Table 80**. Between 1970 and 2010, the population fluctuated in Rosebud County, steadily declined in Treasure County, and grew in Big Horn County. Between 2000 and 2010, Rosebud and Treasure Counties and communities all experienced a decline in population, while Big Horn County experienced minor to moderate growth. Population estimates for 2010 to 2016 show a moderate population increase in all counties and for the state of Montana. The population trend between 2000 and 2016 indicates population has declined slightly in Rosebud and Treasure Counties and increased in Big Horn County and Montana as a whole. Montana's overall population has steadily increased between 1950 and 2016 (USCB 2017).

The median age in 2016 was 36.3 years in Rosebud County, 48.9 years in Treasure County, and 30 years in Big Horn County, compared to 39.8 years in Montana as a whole (USCB 2017). Treasure County has an aging workforce and experienced a negative population trend between 1980 and 2010, but population increased between 2010 and 2016 and median age decreased.

Table 80. Rosebud, Treasure, and Big Horn Counties Population (1970–2016).

Jurisdiction	1970	1980	1990	2000	2010	2016	Change 2000–2016
Rosebud County	6,032	9,899	10,505	9,383	9,233	9,348	-35
% change	—	64.1%	6.1%	-10.7%	-1.6%	1.2%	-0.4%
Forsyth	1,873	2,553	2,178	1,944	1,777	1,837	-107
% change	—	36.3%	-14.7%	-10.1%	-8.6%	3.4%	-5.5%
Colstrip	—	—	—[1]	2,346	2,214	2,288	-58
% change	—	—	—	-22.7%	-5.6%	3.3%	-2.5%
Treasure County	1,069	981	874	861	718	846	-15
% change	—	-8.2%	-10.9%	-1.5%	-16.6%	17.8%	-1.7%
Hysham	373	449	361	330	312	408	78
% change	—	20.3%	-19.6%	-8.6%	-5.5%	30.8%	23.6%
Big Horn County	10,057	11,096	11,337	12,671	12,865	13,214	543
% change	—	10.3%	2.2%	11.8%	1.5%	2.7%	4.3%
Hardin	2,733	3,300	2,940	3,384	3,668	3,803	419
% change	—	20.8%	-10.9%	15.1%	8.4%	3.7%	12.4%
Montana	694,409	786,690	799,065	902,125	989,415	1,023,391	121,266
% change	—	13.3%	1.6%	12.9%	9.7%	3.4%	13.4%

Source: Montana Department of Commerce 2012a, 2012b, 2012c; USCB 2017.
[1] Colstrip was incorporated in 1998.

Incorporated Population Centers

The population characteristics of the counties' incorporated towns between 1970 and 2016 are shown in **Table 80**. In Rosebud County, Colstrip has about 25 percent of the population, and Forsyth has about 20 percent of the population. A population boom occurred in Colstrip in the 1970s and 1980s during the construction of the coal-fired electric power plants (see **Section 1.2.2, Coal Combustion**). Since then, Colstrip has steadily decreased in population. In Treasure County, 48 percent of the population lives in Hysham. In Big Horn County, 29 percent of the population lives in Hardin, the county seat. By 2010, Forsyth, Colstrip, and Hysham had experienced a population decrease of 5 percent or more from their 2000 populations, while Hardin experienced a population increase of over 8 percent. Although each of the incorporated areas has grown between 2010 and 2016, overall demographic trends between 2000 and 2016 indicate that population has decreased marginally in Forsyth and Colstrip and increased in Hysham and Hardin.

Population Projections

Population projections for Montana, the counties, and the incorporated municipalities are shown in **Table 81**. The populations of Rosebud, Treasure, and Big Horn Counties are projected to decrease between 2017 to 2030. Population projections for municipalities within the analysis area shown in **Table 81** were obtained by applying county population projected growth rates from 2020 to 2030 to the municipalities. The population in Colstrip is expected to decrease by 219 people between 2017 and 2030. Forsyth's population is expected to decrease by 174 people, Hysham's population is expected to decrease by 31 people, and Hardin's population is expected to decrease by 603 people (MEIC 2019; USCB 2017).

Table 81. Rosebud, Treasure, and Big Horn Counties and Montana Population Projections (2020–2030).

Jurisdiction	Current (2016)	2020	2025	2030	Change 2016–2030
Rosebud County	9,292	8,870	8,635	8,388	-904
% change	-	-4.5%	-2.6%	-2.9%	-9.7%
Forsyth	1,793	1,712	1,666	1,619	-174
Colstrip	2,253	2,151	2,094	2,034	-219
Treasure County	790	669	696	718	-72
% change	-	-15.3%	4.0%	3.2%	-9.1%
Hysham	343	290	302	312	-31
Big Horn County	13,290	12,171	11,631	11,189	-2,101
% change	-	-8.4%	-4.4%	-3.8%	-15.8%
Hardin	3,812	3,491	3,336	3,209	-603
% change	-	-8.4%	-4.4%	-3.8%	-15.8%
Montana	1,029,862	1,060,332	1,102,711	1,136,559	106,697
% change	-	3.0%	4.0%	3.1%	10.4%

Source: USCB 2017.

3.12.2.2 Economic Characteristics

Employment

Employment conditions in the analysis area are presented in terms of historical employment trends, current types of employment, and baseline employment projections by county.

Rosebud County

Rosebud County's traditional major industries of coal mining, the railroad, and agriculture remain the driving forces of the area's economy. Rosebud County has experienced a declining economy in the last several decades. Primary businesses in the county have downsized, and a small U.S. Air Force base closed. Ongoing drought conditions in southeastern Montana have impacted the county's agricultural sector. The Tongue River Lumber Mill (a major employer of Native Americans) closed but has attempted to reopen numerous times in the last 10 years.

The top 10 private employers for Rosebud County in 2016, listed in alphabetical order, were Charging Horse Casino, Colstrip Electric, Lame Deer Trading Post, North American Energy Services, PP&L of Montana (now Talen Energy), Prince Inc., Rosebud Community Hospital, St. Labre Indian School, Town Pump, and Western Energy, which is now Westmoreland Rosebud (Montana Department of Labor and Industry 2017).

The top employment by industry with the number and percentage rate of employees is shown in **Table 82**. Four sectors (educational services, and health care and social assistance; agriculture, forestry, fishing and hunting, and mining; transportation and warehousing, and utilities; and arts, entertainment, and recreation, and accommodation and food services) comprise over two-thirds of the total employment in the county.

In Rosebud County, the unemployment rate—defined as the number of unemployed persons as a percentage of the labor force—decreased from 7.0 percent in 2010 to 5.0 percent in the second quarter of

2018. This was somewhat higher than the overall unemployment rate in Montana, which was 3.2 percent during the second quarter of 2018 (Montana Department of Labor and Industry 2018).

Table 82. Rosebud County Employment by Industry 2012–2016 (5-Year Estimates).

Industry	Number	Percent
Agriculture, forestry, fishing and hunting, and mining	792	19.4
Construction	291	7.1
Manufacturing	35	0.9
Wholesale trade	7	0.2
Retail trade	236	5.8
Transportation and warehousing; utilities	467	11.4
Information	89	2.2
Finance and insurance; real estate, rental, and leasing	176	4.3
Professional, scientific, management, and administrative	78	1.9
Educational services; health care and social assistance	1,078	26.4
Arts, entertainment, and recreation; accommodation and food services	447	10.9
Other services, except public administration	117	2.9
Public administration	276	6.7
Total	**4,089**	**100.0**

Source: Missouri Census Data Center 2017.

Local businesses in the city of Colstrip include two banks, a credit union, two hardware stores, two motels, a bowling alley, a grocery store, casinos, a floral shop, a post office, a clothing store, a library, restaurants, and convenience stores. These businesses are supported by income from the Colstrip Power Plant, the Rosebud Power Plant, and the Rosebud Mine, as well as the agricultural production in the area surrounding Colstrip, including the Crow Reservation and the Northern Cheyenne Indian Reservation.

The Colstrip Power Plant retirement of Colstrip Units 1 and 2 on January 5, 2020 resulted in an approximate 30 percent decrease in Rosebud Mine employment and total annual output. This has resulted in an adverse impact on the local, state, and federal economy. While these effects are immediate with regard to loss of jobs, some of these effects will be felt over the next year to several years.

The incorporated city of Forsyth is the largest commercial district in Rosebud County with a post office, two banks, several motels, and numerous retail stores, restaurants, and services. The primary employers are the railroad, agriculture, government, the hospital and nursing home, the school district, and retail and service businesses, with some residents traveling 36 miles south to Colstrip to work at the coal mine or the power plants.

During 2019, a total of 349 people worked at the Rosebud Mine for some portion of the year (BBC 2020). The coal mined from the Rosebud Mine is the primary fuel for the Colstrip Power Plant, which is operated by Talen Energy, and is sent directly to the mine via conveyor belt. As the mine adjusts to the closure of Colstrip Units 1 and 2, employment at the Rosebud Mine in 2020 and 2021 is expected to decline to 316 workers (BBC 2020).

Treasure County

Treasure County's principal industries are farming and ranching. The top employment sectors by industry with the number of employees are shown in **Table 83**. Crops include sugar beets, corn, wheat, barley, and beans. Hysham is the county seat with a small business district that has two restaurants, a hardware store, a bank, a few service businesses, and two convenience stores. A motel and a bed-and-breakfast provide

places to stay for hunters and tourists. Other businesses include a veterinarian clinic, a farm-implement dealer, and Simplot Elevator services.

The unemployment rate decreased from 5.3 percent in 2010 to 2.4 percent in the second quarter of 2018, lower than Montana's 3.2 percent unemployment rate (Montana Department of Labor and Industry 2018).

Table 83. Treasure County Employment by Industry 2012–2016 (5-Year Estimates).

Industry	Number	Percent
Agriculture, forestry, fishing and hunting, and mining	163	41.1
Construction	21	5.3
Manufacturing	4	1
Wholesale trade	5	1.3
Retail trade	28	7.1
Transportation and warehousing; utilities	40	10.1
Information	10	2.5
Finance and insurance; real estate, rental, and leasing	11	2.8
Professional, scientific, management, and administrative	8	2
Educational services; health care and social assistance	65	16.4
Arts, entertainment, and recreation; accommodation and food services	11	2.8
Other services, except public administration	8	2
Public administration	23	5.8
Total	**397**	**100.0**

Source: Missouri Census Data Center 2017.

Big Horn County

Big Horn County is Montana's 14th most-populous county; Hardin, the county seat, is the state's 22nd largest city. The majority of Big Horn County lies within the Crow Reservation and the Northern Cheyenne Indian Reservation. Coal mining and agriculture both play major roles in Big Horn County's economy. Farms and ranches in the county produce mainly beef cattle, sugar beets, alfalfa, and small grains.

The top employment sectors by industry with the number of employees are shown in **Table 84**. Three sectors (agriculture, forestry, fishing and hunting, and mining; transportation and warehousing, and utilities; and educational services, and health care and social assistance) comprise two-thirds of the total employment in the county. The unemployment rate decreased from 11 percent in 2010 to 8.9 percent during the second quarter of 2018. This was more than twice Montana's overall unemployment rate of 3.2 percent (Montana Department of Labor and Industry 2018).

Table 84. Big Horn County Employment by Industry 2012–2016 (5-Year Estimates).

Industry	Number	Percent
Agriculture, forestry, fishing and hunting, and mining	640	13.5
Construction	177	3.7
Manufacturing	34	0.7
Wholesale trade	45	0.9
Retail trade	441	9.3
Transportation and warehousing; utilities	174	3.7
Information	16	0.3
Finance and insurance; real estate, rental, and leasing	133	2.8
Professional, scientific, management, and administrative	56	1.2
Educational services; health care and social assistance	1,354	28.5
Arts, entertainment, and recreation; accommodation and food services	452	9.5
Other services, except public administration	123	2.6
Public administration	1,109	23.3
Total	**4,754**	**100.0**

Source: Missouri Census Data Center 2017.

Income

Median household income (MHI), per capita income (PCI), and persons below the poverty line (poverty rate) are variables used to understand income (**Table 85**). All three counties have lower PCIs than the state. Big Horn and Treasure Counties have lower MHIs than the state. Rosebud County has a higher MHI and PCI and a slightly higher poverty rate than Treasure County and substantially lower poverty rate than Big Horn County. Big Horn County has a substantially lower PCI and a higher rate of persons below the poverty line than the state and the other counties. PCI can be relatively low when a disproportionate number of nonworking residents (children, the elderly, and the disabled) are included in the population, which is the case for Treasure County. All three counties in the analysis area have a higher percentage of people living below the poverty line than the state.

Table 85. Household Income in Rosebud, Treasure, and Big Horn Counties and Montana.

Parameter	Rosebud County	Treasure County	Big Horn County	Montana
Median household income	$55,609	$42,500	$44,136	$48,380
Per capita income	$23,387	$21,255	$17,352	$27,309
Percentage of persons below poverty line	19.7%	19.1%	27.8%	14.9%

Source: Missouri Census Data Center 2017.

Housing

All three of the counties have a housing surplus, with between 19 and 24 percent of housing units vacant. Rosebud County had 4,104 housing units in 2016, while Treasure County had 452 and Big Horn County had 4,678. Overall, the percentage of owner-occupied housing units in the analysis area (about 79 percent in Rosebud County, 82 percent in Treasure County, and 77 percent in Big Horn County) was lower than but comparable to the state's 84 percent (Missouri Census Data Center 2017).

3.12.2.3 Public Services and Infrastructure

Schools

Colstrip. The Colstrip Public School System has an elementary school, a middle school, and a high school. Pine Butte Elementary School houses kindergarten through grade 5, Frank Brattin Middle School houses grades 6 through 8, and Colstrip High School houses grades 9 through 12. The school district has about 700 students. When local populations decreased in the 1990s, a second elementary school was closed.

Forsyth. Forsyth Public Schools has an elementary school and a high school. Forsyth Elementary School serves kindergarten through grade 6, while Forsyth High School serves grades 7 through 12. The school district has about 400 students.

Hysham. Hysham Public Schools has an elementary school, a middle school, and a high school. Hysham Elementary School serves prekindergarten through grade 6, Hysham Middle School serves grades 7 and 8, and Hysham High School serves grades 9 through 12. The school district has about 100 students.

Hardin. Hardin Public Schools are home to about 1,900 students who attend classes in seven schools. There are two elementary schools that serve kindergarten through grade 5—the Crow Agency School and Fort Smith School. In addition to a kindergarten readiness center, the Hardin Primary School serves kindergarten through grade 3, the Hardin Intermediate School serves grades 3 through 5, the Hardin Middle School serves grades 6 through 8, and the Hardin High School serves grades 9 through 12.

Law Enforcement

Colstrip. Initiated in 2004, the Colstrip Police Department provides safety, protection, code enforcement, and animal control, and operates a seven-bed jail holding facility. The department currently has six full-time officers, two reserve officers, and five 911 dispatchers.

Forsyth. Forsyth contracts with Rosebud County for law enforcement services. The Rosebud County Sheriff's Office located in Forsyth was established in 1901. The office has seven officers, four dispatchers, and additional detention staff. The Rosebud County Detention Center holds up to 26 inmates. Dispatch for the Rosebud County Sheriff's Office also works with local Montana Highway Patrol officers and FWP game wardens. The Rosebud County Sheriff's Office is also responsible for paging Disaster and Emergency Services, Forsyth Ambulances, and Rural County Fire Departments.

Hysham. There is no city police department in Hysham. Under a cooperative agreement with Hysham, the Treasure County Sheriff Department provides police services to both the city and county. Treasure County uses Rosebud County's dispatch and detention services. Montana Highway Patrol officers also provide law enforcement services.

Hardin. There is no city police department in Hardin. The Big Horn County Sheriff Department provides police services to both the city and county.

Fire Protection

Colstrip. The Colstrip Volunteer Fire Department serves the city and surrounding community. The fire department follows the policies and procedures of the city of Colstrip and state law (7-33-4104 through 4133, MCA) relevant to municipal fire departments. The 26 volunteer firefighters train regularly and are required to complete 30 hours of basic firefighting training.

Forsyth. Forsyth has two fire stations and two fire departments—the Forsyth Fire Department and Rosebud County Fire.

Hysham. The Hysham Volunteer Fire Department, located in the center of town, has 20 volunteers and no paid staff.

Hardin. The Hardin Volunteer Fire Department has about 20 volunteers and no paid staff.

Health Care Facilities

Colstrip. The Colstrip Medical Center serves the community and surrounding areas as a primary-care facility. Staffing includes two full-time family physicians, two full-time physician assistants, several nurses, a physical therapy program, a diagnostic center, and a health and wellness program. The nearest hospital is Rosebud Community Hospital located 30 miles north in Forsyth. Colstrip has an ambulance service that operates within a 30-mile radius around Colstrip and is dispatched through the local police department.

Forsyth. Forsyth has a fully staffed hospital and nursing home with three physicians on staff and two medical clinics in town and serves all of Rosebud County. The county owns the hospital buildings and land. Operating revenues and private donations support all other expenses. Recently, a task force worked to build an assisted-living facility in Forsyth.

Hysham. The Hysham Community Health Clinic and Treasure County Health Department are combined as the public health-care provider for Hysham. The facility is staffed by a physician 1 day a week to provide general clinic services. There are no nursing homes or elderly-care facilities in Hysham. However, the Treasure County Senior Citizens Center provides meals and a social meeting space. Local ambulance service is dispatched through the county.

Hardin. In 1959, Hardin opened its present hospital, Big Horn County Memorial Hospital. In 1974, a 34-bed nursing home was constructed by Big Horn County and attached to the existing hospital. In 1982, the Heritage Acres Nursing Home complex was built with 36 long-term care beds and 20 independent-living apartments. The Big Horn Hospital Association constructed a new clinic to house five physicians and staff an outpatient rehabilitation facility. Big Horn County Memorial Hospital is a critical access hospital with about 60 beds.

Water Supply

Colstrip. The public water supply is sourced from the Yellowstone River 6 miles west of Forsyth to a storage impoundment (Castle Rock Lake) immediately west of Colstrip. Stored water is then treated at the Colstrip Water Treatment Plant for potable use. Potable water is distributed from the plant through six high-service pumps entering three separate pressure zones over 26 miles of distribution lines servicing Colstrip. Three separate reservoirs totaling 3.15 million gallons of water maintain the pressure zones.

Forsyth. The Forsyth City Water Works Department provides municipal potable water treatment. The water-treatment plant is located near the source intake on the Yellowstone River. Treated potable water is piped to municipal users through a pressurized distribution network.

Hysham. Hysham provides municipal potable water. The municipal water-treatment plant is located near the source intake on the Yellowstone River. Treated potable water is piped to municipal users through a pressurized distribution network.

Hardin. Hardin water treatment consists of a surface water plant that treats water pumped from the Big Horn River with a capacity of 2 million gallons a day and two 500,000-gallon storage reservoirs.

Wastewater Treatment

Colstrip. Wastewater is collected from the city of Colstrip through two sanitary collection systems into a municipal water-treatment plant. Effluent is discharged to a holding pond for use as reclaimed water on the local Pine Butte Golf Course. Sludge is disposed in a storage lagoon. The wastewater-treatment plant currently operates at 200,000 gallons per day but is designed for a larger population with average daily flows of 600,000 gallons.

Forsyth. Wastewater in Forsyth is collected through a sewer network for treatment at the municipal wastewater-treatment plant. The wastewater-treatment plant's maximum design volume is 1 million gallons per day, but it is presently treating an average 300,000 gallons per day.

Hysham. Wastewater in Hysham is collected through a sewer network for treatment at the municipal wastewater-treatment plant. The wastewater-treatment plant's maximum design volume is 864,000 gallons per day. Presently the plant is treating 250,000 to 300,000 gallons per day in the summer and 35,000 to 50,000 gallons per day in the winter.

Hardin. Wastewater in Hardin is collected through a sewer network for treatment. The sewer treatment plant's current effluent flow is 750,000 to 900,000 gallons per day. The plant has a capacity of 1.1 million gallons per day and uses aerobic digestion and oxidation systems.

3.12.3 Environmental Consequences

This section discloses the impacts on socioeconomic conditions in the analysis area resulting from the No Action Alternative (Alternative 1) and the Proposed Action (Alternative 2). The impacts analysis and impacts analysis terminology for socioeconomic conditions is structured differently than for other resource areas due to the nature of the issue and the methods used for analysis, as described above in **Section 3.12.1.2, Analysis Area and Methods**.

As described in the sections below, the annual economic effects associated with continued operation of the Rosebud Mine would be the same for Alternatives 1 and 2. The difference among alternatives is that selection of Alternative 2 would extend the life of Permit Area B by 15 years and the life of the Rosebud Mine (and the annual direct, indirect, and induced socioeconomic effects at current levels) by 7 years beyond the life of the mine as currently permitted (see **Section 2.2.4, Life of Operations**). This would lead to an extension of economic activity related to the mine for 7 years as well as an estimated 104.3 million tons of coal mined to be used for electricity production and perhaps other economic uses (see **Section 2.1.3**). Under the No Action Alternative, the operational life of the Rosebud Mine would be expected to end in 2038, and the life of Area B would be expected to end in 2030.

3.12.3.1 Socioeconomic Impacts of Mine Closure – All Alternatives

When the Rosebud Mine eventually closes (closure year depends on selection of the No Action Alternative or Alternative 2—see **Section 2.2.4, Life of Operations**), unemployment rates would likely increase, and income would decrease with the loss of jobs. It is possible the analysis area would experience further negative population growth and increased poverty rates compared to present conditions. Sources of revenue from the mine that fund community institutions and essential social services would be eliminated after mine closure. These institutions would likely experience further decreases in funding as a result of lower employment rates, lower wages, and the total loss of tax revenue

from the mine operation. Coal extraction from the mine would stop and no longer be available for its various uses.

Direct socioeconomic impacts on local communities would occur in Rosebud County as a result of employment and economic output from the mine operations (**Table 86**). Indirect and induced impacts (as defined above) on local populations would be experienced in Rosebud, Treasure, and Big Horn Counties, and in the Northern Cheyenne Indian Reservation and Crow Reservation (**Table 87** and **Table 88**).

Communities in Rosebud County would be directly and indirectly impacted from the loss of wages and economic activity from mine operations when the mine closes. Rosebud Mine jobs and direct economic output (including payroll and the supplies, materials, and purchases made by the Rosebud Mine as a result of the Proposed Action) that support the local economic activity would cease (see **Section 3.12.1.1, Regulatory Framework**). Mine closure would likely result in long-term adverse impacts.

Direct Effects – All Alternatives

Under all alternatives, the Rosebud Mine would continue to provide the coal needed by the Colstrip Power Plant. One difference among alternatives is which permit area of the Rosebud Mine would supply coal to Colstrip Units 3 and 4. Under the No Action Alternative, coal would be supplied by other areas of the Rosebud Mine through 2038 (see **Section 2.2.2.2, General Mining Method**), but under Alternative 2, coal would be supplied by the Project through 2045 and other permit areas through 2038.

Another difference among alternatives is life of operations. Under the No Action Alternative, the Rosebud Mine would be expected to operate until 2038, supporting 316 direct jobs and $154 million in annual direct economic output. Under Alternative 2, the mine's operational life would be extended by 7 years, from 2038 until 2045, continuing to support the 316 direct jobs and $154 million in annual direct economic output, and 62 indirect jobs and $30 million in annual induced economic output for the Northern Cheyenne Indian Reservation.

Table 86. Rosebud Mine Annual Direct Economic Effects Under all Alternatives.

Location	Employment - Current Conditions (through 2038*)	Total Annual Output under Current Conditions (through 2038*)
Rosebud County	316	$154,123,000
Treasure County	0	$0
Big Horn County	0	$0
Total	**316**	**$154,123,000**
Northern Cheyenne Indian Reservation	62	$30,239,000

Source: BBC 2020.
*These conditions would continue through 2045 in Alternative 2.

Indirect Effects – All Alternatives

The estimated indirect economic effects on the region from the Rosebud Mine are shown in **Table 87**. Indirect effects likely would continue to occur outside of the three-county analysis area—particularly in Yellowstone County, which includes the city of Billings. Billings is the largest city and the primary regional trade center in southeastern Montana.

The Rosebud Mine supports 70 indirect jobs, 13 of which occur in the Northern Cheyenne Indian Reservation (**Table 87**). This level of indirect employment would be expected to continue through 2038 for all alternatives. The mine also generates $18 million annually in indirect economic output in the region. This level of indirect economic output would be expected to continue under all action alternatives.

One difference among alternatives is which permit area of the Rosebud Mine would supply coal to Colstrip Units 3 and 4. Under the No Action Alternative, coal would be supplied by other areas of the Rosebud Mine through 2038 (see **Section 2.2.2.2, General Mining Method**), but under Alternative 2, coal would be supplied by the Project as well. Another difference among alternatives is life of operations; in the No Action Alternative, the Rosebud Mine would be expected to operate until 2038, supporting 70 indirect jobs and $18 million in annual indirect economic output, and 13 indirect jobs and $3.2 million in annual induced economic output for the Northern Cheyenne Indian Reservation. In Alternative 2, mine life would be extended by an additional 7 years (until 2045), continuing to support the 70 indirect jobs and $18 million in annual indirect economic output over this time.

Table 87. Rosebud Mine Indirect Annual Economic Effects Under all Alternatives (Through 2038 in Alternative 1) (Through 2045 in Alternative 2).

Location	Employment under Current Conditions (through 2038*)	Total Annual Output under Current Conditions (through 2038*)
Rosebud County	65	$16,431,000
Treasure County	3	$417,000
Big Horn County	2	$1,249,000
Total	**70**	**$18,097,000**
Northern Cheyenne Indian Reservation	13	$3,224,000

Source: BBC 2020.

Induced Effects – All Alternatives

Table 88 shows the estimated induced effects of the Rosebud Mine in Rosebud, Big Horn, and Treasure Counties and in the Northern Cheyenne Indian Reservation. The Rosebud Mine would support 91 induced jobs and $11.6 million in annual induced input (**Table 88**).

One difference among alternatives is which permit area of the Rosebud Mine would supply coal to Colstrip Units 3 and 4. Under the No Action Alternative, coal would be supplied by other areas of the Rosebud Mine (see **Section 2.2.2.2, General Mining Method**), but under Alternative 2, coal would be supplied by the Project as well as other permit areas. Another difference among alternatives is life of operations. Under the No Action Alternative, the Rosebud Mine would be expected to operate until 2038, supporting 91 induced jobs and $11.6 million in annual induced economic output in the three counties and of that total, 17 induced jobs and $2.1 million in annual induced economic output for the Northern Cheyenne Indian Reservation. Under Alternative 2, mine life would be extended by 7 years, continuing to support the induced jobs and economic output over this time.

Table 88. Rosebud Mine Induced Economic Effects Through 2038.

Location	Employment under Current Conditions (through 2038*)	Total Annual Output under Current Conditions (through 2038*)
Rosebud County	86	$10,936,000
Treasure County	1	$117,000
Big Horn County	4	$596,000
Total	**91**	**$11,649,000**
Northern Cheyenne Indian Reservation	17	$2,146,000

Source: BBC 2020.
*These conditions would continue through 2045 in Alternative 2.

Total Socioeconomic Effects – All Alternatives

The total regional economic employment and output of the mine is derived by combining the direct, indirect, and induced effects described in previous sections. The majority of the economic effects would continue to occur at or near the mine, and Rosebud County would continue to experience the majority of beneficial economic effects until the end of operational mine life. However, since indirect and induced spending occurs across the larger regional economy, both Big Horn and Treasure Counties would continue to experience some economic effects due to mine operations until the end of operational mine life (**Table 89**).

Table 89. Rosebud Mine Total Annual Economic Effects.

Location	Employment under Current Conditions through 2038*	Total Annual Output under Current Conditions through 2038*
Rosebud County	467	$181,490,000
Treasure County	4	$534,000
Big Horn County	6	$1,845,000
Total	**477**	**$183,869.000**
Northern Cheyenne Indian Reservation	92	$35,609,000

Source: BBC 2020.
*These conditions would continue through 2045 in Alternative 2.

The Rosebud Mine would support about 477 direct, indirect, and induced jobs throughout the tri-county analysis area and continue to stimulate $183.9 million in annual economic output (**Table 89**). About 92 of these jobs and $35.6 million of the annual total output would occur within the Northern Cheyenne Indian Reservation. Economic impacts on the Crow Reservation were not calculated given the small economic impacts projected to occur in Big Horn County compared with Rosebud County (BBC 2020).

One difference among alternatives is which permit area of the Rosebud Mine would supply coal to Colstrip Units 3 and 4. Under the No Action Alternative, coal would be supplied by other areas of the Rosebud Mine (see **Section 2.2.2.2, General Mining Method**); under Alternative 2, coal would be supplied by the Project as well as other permit areas. Another difference among alternatives is life of operations. Under the No Action Alternative, the Rosebud Mine would be expected to operate until 2038, supporting the 477 direct, indirect, and induced jobs and $183.9 million in annual economic output. Under Alternative 2, mine life would be extended by 7 years (until 2045), continuing to support the 477 direct, indirect, and induced jobs and $183.9 million in annual economic output.

3.12.3.2 Government Revenue Impacts – All Alternatives

Another important component of the mine's economic impact is the resulting fiscal revenues provided to local governments, the state of Montana, and the federal government.

Based on the BBC Effects Analysis, the Rosebud Mine would provide $46 million in annual direct revenues to Rosebud County, the state of Montana, and the federal government in 2020 under current conditions (**Table 90**). These revenues would include federal and state payroll and income taxes, severance taxes, resource indemnity trusts, gross proceeds taxes, and property taxes. State and federal royalties would also provide substantial revenue.

As shown in **Table 90**, the Rosebud Mine would directly generate $27.5 million in annual state revenues in 2020 under current conditions. Local governments and the federal government would each receive about $8 million in annual taxes and royalties under current conditions.

Table 90 depicts the projected government revenues supported by operations of the Rosebud Mine in the No Action Alternative and Alternative 2. Under Alternative 2, these revenues would continue 7 years longer (2045) than the No Action Alternative (2038).

Table 90. Projected Effects of Mine Operations on Government Revenues (through 2038).

	Local Governments	State of Montana	Federal Government
Direct	$8,361,000	$26,994,000	$8,365,000
Indirect	$531,000	$331,000	$610,000
Induced	$289,000	$214,000	$502,000
Total	**$9,181,000**	**$27,539,000**	**$9,477,000**

*These conditions would continue through 2045 in Alternative 2.

3.12.3.3 Cumulative Impacts

The analysis area for cumulative impacts is the same as the analysis area for direct effects. Past, present, and related future actions under concurrent consideration that would contribute to cumulative impacts include:

- Agricultural operations
- Past, ongoing, and future permitted mining at the Rosebud Mine
- Past, ongoing, and future operations of the power plants

The traditional major industries of coal mining, power production, and agriculture (ranching and farming) have been and are the driving forces of the area’s economy. Past and ongoing mining at the Rosebud Mine have resulted in the loss of potential agricultural lands and economic productivity associated with agriculture. Future mining in existing permit areas of the Rosebud Mine will continue to impact agriculture. It should be noted that this loss of potential agricultural lands is temporary, as mined areas are reclaimed and returned to postmine land use. For example, reclaimed areas are available for grazing as soon as the vegetation is established and a management unit is large enough to support appropriate numbers of livestock.

Continued power production at the Rosebud Power Plant and the Colstrip Power Plant is expected to continue to contribute to the analysis area economy. If the proposed AM5 expansion area is approved, the Project area would be mined until 2045. The approval of AM5 would result in a short- to long-term impact on the socioeconomic environment, in that it would extend the life of the mine beyond the currently anticipated closure of 2030 to 2045 (see **Section 2.2.4, Life of Operations**) and therefore preserve the jobs, income, and economic activity from mine operations in the socioeconomic analysis area.

3.12.3.4 Unavoidable Adverse Impacts

There would be no unavoidable adverse impacts on socioeconomic resources as a result of the Proposed Action.

3.12.3.5 Irreversible and Irretrievable Impacts

There would be no irreversible and irretrievable impacts on socioeconomic resources as a result of the Proposed Action.

3.13 VISUAL RESOURCES

3.13.1 Introduction

This section describes the visual character within and near the Project area and the regulatory authorities governing visual resources. The analysis area for visual resources is defined below in **Section 3.13.1.2, Analysis Area and Methods**.

This section also analyzes the environmental consequences, including the direct, secondary, and cumulative impacts, of the No Action Alternative (Alternative 1) and the Proposed Action (Alternative 2) with respect to visual resources in the analysis area.

3.13.1.1 Regulatory Framework

Federal Requirements

There are no federal regulations applicable to visual resources within or near the analysis area.

State Requirements

Under MSUMRA, DEQ does not have any regulatory authority over impacts on visual resources. State regulations indirectly applicable to visual resources include ARM 17.24.711 (Establishment of Vegetation during Reclamation) and 82-4, MCA (Reclamation). Reclamation affects long-term visual impacts.

Local Requirements

There are no local regulations applicable to visual resources within or near the analysis area.

3.13.1.2 Analysis Area and Methods

Analysis Area

The analysis area for direct and secondary impacts is the viewshed of the 15,153-acre Project area, including the AM5 expansion area. The viewshed is the landscape that can be directly seen under favorable atmospheric and topographic conditions from a given viewpoint. Based on rolling hillsides and terrain, the viewshed is defined as the Project area plus a 5-mile buffer. This is the area where line-of-sight may allow Project activities to be viewed and the horizon does not obstruct the view of an observer. Seven Key Observation Points (KOPs) were identified in the analysis area to assess visual impacts. These KOPs were identified as areas with sensitive viewers in the analysis area. KOPs were located near residences, along Airport Road, along State Highway (SH) 39, and at a gas station on the western edge of the city of Colstrip (**Table 91** and **Figure 68**). KOPs were visited on June 16, 2018, and panoramic photos were taken.

Analysis Methods

Although there are no BLM lands in the Project area, the BLM Visual Resource Management (VRM) process serves as a consistent method for visual resource impact analysis (BLM 1984). Concepts and terminology borrowed from VRM were used to provide consistent language to describe and understand the visual character of the analysis area. The degree of viewer sensitivity, Project visibility, and contrast were evaluated to measure the environmental impacts of the Project. The method used to determine

potential impacts on visual resources involved assessing the location of the proposed mining operations relative to the locations of the KOPs and using professional judgment to estimate the resulting visual changes. Viewer sensitivity level varies based on the type of user, the number of users, public interest, or adjacent land uses (BLM 1984). Potential visibility of the proposed mining operation from KOPs was estimated using aerial and ground photographs, Google Earth Viewshed analysis, maps, and written descriptions of the existing environment from the Application. Also considered in this analysis was the length of viewing time, type of view (obstructed vs. nonobstructed), and distance between a KOP and the proposed mining operation; the amount of potential contrast created by Project impacts; and the presence of visual obstructions between a KOP and the proposed Project.

Seven KOPs were identified using Google Earth, MapQuest, site photos, and USGS 7.5-minute quadrangle maps. **Table 91** provides the type of KOP, the direction of photos, and the visual description from the KOPs in the analysis area. The KOPs are shown on **Figure 68** and include:

- Three residences within 1 mile of the AM5 expansion area
- Airport Road
- SH 39
- The airport
- A gas station in the city of Colstrip

Impacts are described as short-term, long-term, or both (see **Section 3.1.1, Definitions Used for Impacts Analyses**). The following definitions for distance zones were used to describe the nature of impacts (BLM 1984):

- Foreground–middle ground – areas seen from highways, rivers, or other viewing locations less than 5 miles away
- Background – areas beyond the foreground–middle ground but less than 15 miles away
- Seldom seen – areas usually hidden from view, more than 15 miles away

Table 91. Key Observation Points in the Analysis Area.

Key Observation Point (KOP) Name	Type	Panorama Picture Direction, Looking Toward the Project Area	Description
KOP 1 – Residence 1	One residence	115 to 160 degrees	Undulating terrain with primarily uniform green vegetation (grass) in the foreground–middle ground. Rounded hill with vertical, sharp, dark tree silhouettes (partially dead pine trees). Faint gray cliff band in the left of the frame, background view. Man-made features include two powerlines with silver wire between poles left and right of the small hill in the foreground–middle ground, short barbed-wire fence bordering pasture, ranch head gate and small residential building, and dark gray dirt road in immediate foreground–middle ground. Project area may be visible in the background only.
KOP 2 – Residence 2	Two residences	115 to 180 degrees	Uniform, undulating green hills dotted with darker triangular green conifer trees on the hill tops and toe of slopes. Prominent and contrasting rocky hill in the background with reddish bare rock and patchy dark green trees. Man-made features include low residences with reflective metal roofs, red dirt two-track road, gray dirt two-track road, wooden and wire fence at border of property, and small single-pole distribution line along road and to properties, crossing up and over the hillside.
KOP 3 – Airport Road	Airport Road and mine road intersection	115 to 180	Low, undulating, uniformly green hills with discontinuous clumps of darker green trees in the foreground–middle ground. Light tan exposed soil (rocky outcrop), possibly from erosion. Rocky, prominent hills in foreground–middle ground with patchy vertical trees. Far left view, faint gray cliff band, and unvegetated soil and dust related to mining activity. Man-made features include reflective metal roofs of residences in the foreground–middle ground; vertical, single-pole, brown, wooden distribution line structures and silvery gray wires; transmission poles in the background; and red and dark gray dirt two-track roads.
KOP 4 – Residence 3	Active ranch and residence south of Airport Road	150 to 210	Low gray and very light tan hills (spoil from mining) in foreground–middle ground just beyond the residence. Low rounded trees along ephemeral drainage and near house. Man-made features include residence, numerous ranch buildings and water tanks, scattered parked trucks and campers, broken-down buildings and metal scraps, distribution and transmission lines, dark gray to red dirt road, short wooden fence and barbed wire, large tractor tires, and cattle guard across road.

Table 91. Key Observation Points in the Analysis Area.

Key Observation Point (KOP) Name	Type	Panorama Picture Direction, Looking Toward the Project Area	Description
KOP 5 – Highway 39	Valley 4.2 miles SE of the AM5 expansion area	300 to 340	Scenic low green grass and shrubland in foreground–middle ground with scattered, low, rounded clumps of trees. Some brown-reddish bare ground visible in ephemeral wash. Grass is smooth and flat to gently sloping plane to the base of the distant hills. Low, smooth, mounded hills dot the grassy plane. Distant hills are bold and in the foreground–middle ground, horizontally striated pattern with patchy angular dark trees on top, visible across the entire field of view. Man-made features include single-pole wooden distribution structures and wire, residential buildings, low wooden fence and wire fence, and tire tracks from off-road travel.
KOP 6 – Airport	Airport buildings	180 to 230	Uniformly green, grassy, mostly flat to smooth hill (appears reclaimed) with clumped and rounded trees and shrubs. Light tan to brown bare dirt and road associated with Area B active mine. Man-made features include red to dark gray dirt road, two transmission lines, light tan active mine road in foreground–middle ground, street sign, and bright tan spoil pile in right field of view.
KOP 7 – Colstrip Gas Station	Colstrip about 4.2 miles from AM5 expansion area	215 to 245	Mostly built environment. Pavement, signs, cars, buildings associated with gas station on the edge of town, vertical street lights, power lines and poles, chain link fence, and concrete wall. Smooth, lightly undulating green hill (looks reclaimed) in foreground–middle ground with a few scattered clumps of planted trees.

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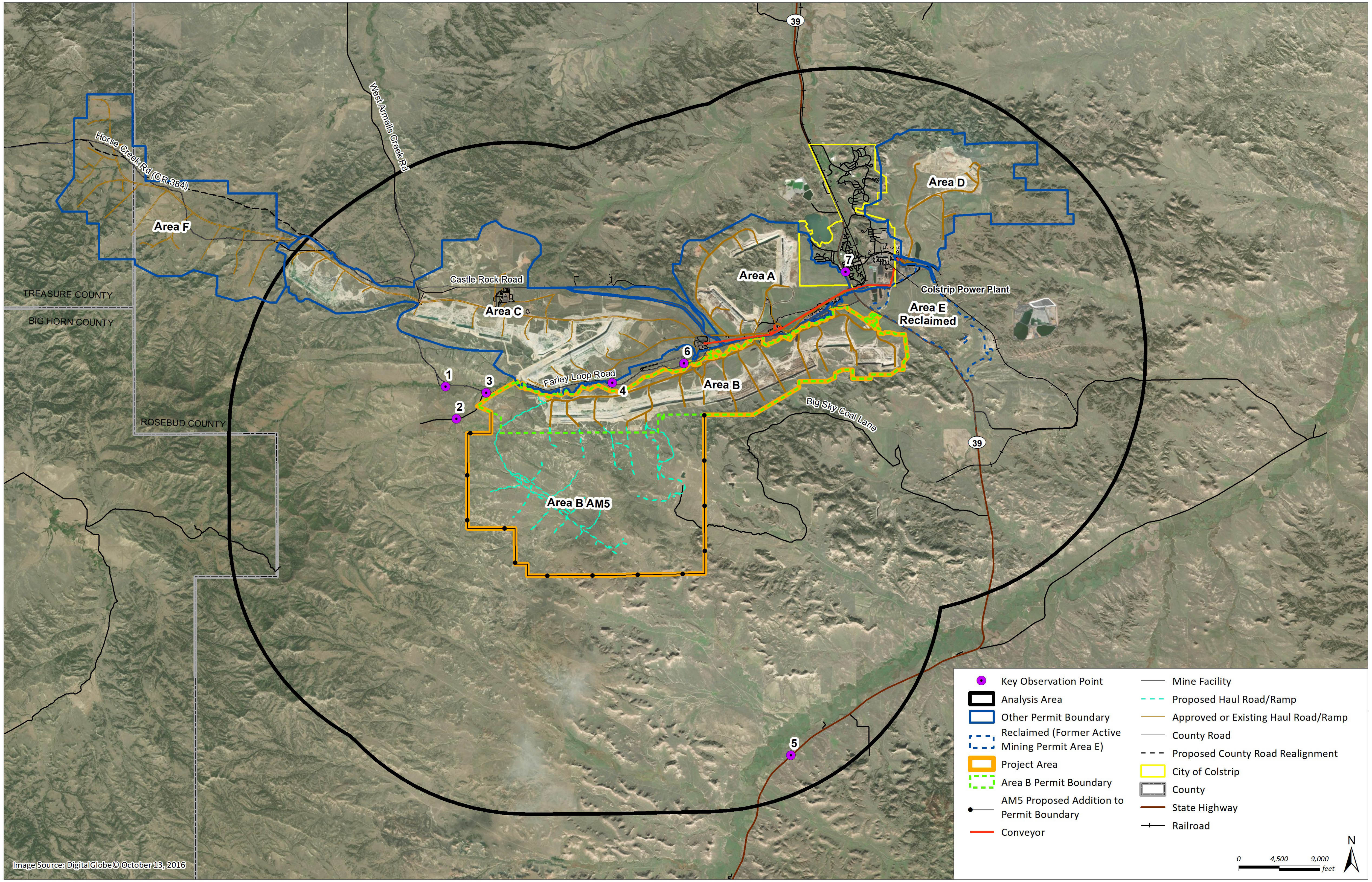

Figure 68. Key Observation Points with Potential Visibility of the Proposed Project.

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3.13.2 Affected Environment

Visual resources in the Project area and the encompassing analysis area are described in the sections below.

3.13.2.1 Project Area

The proposed Project area includes areas of active mining and associated disturbance in the existing Area B permit area and grassy rangelands, conifer hills, and shrublands in the AM5 expansion area. Scattered throughout the Project area are hills with highly visible rock outcrops interspersed with sparse conifer forests. Vegetation surveys conducted in the Project area are summarized here, but more detail can be found in Westmoreland Rosebud's Application Appendix E, and in **Section 3.10, Vegetation** of this EIS.

In vegetation surveys conducted in 2013 and 2016, seven major vegetation communities in the AM5 expansion area portion of the Project area were identified: conifer/sumac, grassland, improved pasture, mixed shrub, revegetation, sagebrush, and woody draw (Cedar Creek Associates 2016). A year before the vegetation surveys were initiated in 2013, the Chalky Fire of 2012 consumed the vegetation on the majority of the AM5 expansion area. Most surface vegetation (grasses, forbs, and shrubs) was consumed, and most conifer trees were burned as well. The AM5 expansion area is drained by a series of coulees, including Lee Coulee, Richard Coulee, and Rape Coulee, southeast to Rosebud Creek and eventually the Yellowstone River. The closed and reclaimed Big Sky Mine partially occurs within the eastern edge of the AM5 expansion area. The primary land use in the AM5 expansion area is rangeland with livestock grazing (see **Section 3.14, Land Use and Recreation**).

Vegetation surveys for the existing Area B permit area were conducted in 1980 and 1984 by ECON Inc. The existing Area B permit area is primarily disturbed by active mining, based on review of 2014 aerial imagery. Active mining appears as light tan, gray, or red surface disturbance, mounds, and berms.

3.13.2.2 Analysis Area

As shown on **Figure 68**, within the 5-mile buffer surrounding the proposed Project area is the city of Colstrip (northeast of the Project area), existing permit areas of the Rosebud Mine (north of the Project area), Castle Rock Road (northern edge of the Project area running roughly east-west), and the airport and Airport Road (north of the Project area). The analysis area is in the Northwestern Great Plains ecoregion, an unglaciated, semiarid rolling plain with occasional buttes, badlands, and ephemeral and intermittent streams (Woods et al. 2002). The analysis area contains low-lying, long, rolling hills vegetated with predominantly native and planted grasslands and scattered, small native woody shrubs (sagebrush) with patches of conifer woodlands. Light tan to gray hills associated with existing mining are visible.

The views in the analysis area include distant mountains, but only from topographic high points. Distant mountains are typically visible to the west and north, and large areas of the sky and changing weather conditions can be seen in all directions. The landscape has only subtle variations in color and texture, except occasional buttes and rock outcrops or when rolling grasslands transition to ponderosa forests. The surface in the analysis area has low visible human disturbance related to rural life, from livestock grazing, agriculture, roads, utility corridors, and buildings.

The rolling topography of the analysis area screens most views from KOPs of existing ground disturbance in the existing Area B portion of the Project area; visibility ranges from 0.5 to 1 mile for most areas. The existing Rosebud Mine operations in Areas A, B, and C look industrial, with large buildings, conveyors, coal piles, large equipment, draglines, evaporative ponds, and land scars of bare soil from the open pits,

maintenance, and haul roads. Area D is currently being reclaimed and looks less industrial than active mine areas. Steam from cooling facilities and the smokestacks of the Colstrip Power Plant (built in 1975) are visible from most locations in the city of Colstrip including residential homes, local roads, commercial businesses, recreation and park facilities, and SH 39 north and south of Colstrip. Associated mine and power plant facilities such as the railroad tracks, a pipeline, and haul roads are also visible from the south side of Colstrip and from SH 39 as it passes through Colstrip. Although Colstrip residences are located directly east of active mining in Area A, very little of the mining operation is visible from these residences because it is obscured by low, rolling hills. The Rosebud Power Plant is visible for only a short time as travelers drive past it on SH 39, for 2 to 3 minutes. It is not visible from any of the KOPs (see **Table 91**).

3.13.3 Environmental Consequences

3.13.3.1 Alternative 1 – No Action

Under the No Action Alternative, the AM5 amendment (proposed Project) would not be permitted. Westmoreland Rosebud would complete mining and reclamation in the Area B permit area according to its currently approved operating permit. Mining is permitted in Area B until 2030, and initial stages of reclamation would be completed within 2 years of the cessation of mining. There would be no Project impacts on visual resources described above in **Section 3.13.2, Affected Environment**, because none of the disturbances associated with development of the Project would occur.

The No Action Alternative would not change the status of the existing Area B permit area or other permit areas, including Area F, of the Rosebud Mine (**Section 2.2, Existing Operating Permits, Disturbance, and Reclamation**), nor would it affect the federal coal lease MTM 80697 (tracts in Areas B and C) modification application, which is currently being evaluated by the Bureau of Land Management (**Section 3.1.4.2, Related Future Actions**). Impacts on visual resources due to current and future mining and reclamation in the existing Area B permit area and other permit areas of the Rosebud Mine would continue.

3.13.3.2 Alternative 2 – Proposed Action

Direct Impacts

Topography is the greatest factor affecting visibility of proposed mining activities. There would be no direct visual impacts from Project area mining operations on residences in the city of Colstrip, commercial sites (KOP 7—gas station), local recreation areas such as Winchester Park and Castle Rock Lakes, or locations along SH 39 (KOP 5) in the analysis area due to the following conditions:

- The nature of the topography in the analysis area, which includes long, rolling hills and occasional bluffs and excludes views of the Project area from Colstrip residences, businesses, and recreation sites, which are about 0.5 mile northeast of the Project area and 4 miles northeast of the AM5 expansion area portion where new disturbance would occur; and
- The long distance between mining operations in new disturbance areas and KOPs.

The Proposed Action would delay reclamation of ramp roads and the haul roads in the existing Area B permit area for an additional 15 years while mining occurs in the AM5 expansion area. Implementation of the Proposed Action would also delay reclamation of mine support facilities in Areas A and C by 7 years (see **Section 2.2.2.3, Existing Support Facilities**) due to extended mine life.

The adverse impact on visual resources from Project activities would be lessened in the analysis area by the following conditions:

- Interim reclamation would continue to occur on the edge of mined areas and consist of recontouring and revegetation. Visible exposed tan, gray, and red soil would be removed, reducing contrast with intact vegetation.
- Existing visible mining operations from KOPs 4 and 6 already result in visual impacts.
- The area of visible mining disturbance would be relatively small compared to the view from a given location.

There would be short-term adverse impacts during the life of the mine on vehicular drivers traveling along Airport Road. Mining and associated mining activity, such as extension of the existing Area B and haul road, would result in increased visual contrast in the foreground–middle ground, including changes in the color of the landscape from removal of vegetation and exposure of soil, as well as changes to the contour of the landscape. Large equipment may be visible during active mining. However, viewing times would be relatively short while drivers travel adjacent to the Project area, and views would be similar to existing views of current mining operations in Area B.

Approximate distances of KOPs to the proposed disturbance in the Project area are listed in **Table 92**, and the locations of KOPs are shown on **Figure 68**. There would be limited visual impact at KOPs 1 and 2 since existing topography would screen views of mining operations. As mining progresses in the Project area, contrasting exposed soil and trucks may be visible in the distance but would constitute a small area visible to the residences. Impacts at KOP 4 would be long-term, because active mining would be visible for a longer time frame (an additional 15 years beyond what is currently permitted), and eventual reclamation would occur in the direct view of the KOP. Impacts at KOP 3 along Airport Road would be short-term and visible to cars driving by for only a short time. Mining activities do not currently dominate the view because of existing topography, and the distance from mining activities makes them less noticeable. KOP 6, located at the airport, already has views of active mining in Area B. The Area B and Lee haul roads and Area B ramp roads would remain open up to 15 years longer than currently permitted. In accordance with the reclamation plan, the postmine landscape of the Project area would be restored to the approximate original contour. The PMT that Westmoreland Rosebud proposes to meet at final bond release is shown on **Figure 9** in **Chapter 2**. During final grading, Westmoreland Rosebud may be able to incorporate additional drainage features to more closely approximate original contours (see **Section 3.2, Topography**).

Table 92. Approximate Distances from KOPs to the Project Area.

Label	Location	Direction from Project Area	Distance to Project Area/ Disturbance Area (Miles)	Visual Impacts
KOP 1	Residence 1	NW of the Project area	0.8/1.4	Possibly visible as mining progresses—short-term impact background, small area visible
KOP 2	Residence 2	NW of the Project area	0.4/0.9	Possibly visible in the foreground–middle ground as mining progresses—short-term impact, small area visible
KOP 3	Airport Road	NW of the Project area	0.1/0.7	Possibly visible in the foreground–middle ground as mining progresses—short-term impact, small area visible and existing mining
KOP 4	Residence 3	N of the Project area	0.2/0.9	Ramp roads and spoil piles are currently visible in Area B and would remain visible as mining progresses 15 years longer—long-term changes to topography would be noticeable
KOP 5	SH 39	SW of the Project area	4.1/5.2	Not visible due to topography and distance—no impact
KOP 6	Airport	N of the Project area	0.1/1.1	Possibly visible as mining progresses—long-term impact from reclaimed lands in direct view
KOP 7	Colstrip Gas Station	NE of the Project area	0.7/4.8	Not visible due to topography and reclamation of existing permit areas—no impact

Secondary Impacts

No secondary impacts are expected for visual resources. Changes to the visual resource would not result in subsequent impacts.

3.13.3.3 Cumulative Impacts

The analysis area for cumulative impacts is the same as the analysis area for direct and secondary impacts. Past, present, and related future actions under concurrent consideration that may impact visual resources in the analysis area include:

- Past, ongoing, and future permitted mining at the Rosebud Mine
- Past, ongoing, and future operations of the power plants
- Agricultural operations
- Past and future wildland fires and prescribed burns in and around the Project area

Mining operations at the Rosebud Mine and the Big Sky Mine have resulted in increased visual contrast on the landscape, including changes in the color of the landscape from removal of vegetation and exposure of soil, as well as changes to the contour of the landscape. Wildland fire also has impacted visual resources south of the Project area in the past by burning the shrubs, grasses, and trees in the analysis area and leaving large swaths of blackish charred areas. The visual impacts from wildland fires will continue until the burned areas have become naturally revegetated over the next several years. In combination with the impacts on visual resources from other active mining areas and wildland fires in the analysis area, Alternative 2 would have a short-term contribution to cumulative impacts.

The continued combustion of coal at the Rosebud Power Plant and the Colstrip Power Plant contributes particulate and gaseous air pollutants that contribute to regional haze in the surrounding viewshed. Prolonging the life of the mining may prolong the life of the power plants (depending on source of coal) and the amount of time that coal is burned in the area. Depending on atmospheric conditions and sources of emissions, haze could reduce the visibility of distant mountains and hills, contribute a “smoky” appearance, and detract from the clarity of the landscape.

3.13.3.4 Unavoidable Adverse Impacts

Short-term unavoidable adverse impacts on visual resources would occur during mining as the topography is altered for coal removal. In the long term, after reclamation activities, adverse visual impacts would be reduced. How viewers perceive the change in landscape is subjective and depends on factors such as place of employment, visibility from residences, and the length of time living in the area. The topography in adjacent areas would be similar for revegetated mined lands, reducing the visual contrast perceptible to viewers.

3.13.3.5 Irreversible and Irretrievable Impacts

An irreversible and irretrievable commitment of visual resources would occur from the proposed Project. Surface mining would be short-term during the life of the mine; the area would be reclaimed after mining is complete. Although the land would be recontoured and revegetated during reclamation, visual changes would include loss of natural rock outcrops, diverse vegetation, and natural drainages, gradually blending into the surrounding landscape over time. Visual changes to the land postmining would be subtle to some viewers (e.g., viewers in cars traveling on Airport Road through the Project area) and more noticeable to viewers familiar with the pre-mining landscape (e.g., residents near the Project area). Long-term impacts on the landscape would include the appearance of revegetated hills more rounded and regular than the natural pre-mine topography.

3.14 LAND USE AND RECREATION

3.14.1 Introduction

This section describes the affected environment with respect to land use and recreation within the analysis area, including the regulatory requirements governing the Project. The analysis area is defined below in **Section 3.14.1.2, Analysis Area and Methods**.

This section also analyzes the environmental consequences, including the direct, secondary, and cumulative impacts of the No Action Alternative (Alternative 1) and the Proposed Action (Alternative 2) with respect to land use within the analysis area.

3.14.1.1 Regulatory Framework

Federal Requirements

There are no applicable federal land use and recreation requirements for the Project.

State Requirements

Land use is defined in MSUMRA (82-4-203(29), MCA) as "specific uses or management-related activities, rather than the vegetative cover of the land. Land uses may be identified in combination when joint or seasonal uses occur and may include land used for support facilities that are an integral part of the land use. Land use categories include cropland, developed water resources, fish and wildlife habitat, forestry, grazing land, industrial or commercial, pastureland, land occasionally cut for hay, recreation, or residential." Under 82-4-232(7), MCA, all disturbed areas must be reclaimed in a timely manner to conditions that are capable of supporting the land uses that they were capable of supporting prior to any mining or to higher or better uses as approved under 82-4-232(8), MCA. To satisfy 82-4-232(7), MCA, the following principles are set forth in ARM 17.24.762(1):

a) The pre-mining uses of the land to which the postmining land use is compared are those that the land previously supported or could have supported if the land had not been mined and had been properly managed.

b) The postmining land use for land that has been previously mined and not reclaimed must be judged on the basis of the land use that existed prior to any mining. If the land cannot be reclaimed to the use that existed prior to any mining because of the previously mined condition, the postmining land use must be judged on the basis of the highest and best use that can be achieved and is compatible with surrounding areas.

c) The postmining land use for land that has received improper management must be judged on the basis of the pre-mining use of surrounding lands that have received proper management.

d) If the pre-mining use of the land was changed within five years of the beginning of mining, the comparison of postmining use to pre-mining use must include a comparison with the use of the land prior to the change as well as its uses immediately preceding mining.

Under ARM 17.24.762(2), "[a]lternative postmining land uses may be proposed and must be determined in accordance with 82-4-232(7) and (8), MCA, ARM 17.24.821, and ARM 17.24.823. Under 82-4-232(10), MCA, certain pre-mining facilities may be replaced as part of the reclamation plan.

Recreation is defined in MSUMRA in 82-4-203(45), MCA as "land used for public or private leisure time activities, including developed recreation facilities such as parks, camps, and amusement areas, as well as areas for less-intensive uses such as hiking, canoeing, and other undeveloped recreational uses." Montana Fish, Wildlife & Parks (FWP) manages wildlife populations and establishes limits on fishing and hunting activities statewide. FWP's mission, through its Employees and Citizen Commission, provides for the stewardship of the fish, wildlife, parks, and recreation resources of Montana while contributing to the quality of life for present and future generations. FWP's mission is not an enforceable standard.

Local Requirements

The Rosebud County Planning & Permitting Department oversees development of land, including the county subdivision regulations, as well as floodplain and zoning regulations and enforcement. The 2013 Rosebud County Growth Policy and Land Use Plan captures a snapshot of county characteristics and establishes goals, objectives, and policies to guide planning and growth (Rosebud County 2013).

The City of Colstrip Building and Zoning Department oversees development within the city limits. The 2013 City of Colstrip Comprehensive Growth Policy establishes the community goals and objectives, describes the existing characteristics, and provides an overview on how growth will occur within the city.

Neither Rosebud County nor the city of Colstrip has a recreation department or recreation master plans. However, the Colstrip Comprehensive Growth Policy establishes a goal to "encourage recreation development" (City of Colstrip 2013).

Lease and Deed Agreements

Private surface and subsurface owners in the analysis area granted Western Energy (predecessor to Westmoreland Rosebud) exclusive rights to use and control their lands through lease and deed agreements dated from 1959 to 2015. These agreements may vary slightly from owner to owner. The agreements place restrictions, covenants, or transfers on property rights on the use by Western Energy. In general, the owners (sellers) have leased or deeded Western Energy all coal and coal deposits, together with the right of ingress and egress for the exploration for and development, production, or mining of coal. In addition, all interests of the sellers have been transferred to Western Energy including easements and other appurtenances on or attached to property fixtures including buildings, water rights, and crop production. In other cases, Western Energy directly purchased lands with surface and mineral rights from other private owners; Westmoreland Rosebud now manages these lands.

3.14.1.2 Analysis Area and Methods

Analysis Area

The analysis area used to describe the affected environment as it relates to land use and recreation and used to assess direct and secondary impacts is the 15,153-acre Project area (**Figure 69** and **Figure 70**).

Analysis Methods

Land-use impacts were determined based on the information contained in the Application. The Application provided analysis area mining areas and land-use areas defined in MSUMRA (82-4-203, MCA) as specific uses or management-related activities.

The assessment of direct and secondary impacts on recreation resources was based on the type and amount of disturbance within the analysis area where recreation activities may take place. The magnitude of impact on recreation resources was based on the amount and type of loss, with a major impact defined as one that would permanently remove a recreational opportunity.

3.14.2 Affected Environment

3.14.2.1 Land Ownership

The land surface within the analysis area is owned by seven landowners (**Figure 69**). No federal lands are located in the analysis area. The landowners include Big Sky Coal Company, Booth Land and Livestock Company, Great Northern Properties LP (GNP), Rosebud County Airport, State of Montana, Western Energy (now Westmoreland Rosebud), and WPP, LLC (**Table 93**). Westmoreland Rosebud owns the largest amount of land in the analysis area, with 5,943 acres. The second largest landowner is WPP with 3,264 acres.

Subsurface coal within the analysis area is held under federal, state, and private ownership (**Table 94**). Nongovernmental subsurface mineral owners include GNP and private owners (**Figure 70**). Approximately 9,862 acres of subsurface coal in the analysis area is privately owned. Although 4,059 acres of subsurface coal in the analysis area is federally owned, none of it will be mined under the Proposed Action.

Table 93. Analysis Area Surface Ownership.

Owner	Acres Permitted
Big Sky	1,244
Booth Land and Livestock Company	1,764
Great Northern Properties (GNP)	1,755
Rosebud County Airport	2
State of Montana	1,159
Westmoreland Rosebud LLC	5,943
WPP	3,264

Table 94. Analysis Area Subsurface (Coal) Ownership.

Owner	Acres Permitted
Great Northern Properties (GNP)	80
State of Montana	1,159
Federal	4,059
Private	9,862

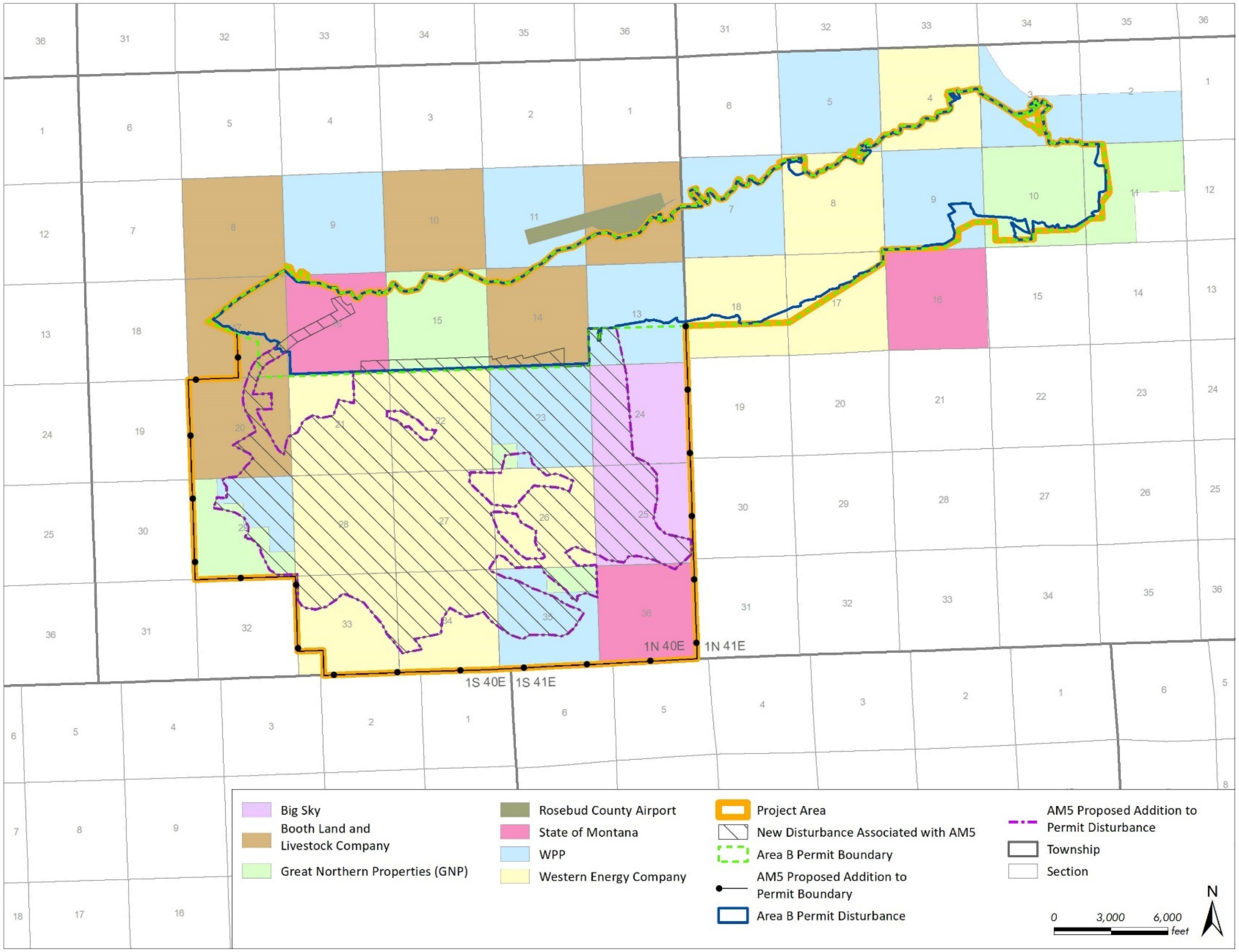

Figure 69. Analysis Area Surface Ownership.

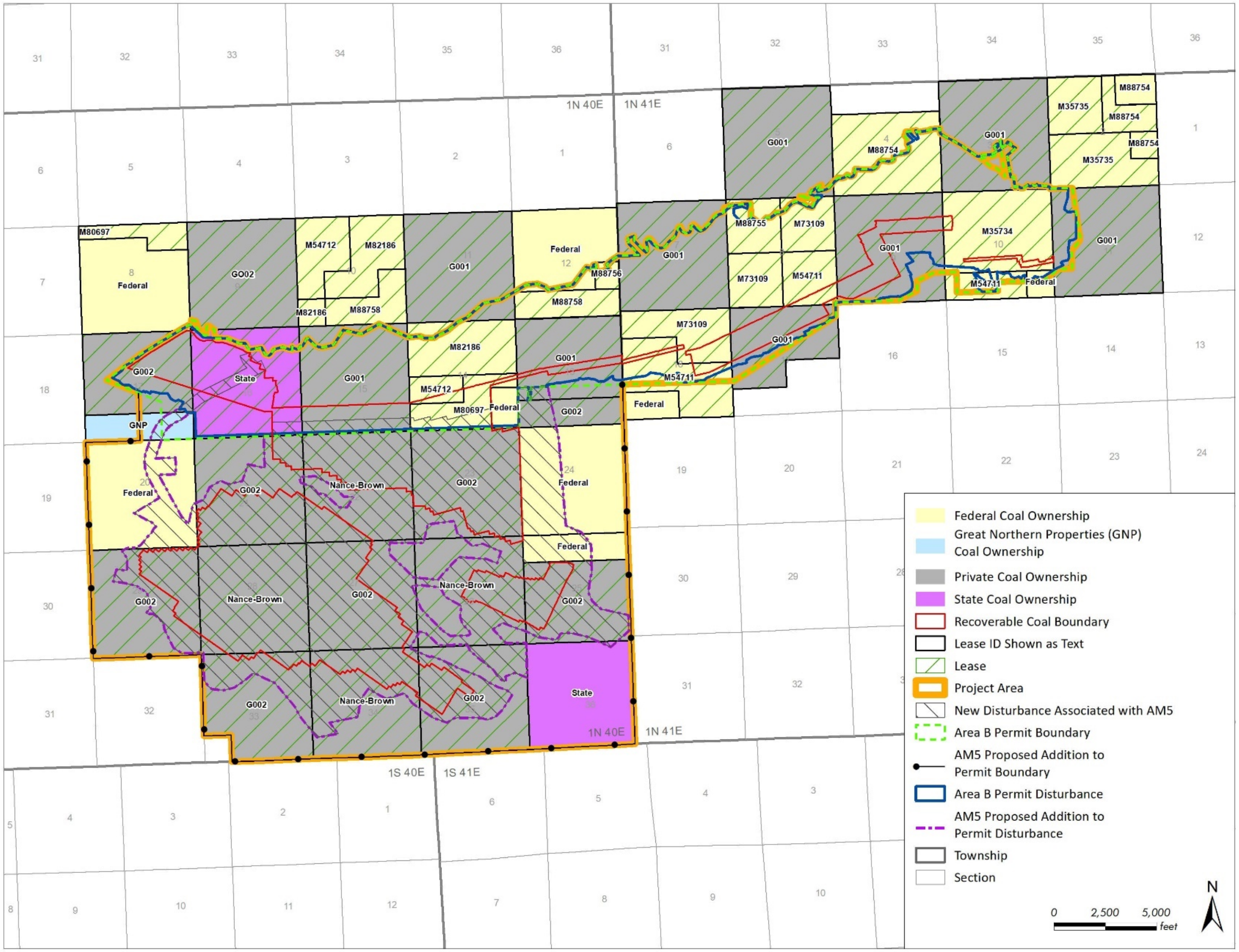

Figure 70. Analysis Area Coal Ownership.

3.14.2.2 Primary Pre-mining Land Uses

Primary pre-mine land uses in the analysis area include grazing land, pastureland, cropland, and wildlife habitat. Descriptions below focus on the AM5 expansion area, as the existing Area B permit area is already being actively mined and new disturbance within the existing portion would be limited. Land use within undisturbed portions of the existing Area B permit area where disturbance is proposed is similar to what is described below for the AM5 expansion area.

Grazing Land

Grazing is the predominant pre-mine surface land use within the AM5 expansion portion of the analysis area. Grazing land is defined in 82-4-203(22), MCA as "land used for grasslands and forest lands where the indigenous vegetation is actively managed for livestock grazing or browsing or occasional hay production." Approximately 6,497 acres of grazing land occur within the AM5 expansion portion of the analysis area. In 2016, the analysis area total production ranged from 471 to 797 pounds per acre depending on the plant community, and stocking rates ranged from 0.25 to 0.42 animal unit months per acre (Cedar Creek Associates 2016). Production can vary from year to year based on precipitation.

Pastureland

Pastureland is defined in 82-4-203(38), MCA as "land used primarily for the long-term production of adapted, domesticated forage plants to be grazed by livestock or occasionally cut and cured for livestock feed." No pasturelands (also referred to as improved pasture) occur in the AM5 expansion area.

Cropland

Cropland is defined in 82-4-203(13), MCA as "land used for the production of adapted crops for harvest, alone or in rotation with grasses and legumes, that include row crops, small grain crops, hay crops, nursery crops, orchard crops, and other similar crops." Land that is used for facilities in support of cropland farming operations and is adjacent to or an integral part of these operations is also included in this category.

Approximately 100 acres of nonirrigated cropland are located in the AM5 expansion portion of the analysis area, and are primarily winter wheat fields or hay meadows. Hay meadows vary between entirely composed of alfalfa or crested wheatgrass and a mixture of the two. There are no prime farmlands in the analysis area, only farmland of statewide importance.

Fish and Wildlife Habitat

Fish and wildlife habitat is defined in 82-4-203(20), MCA as "land dedicated wholly or partially to the production, protection, or management of species of fish or wildlife." Fish and wildlife habitat is located in the analysis area and is discussed in detail in **Section 3.10, Fish and Wildlife Resources**.

3.14.2.3 Other Pre-mining Land Uses

Other land uses defined in MSUMRA that may be found in the analysis area are described below. Recreation is discussed in **Section 3.14.2.4, Recreational Opportunities**.

Industrial or Commercial

Industrial or commercial is defined in 82-4-203(26), MCA as “land used for: (a) extraction or transformation of materials for fabrication of products, wholesaling of products, or long-term storage of products. This includes all heavy and light manufacturing facilities, and (b) retail or trade of goods or services, including hotels, motels, stores, restaurants, and other commercial establishments.”

Existing industrial or commercial land uses within the existing Area B permit boundary include the area of active mining, disturbed lands, existing reclamation areas, and mine supporting facilities, which account for 4,893 acres in the Project area (see **Figure 6** in **Chapter 2**). Supporting facilities in Area B include haul and ramp roads, phone lines, and electric transmission lines as shown in **Figure 7** in **Chapter 2**.

Developed Water Resources

Developed water resources are defined in 82-4-203(16), MCA as the “use of land for storing water for beneficial uses such as stock ponds, irrigation, fire protection, flood control, and water supply.”

Eight springs are located in the analysis area (see **Section 3.5, Water Resources – Surface Water** for more information). Seven of the springs are located adjacent to tributaries or mainstems of Richard Coulee (SP-300, 301, 302, 305, 307, 308, and 309) and Lee Coulee (SP-306). The likely ground water source for monitored springs is overburden except for SP-306, which is sourced from spoil (see **Section 3.6, Water Resources – Ground Water**). The springs provide sources of water for wildlife and livestock use and supply water to some existing ponds and wetlands (see **Section 3.9, Wetlands**). Some of the springs have been improved by ranchers to increase water availability for livestock use. No water rights appear to be associated with any of the 11 monitored springs. Spring discharge volumes and rates vary with season and climatic conditions and are quantifiable in only three springs (SP-300, 301, and 309). Over the past decade, the highest flow occurred at SP-300 in April–May 2016 at 2.7 gallons per minute.

Fifteen ponds are located in the analysis area (see **Section 3.5, Water Resources – Surface Water**). Six of the ponds are permanent sedimentation ponds located within the existing Area B disturbance area. Nine ponds are in or near the analysis area on (stream-fed) or adjacent to (spring-fed) surface water features. All the ponds are used as livestock water impoundments, and all except two of the ponds (PO-304 and PO-305) have year-round water rights with allowable diversion volumes of 30 gallons per day per animal (Montana Department of Natural Resources and Conservation [MDNRC] 2018; Application Appendix O, Attachment G). During the past decade of monthly monitoring, pond depths ranged from dry to 4.3 feet deep (PO-300), and PO-305/BLCPI was consistently ponded at unknown depth.

Forestry

Forestry is defined in 82-4-203(21), MCA as “land used or managed for the long-term production of wood, wood fiber, or wood-derived products.” There are no lands used for forestry in the analysis area.

Residential

Residential land use is defined in 82-4-203(48), MCA as the “use of land for single- and multiple-family housing, mobile home parks, or other residential lodgings.” Land that is used for facilities in support of residential operations and that is adjacent to or an integral part of these operations is also included. Support facilities include but are not limited to vehicle parking and open space that directly relate to the residential use. No residential land use is located in the analysis area.

3.14.2.4 Recreational Opportunities

Outdoor recreation is an important part of the lifestyle and economy throughout Montana. Recreation survey data presented in the Montana Statewide Comprehensive Outdoor Recreation Plan (SCORP) cited fishing, hunting, and backpacking to be among the top five outdoor recreation activities for Montana residents. SCORP projected increases over the next 35 years in developed and undeveloped skiing as well as challenge activities such as mountain climbing, rock climbing, and motorized water activities. Activities that will see large decreases in per capita participation include visiting primitive areas, hunting, and fishing (FWP 2014).

The analysis area is located in the Southeast Montana SCORP region, one of six tourism regions in the state, and the largest SCORP region. The Southeast Montana region encompasses 5.8 million acres of public land, of which 47 percent is federally owned: BLM manages 37 percent, and the Forest Service manages 9 percent. About 21 percent of the public land is state land, with the majority managed through MDNRC as State Trust Land.

The region offers an abundance of recreational activities, including hunting, fishing, boating, hiking, golfing, canoeing, bird-watching, rock-hounding, photography, and dinosaur fossil digging. Popular recreational sites include the Bighorn River and Bighorn Canyon National Recreation Area, Custer National Forest, Makoshika State Park, Little Bighorn Battlefield National Monument, and Pompeys Pillar National Monument. Recreational opportunities are available to the public on all federally administered (BLM, Forest Service, and NPS) lands in Southeast Montana that have legal access.

Private land within the analysis area is used for private recreational purposes, primarily hunting. Private leasing of hunting lands or contracting of guide services is ongoing in the area. There are no public easements, trails, or recreation facilities within the analysis area. The Rosebud Mine, including the analysis area, is within FWP Hunting District 702, which comprises 1,793,846 acres. During hunting season for big game (mule deer, white-tailed deer, pronghorn, and elk) and upland birds, Westmoreland Rosebud allows public access to inactive areas of the mine through FWP's Block Management Program. A cooperative program between private landowners and FWP, Block Management helps landowners manage hunting activities and provides the public with free hunting access to private land, and sometimes to adjacent or isolated public lands.

Based on data for 2009 through 2018, an average of 343 hunter days (all days hunted by all hunters) each year have been hunted on the mine site. (Peterson 2019).

3.14.3 Environmental Consequences

3.14.3.1 Alternative 1 – No Action

Under the No Action Alternative, the AM5 amendment (proposed Project) would not be permitted. Westmoreland Rosebud would complete mining and reclamation in the Area B permit area according to its currently approved operating permit. Mining is permitted in Area B until 2030, and initial stages of reclamation would be completed within 2 years of the cessation of mining. There would be no Project impacts on the land uses described above in **Section 3.14.2, Affected Environment** because any changes associated with the proposed Project would not occur. In addition, under the No Action Alternative, no impacts on existing recreation in the analysis area would occur.

The No Action Alternative would not change the status of the existing Area B permit area or other permit areas, including Area F, of the Rosebud Mine (see **Section 2.2, Existing Operating Permits, Disturbance, and Reclamation**), nor would it affect the federal coal lease MTM 80697 (tracts in Areas B

and C) modification application, which is currently being evaluated by the Bureau of Land Management (see **Section 3.1.4.2, Related Future Actions**). Impacts on land use and recreation due to current and future mining and reclamation in the existing Area B permit area and other permit areas of the Rosebud Mine would continue.

3.14.3.2 Alternative 2 – Proposed Action

During the life of the operation, use of the lands within the analysis area would be devoted to mining and associated activities. All current land uses within the analysis area would be temporarily disturbed during the 30 years of mining operations in the analysis area. Within 2 years of mining, Westmoreland Rosebud would grade, apply soil to, and seed each mine pass; however, this analysis assesses land uses within the analysis area as a whole and does not consider concurrent reclamation that would occur during active mining. As described in **Section 2.4.5, Reclamation Plan**, the primary postmine land use would be grazing lands to be supported by appropriate vegetation (see **Figure 11** in **Chapter 2**). Reclamation would also facilitate the following postmine land uses: pastureland, cropland, and wildlife habitat. Westmoreland Rosebud's proposed revegetation plan, including proposed seed mixes, is presented in the Application (see **Appendix A**).

Direct Impacts

Grazing land would be the most impacted land use in the analysis area under Alternative 2. Impacts would occur during mine operations in the analysis area (30 years; see **Table 9** and **Section 2.4.1, Operating Permit and Disturbance Acres**) and would extend until the postmining land use, domestic livestock grazing, was achieved through reclamation (see **Section 2.4.5, Reclamation Plan**). Impacts on grazing land would be long-term, moderate, and beneficial. Westmoreland Rosebud proposes 10,319 acres of postmine grazing land in the analysis area, which would be an increase of 235 acres over pre-mine conditions. Similarly, impacts on cropland would occur during the period of active mining and would extend until the postmining land use, cropland, is achieved (see **Section 2.4.5, Reclamation Plan**). During active mining, there would be no cropland. Impacts on cropland would be long-term, moderate, and adverse. After reclamation, Westmoreland Rosebud proposes 464 acres of cropland in the analysis area, which would be an increase of 364 acres from pre-mine conditions. No impacts on pastureland would occur; however, Westmoreland Rosebud proposes 381 acres of pastureland as a postmining land use. **Table 95** shows pre-mine and postmine land use and acreages.

All the lands within the proposed permit area function as wildlife habitat. Impacts on fish and wildlife habitat are discussed in detail in **Section 3.10, Fish and Wildlife Resources**.

Table 95. Alternative 2 Land-Use Impacts.

Land Use	Pre-mine Land Use in Analysis Area (acres)	Postmine Land Use in Analysis Area (acres)
Cropland	100	464
Fish and wildlife habitat	79	21
Grazing land	10,084	10,319
Pastureland	4	381
Industrial, commercial, or developed water resources*	2,453	0
Disturbed and existing reclamation areas	2,440	0
Total	15,153	11,185[1]

* Includes active mining operations. [1]Postmine acreages do not include land in the analysis area currently being mined or disturbed under the existing Area B permit.

Impacts on developed water resources (i.e., stock ponds) within the Project area are discussed in **Section 3.7, Water Resources – Water Rights**. After reclamation, Westmoreland Rosebud proposes no industrial or commercial land uses in the analysis area. No impacts on other land uses, including forestry, residential, and recreation, would result from the Proposed Action. The Proposed Action would delay reclamation of some ramp roads and the haul roads in the existing permit area by 15 years.

Surface and subsurface land ownership would not change under the Proposed Action. Most of the coal to be mined under the Proposed Action is located within two private leases (G002 and Nance-Brown) with small portions of State of Montana coal to be mined (22 acres) as well as a third private lease (G001). See **Section 2.4.1, Operating Permit and Disturbance Acres** for more information.

During active mining, use of the lands within the analysis area would be devoted to mining and associated activities, and recreational activities, mostly hunting, would not be permitted. Hunting opportunities within the analysis area would be lost until revegetation and forage production could meet pre-mining levels. Thus, impacts on recreation in the analysis area would be long-term and adverse. However, since the analysis area represents less than 0.01 percent of Hunting District 702, the private lands within the Project area represent a relatively small portion of the currently accessible public (state) surface lands for recreational opportunities.

Secondary Impacts

The Proposed Action would not create unplanned development or induce new offsite areas for development. The Proposed Action would not reduce development restrictions or substantially induce new development in adjacent areas. Therefore, there would be no secondary impacts on land use associated with the Proposed Action.

Adjacent recreation uses during mine operations would be affected to some extent; these impacts are described in **Section 3.17, Noise**; **Section 3.13, Visual Resources**; and **Section 3.10, Fish and Wildlife**. There would be no impacts on recreation uses in and immediately surrounding the city of Colstrip or in southeastern Montana.

3.14.3.3 Cumulative Impacts

The analysis area for cumulative impacts is the same as the analysis area for direct and secondary impacts. Past, present, and related future actions under concurrent consideration that may impact land use and recreation in the analysis area include:

- Past, ongoing, and future permitted mining at the Rosebud Mine
- Agricultural operations
- Recreation activities

Depending on the timing of actions associated with these activities, including active mining and reclamation, impacts on land uses and recreational resources may be cumulatively greater within the analysis area. Within the permit areas of the Rosebud Mine, there would be short-term cumulative impacts on grazing, cropland, and fish and wildlife habitat land uses and hunting opportunities.

The timing of mining in the analysis area and the timing of reclamation of other permit areas may lead to an additional loss of fish and wildlife habitat and grazing land uses until vegetation is established on reclaimed mine areas. The conversion of the Project area to full-scale mining is unlikely to contribute to long-term cumulative impacts on land use in the area. After reclamation, the analysis area would revert to

grazing, pastureland, and cropland land uses. Land use in the areas surrounding the Rosebud Mine is unlikely to change substantially given that the existing land uses are well-established and consistent with the types of use under the Proposed Action. The areas surrounding but outside the permit boundaries of the Rosebud Mine could continue to be grazed or used by the landowners for agricultural purposes.

The conversion of the analysis area to full-scale mining is unlikely to contribute to long-term cumulative impacts on recreation in the area. After reclamation, the analysis area would revert to wildlife use and potential hunting by permission. Recreational use in the areas surrounding the Rosebud Mine is unlikely to change substantially given the existing land ownership pattern. The areas surrounding but outside the permit boundaries of the Rosebud Mine could continue to be made available (or be made available in the future) for hunting with landowner permission.

3.14.3.4 Unavoidable Adverse Impacts

No unavoidable adverse impacts would occur on land uses in the analysis area under any alternative.

3.14.3.5 Irreversible and Irretrievable Impacts

Grazing and cropland production within the analysis area would be lost until revegetation and forage production are comparable to pre-mining levels associated with adjacent land. These resources would be irretrievably affected.

3.15 TRANSPORTATION

3.15.1 Introduction

This section describes the affected environment with respect to transportation in the analysis area, including related regulatory requirements. The analysis area is defined below in **Section 3.15.1.2, Analysis Area and Methods**.

This section also analyzes the environmental consequences, including the direct, secondary, and cumulative impacts of the No Action Alternative (Alternative 1) and the Proposed Action (Alternative 2) on the transportation system in the analysis area.

3.15.1.1 Regulatory Framework

Federal Requirements

There are no applicable federal transportation requirements for the Project.

State Requirements

DEQ regulates permitting and operation of surface coal mines within Montana under the authority of MSUMRA (82-4-221 *et seq.*, MCA) and its implementing rules (ARM 17.24.301-1309). Requirements under MSUMRA include:

- Provisions for the relocation of use of public roads (ARM 17.24.319). Each mine application must describe the measures to be used to ensure that the interests of the public and landowners affected are protected if the applicant is seeking approval of (1) conducting the proposed mining activities within 100 feet of the right-of-way line of each public road, except where mine access or haul roads join that right-of-way; or (2) relocating or closing a public road.
- Requirements to develop a transportation facilities plan (ARM 17.24.321). Each mine application must contain a description of each road, conveyor, and railroad loop to be constructed, used, or maintained within the proposed permit area.
- General requirements for road and railroad loop construction (ARM 17.24.601).
- Requirements for the location of roads and railroad loops (ARM 17.24.602).
- Requirements for the location of roads and railroad loop embankments (ARM 17.24.603).
- Requirements to account and design for the hydrologic impact of roads and railroad loops (ARM 17.24.605).
- Requirements for the maintenance of roads and railroad loops (ARM 17.24.607).
- Provisions for permanent roads (ARM 17.24.610).
- Provisions for areas on which coal mining is prohibited that address how to obtain permission to mine near public roads (ARM 17.24.1134). Whenever a proposed mining operation is to be conducted within 100 feet measured horizontally to the outside right-of-way line of any public road (except where mine access roads or haul roads join such right-of-way), DEQ may permit mining to occur if the applicant:
    - Obtains the necessary approval of the authority with jurisdiction over the public road;
    - Gives appropriate notice of a public hearing;
    - Holds a public hearing with the purpose of determining whether the interests of the public and affected landowners would be protected; and

  - Produces a written finding based on the information from the public hearing.
- Areas on which coal mining is prohibited that address the relocation or closure of a public road (ARM 17.24.1135). Whenever any mine application proposes to relocate or close a public road to facilitate surface- or underground-mining operations, the road may not be relocated or closed until:
  - The permit authorizing the operation is granted;
  - The applicant obtains the necessary approval from the authority with jurisdiction over the public road;
  - A notice of a public hearing in a newspaper of general circulation in the affected locale is provided at least 2 weeks before the hearing;
  - An opportunity for a public hearing at which any member of the public may participate is provided in the locality of the proposed mining operations for the purpose of determining whether the interests of the public and affected landowners would be protected; and
  - A written finding based on information received at the public hearing is made within 30 days after completion of the hearing as to whether the interests of the public and affected landowners would be protected from the proposed mining operations.

Local Requirements

There are no applicable local transportation requirements for the Project.

3.15.1.2 Analysis Area and Methods

Analysis Area

The analysis area for access and transportation includes the 15,153-acre Project area, existing permit areas of the Rosebud Mine, and county roads (see **Figure 2** in **Chapter 1**). The regional transportation network is generally described as the coal-transport routes to and from the Rosebud Mine and Rosebud Power Plant.

Analysis Methods

Transportation impacts were determined based on the information contained in Westmoreland Rosebud's Application. The Application provided Project road locations, construction methods, and transportation network uses.

3.15.2 Affected Environment

The transportation system analyzed in this EIS consists of the network of private roads owned by Westmoreland Rosebud and public roads owned and maintained by Rosebud County and the State of Montana that would be used during activities related to the development and mining of the Project area.

3.15.2.1 Mine Access and Internal Road System

Mine Access

The Rosebud Mine is primarily accessed from the east via Castle Rock Road, a Rosebud County road that runs west off of SH 39 about 1 mile south of Colstrip (**Figure 7** in **Chapter 2**). Castle Rock Road is a paved surface road for 10 miles until the Rosebud Mine office; then it becomes a gravel surface road.

Major mine facilities such as the mine office, maintenance shop, and operations and maintenance complex are located on Castle Rock Road. The Project area would be accessed via Castle Rock Road and the Area B haul road.

The Project area and other permit areas of the existing Rosebud Mine are also accessible from the west end of the mine, off of Highway 384 and Horse Creek Road. Highway 384 connects west to Interstate 90 (I-90) just south of Hardin and north to Interstate 94 (I-94) east of Hysham. Horse Creek Road is a gravel surface road maintained by the Rosebud County and Treasure County road departments, and Highway 384 is a Treasure County road.

Rosebud Mine Road System

Westmoreland Rosebud’s road system for the Rosebud Mine comprises four basic types of roads: access, haul, ramp, and service roads. Road materials for the road system primarily consist of pit run, which is crushed or screened scoria. The thickness of road base and finish typically vary by location since there are varying degrees of suitability of scoria on the mine, and roadbed materials vary (see also **Section 2.4.4, Operations Plan** for further details regarding Westmoreland Rosebud’s road system).

Access Roads

Access roads provide access to the Rosebud Mine area from public roadways. These roads are typically 25 to 80 feet wide and are surfaced with road material for all-weather use.

Haul Roads

Haul roads provide the main haul routes for the coal haulers and are used as the main source of ingress and egress to operational areas throughout the Rosebud Mine. The Area B Richard haul road and the Lee haul road serve the current Area B permit area and under the Proposed Action would be extended southward to serve the Project area (see **Section 2.4.4.2, Haul Roads** and **Figure 7** in **Chapter 2** for more information). Two-way haul roads are typically 80 feet wide and surfaced with road material to provide for all-weather use, but wider roads may be constructed in certain areas as needed to accommodate the dragline. As haul roads advance in conjunction with pit development, construction is staged to provide a sound base, usually by watering and compacting the road subbase and blading the road material for proper compaction and final grade. Haul roads are generally at 0 percent to 3 percent grade, but roads with grades up to 8 percent and a maximum pitch grade of 12 percent may be constructed. Exhibit O in Westmoreland Rosebud’s Application provides the design and typical haul road cross sections.

The existing portion of the Area B haul road in the Project area is shown on **Figure 7** in **Chapter 2**. As currently approved in the Area B operating permit, Westmoreland Rosebud would continue advancing the Area B haul road from its current terminus in Section 16 westward into Section 17.

Ramp Roads

Ramp roads provide access into the mine pit. Ramp roads are constructed out of each pit to intercept the haul roads and are moved or advanced with each new pit development. See **Section 2.4.4.3, Ramp Roads** for more information. Ramp roads are typically maintained at a 5 percent or steeper grade and surfaced with road material to provide for all-weather use.

Figure 7 in **Chapter 2** shows the existing ramp roads in the Project area. As currently approved in the Area B operating permit, Westmoreland Rosebud would construct three ramp roads southward from the

haul road to provide access to Sections 16 and 17, which are in the western portion of the current Area B permit area.

Service Roads

Service roads provide access to areas of the Rosebud Mine that are not accessible using the haul roads. Service roads include all other roads in the mine that are generally used for support functions. Service roads can be single-track to 80 feet wide and may or may not be surfaced with road material. There are no service roads proposed in the Project area.

Fugitive Dust Control

Westmoreland Rosebud currently maintains a Fugitive Dust Control Plan in accordance with ARM 17.24.761 and the work-practice standards established within its current air quality permits (see **Section 3.3, Air Quality**). Westmoreland Rosebud proposes the ongoing maintenance and implementation of a dust-control plan for the Project, which includes the Best Available Control Technology (BACT) for the control of fugitive particulate matter consistent with MAQP #1483-08 (as modified) (see **Section 2.4.2.1, Air Quality permit**).

3.15.2.2 Regional Transportation System

Highways

SH 39 is a minor arterial connecting Colstrip with I-94 35 miles to the north. I-94 is a principal arterial for the region. The Rosebud Mine hauls 300,000 tons of coal annually (via a fleet of five covered on-highway haul transports, although only three are used at a time) to the Rosebud Power Plant via the existing Area B haul road and SH 39 (**Figure 7** in **Chapter 2**). Three trucks operate daily, with each truck delivering 6.5 loads daily (19.5 total loads daily).

Average annual daily traffic (AADT) data obtained for the section of SH 39 from I-94 to southeast of Colstrip (**Table 96**) indicates typical volumes for a primary state route. The highest volumes of traffic occur in Colstrip near the intersection of SH 39 and Willow Avenue, representing local commuter traffic. Mine-related traffic is included in the presented AADT. AADT is much lower outside Colstrip.

Table 96. Average Annual Daily Traffic at Four Locations on State Highway 39 near Colstrip, Montana, over 20 Years.

Year	Station 44-5-006 (1 mile south of I-94 intersection)	Station 44-7-001 (2 miles southeast of Colstrip)	Station 44-9-004 (Colstrip at Willow Avenue and Homestead Boulevard)	Station 44-9-006 (Colstrip near Castle Rock Lake Drive)
2017	944	1,054	3,276	2,977
2012	923	960	3,450	2,530
2007	943	1,110	3,350	2,540
2002	919	1,110	3,250	2,460
1997	869	850	2,900	2,150

Source: MDT 2018.

Vehicle classification data from 2017 shows that passenger cars and pickups were the most common vehicles using SH 39 near Colstrip and together accounted for 85.4 percent of the vehicles (**Table 97**). Total combined truck traffic accounted for 12.7 percent of the traffic (Montana Department of Transportation [MDT] 2018).

Table 97. Vehicle Class Count Data for State Highway 39 in Rosebud County.

Vehicle Type	Number on Road	Percentage on Road
Motorcycle (type 1)	5	0.4
Passenger car (type 2)	500	42.8
Pickups (type 3)	498	42.6
Buses (type 4)	18	1.5
Small trucks (types 5–7)	38	3.3
Large trucks (types 8–13)	107	9.2
Unclassified vehicles	2	0.2
All vehicles	1,168	100.0

Source: MDT 2018.

MDT recorded 81 accidents on SH 39 between 2013 and 2017. Accidents were dispersed throughout SH 39. Wild animal, roll over, and fixed object collisions were the most common types of crashes. Approximately 65 percent of all crashes were noninjury accidents, and about 8.6 percent of crashes were fatal. Approximately 79 percent of all crashes on SH 39 occurred on dry roads (MDT 2017).

Bus, Air, and Rail Transport

Colstrip is served by a number of freight carriers. As of 2018, there is no public bus service available in Colstrip. The nearest bus service is 35 miles away in Forsyth. A small, county-owned and operated airport is located just north of Area B along Castle Rock Road (**Figure 7** in **Chapter 2**), and the nearest commercial air transportation is 125 miles away in Billings, Montana. An active Burlington Northern-Santa Fe branch line for freight connects Colstrip to the main east/west rail line that lies 30 miles to the north of Colstrip.

Local Access

A number of local access roads connect to SH 39 in the analysis area. Willow Avenue provides residential access from SH 39 to the Snider Subdivision Road near the Rosebud Power Plant. Pinebutte Drive provides access to residential areas on the north side of Colstrip, and Power Road and Power Plant Road lead to the Colstrip Power Plant. Other informal or two-track roads cross the analysis area but generally do not account for a large amount of traffic.

3.15.3 Environmental Consequences

3.15.3.1 Alternative 1 – No Action

Under the No Action Alternative, the AM5 amendment (proposed Project) would not be permitted. Westmoreland Rosebud would complete mining and reclamation in the Area B permit area according to its currently approved operating permit. Mining is permitted in Area B until 2030, and initial stages of reclamation would be completed within 2 years of the cessation of mining. There would be no Project impacts on the transportation system described above in **Section 3.15.2, Affected Environment**.

Westmoreland Rosebud would continue to plow county roads in the analysis area during large snowstorms when the county may be overwhelmed, until mine closure. The No Action Alternative would not change the status of the existing Area B permit area or other permit areas, including Area F, of the Rosebud Mine (**Section 2.2, Existing Operating Permits, Disturbance, and Reclamation**), nor would it affect the federal coal lease MTM 80697 (tracts in Areas B and C) modification application, which is currently being evaluated by the Bureau of Land Management (**Section 3.1.4.2, Related Future Actions**). Impacts on transportation due to current and future mining and reclamation in the existing Area B permit area and other permit areas of the Rosebud Mine would continue.

3.15.3.2 Alternative 2 – Proposed Action

Direct Impacts

Haul Roads

As described in **Section 2.4.4.2, Haul Roads**, and shown on **Figure 7** in **Chapter 2**, Westmoreland Rosebud would not extend the Area B haul road westward as currently permitted in its Area B operating permit. Instead, in year 6 after completion of mining in Section 16, Westmoreland Rosebud would extend the existing Area B haul road southward from its current terminus in Section 16 through Sections 17 and 20 and advance it through Richard Coulee (Sections 23, 27, 28, 34, and 35) to facilitate mining in the Project area. The haul road extension would be known as the Richard haul road and would be advanced in two phases as mining progressed. A series of ramp roads would be constructed off of the Richard haul road to serve active mining areas (see **Ramp Roads** below).

Around mine year 2, Westmoreland Rosebud would extend the existing Lee haul road from its current terminus in Section 14 southward through Sections 24 and 25 to facilitate mining in the Fossil Fork tributary of Lee Coulee (**Figure 7**). Two ramp roads would be constructed off the Lee haul road to serve active mining areas (see **Ramp Roads** below).

No long-term transportation impacts would be expected from construction of the haul roads, as the overall transportation system would not be disrupted, and any adverse impacts on other resources would be short-term and limited to the period of construction and mine operations in the Project area. Implementation of the Proposed Action would delay the expected reclamation date of the existing Area B and Lee haul roads by 15 years and double the length of each road. All haul roads would be reclaimed in the final year of reclamation (2047 based on current estimates; see **Figure 10** in **Chapter 2**). Temporary and permanent erosion-control measures would be used as necessary during road construction to control sedimentation and minimize erosion (see **Section 3.5, Water Resources – Surface Water** and **Section 3.18, Soil**). After active mining in the Project area, the Area B haul road would be reclaimed as described in **Section 2.4.5.2, Reclamation of the Area B Haul Road and Ramp Roads**.

Ramp Roads

As described in **Section 2.4.4.3, Ramp Roads**, and shown on **Figure 7** in **Chapter 2**, in the Proposed Action, Westmoreland Rosebud would depart from its current operations plan as it relates to ramp roads. Instead, Westmoreland Rosebud would construct a series of ramp roads in the Project area (primarily in Richard Coulee) to connect the active mining and reclamation area pits to the new Richard haul road (extended Area B haul road). Similarly, Westmoreland Rosebud would construct ramp roads off the extended Lee haul road to mining areas in the Fossil Fork tributary of Lee Coulee (Sections 25 and 26). Westmoreland Rosebud would also extend existing ramp roads in the current Area B permit area into the AM5 expansion area (primarily in Lee Coulee).

No long-term transportation impacts would be expected from construction of the new ramp roads, as the overall transportation system would not be disrupted, and any adverse impacts on other resources would be short-term and limited to the period of construction and mine operations in the Project area. Temporary and permanent erosion-control measures would be used as necessary during road construction to control sedimentation and minimize erosion (see **Section 3.5, Water Resources – Surface Water** and **Section 3.18, Soil**). After active mining in the Project area, ramp roads would be reclaimed as described in **Section 2.4.5.2, Reclamation of the Area B Haul Road and Ramp Roads**.

Fugitive Dust Impacts

Road materials to be used in construction include pit run and crushed or screened scoria. Roads would not be constructed or surfaced with waste coal or with acid-producing or toxin-producing materials. Impacts on the natural environment from road materials would be short-term and adverse (see **Section 3.3, Air Quality** for more information about air quality and fugitive dust impacts).

Transportation Impacts

During construction and active mining under the Proposed Action, traffic congestion and accidents could occur on the private and publicly accessible roads and highways in the analysis area. Once all active mining and reclamation in the Project area was over, the potential for traffic congestion and accidents would decrease. Mine haul traffic would not use the mine access roads, but rather would use haul roads (the existing Area B Richard haul road and the Lee haul road), consistent with current mine practices. Coal mined according to the Proposed Action would be transported by haul truck via the Richard and Lee haul roads to the Area C or Area A truck dumps for crushing and handling. From there, in accordance with Westmoreland Rosebud's contract, most of the coal would be sent via the existing 4.2-mile conveyor to the Colstrip Power Plant.

Coal from the Project area with higher sulfur content would be trucked to the Rosebud Power Plant via the Area B Richard and Lee haul roads and SH 39, which is the current practice for Area B and other permit areas of the Rosebud Mine. As Project area coal would be replacing coal from existing Area B operations and other permit areas, coal truck traffic would not be expected to contribute to the existing volume on SH 39. Coal truck traffic could cause some minor delays in public travel from time to time. Thus, the impacts due to traffic would be short-term and adverse.

Existing roads would continue to be graded and maintained as done in other permit areas of the Rosebud Mine. Public roads, such as SH 39 and the Castle Rock Road, would continue to be maintained for local and regional traffic. No additional maintenance on public roads is anticipated; therefore, there would be no impact on public road maintenance.

Secondary Impacts

Employees traveling to and from the Rosebud Mine would contribute to local traffic, but impacts would not change from current conditions. Increases in noise, dust, and lights from road construction (haul roads, ramp roads, etc.) may impact local traffic, residents, and hunters. Overall, indirect impacts on the transportation system would be short-term and adverse.

3.15.3.3 Cumulative Impacts

The analysis area for cumulative impacts is the same as the analysis area for direct and secondary impacts. Past, present, and related future actions under concurrent consideration that would contribute to cumulative impacts on access and transportation include:

- Past, ongoing, and future permitted mining at the Rosebud Mine
- Agricultural operations
- Airport operations
- Recreation activities in the area

Depending on the timing of actions associated with these activities, traffic volumes may be cumulatively greater within the analysis area. Mining in other permit areas of the Rosebud Mine has used, continues to

use and will use the same regional transportation system as the Project. Future coal mining in existing permit areas of the Rosebud Mine includes construction of new roads, road decommissioning activities, road reconstruction, and implementation of BTCA. The related future actions and the Project could have short-term cumulative impacts by increasing traffic volumes near access roads. However, any additional traffic would not adversely affect the level of service on roads within the analysis area or lead to congestion.

3.15.3.4 Unavoidable Adverse Impacts

No unavoidable adverse transportation impacts would occur under any of the alternatives.

3.15.3.5 Irreversible and Irretrievable Impacts

No irreversible and irretrievable transportation impacts would occur under any of the alternatives.

3.16 SOLID AND HAZARDOUS WASTE

3.16.1 Introduction

This section describes the affected environment with respect to solid and hazardous waste generation and storage in the analysis area and the governing regulatory authorities. The analysis area is defined below in **Section 3.16.1.2, Analysis Area and Methods**.

This section also analyzes the environmental consequences, including the direct, secondary, and cumulative impacts, of the No Action Alternative (Alternative 1) and the Proposed Action (Alternative 2) with respect to solid and hazardous waste generation and storage in the analysis area.

3.16.1.1 Regulatory Framework

Federal Requirements

A suite of federal laws governs the management and disposal of solid and hazardous waste. The Solid Waste Disposal Act of 1965 addresses the safe disposal of large volumes of municipal and industrial solid wastes and was the first federal effort covering solid-waste management. The Resource Recovery Act (RRA) of 1970 is an amendment to the Solid Waste Disposal Act and deals with management of solid waste by encouraging waste reduction and resource recovery; the RRA also establishes national disposal criteria for hazardous wastes. The Resource Conservation and Recovery Act (RCRA) of 1976 gives USEPA authority to manage nonhazardous wastes and the generation, transportation, treatment, storage, and disposal of hazardous waste from “cradle to grave.” The Hazardous and Solid Waste Amendment of 1984 requires phasing out land disposal of hazardous waste and provides increased enforcement authority for USEPA, more stringent hazardous-waste management standards, and a comprehensive underground-storage-tank program.

Regulation of solid and hazardous waste management is established under RCRA (40 CFR 239–282). RCRA sets national goals for protecting human health and the environment from the potential hazards of waste disposal, conserving energy and natural resources, reducing the amount of waste generated, and ensuring that wastes are managed in an environmentally sound manner. 40 CFR 239–259 contain the regulations for solid waste, and 40 CFR 260–273 contain the regulations for hazardous waste. Regulations for managing used oil and standards for underground storage tanks are contained in 40 CFR 279–282.

State Requirements

The Montana Hazardous Waste Act (75-10-401, MCA) and the Solid Waste Management Act (75-10-201–250, MCA) regulate the storage and disposal of solid and hazardous wastes. DEQ is responsible for implementing the Solid Waste Management Act under ARM 17.50.101 to 17.50.1405 and for implementing the Hazardous Waste Act under ARM 17.53.101 to 17.53.1502. Coal mines in Montana must also comply with MSUMRA (82-4-201 *et seq.*, MCA). DEQ is responsible for MSUMRA under 82-4-102(3), MCA. The storage and final disposal of solid waste are administered under ARM 17.24.507.

Local Requirements

There are no applicable local solid and hazardous waste regulations within or near the analysis area.

3.16.1.2 Analysis Area and Methods

Analysis Area

The direct and secondary impacts analysis area for solid and hazardous waste includes existing Areas A, B, C, and F of the Rosebud Mine site and the proposed AM5 expansion area; Area D, which is being reclaimed, is not in the analysis area. This analysis area is appropriate because wastes generated from mining operations in the Project area would be stored in other permit areas (Areas A and C) of the Rosebud Mine.

Analysis Methods

Impacts on solid and hazardous waste were determined based on the information contained in the Application. The Application provides details concerning reclamation activities and changes in solid and hazardous waste related to proposed mining and reclamation actions.

3.16.2 Affected Environment

Currently, solid and hazardous wastes are being generated in Areas A, B, and C, the actively mined permit areas of the Rosebud Mine; Area F is in pre-development and is not yet being actively mined. A hazardous waste is defined as "a waste or combination of wastes that, because of its quantity, concentration, or physical, chemical, or infectious characteristics, may: (i) cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness; or (ii) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of or otherwise managed," 75-10-403(8)(a), MCA. Management of hazardous waste is defined as "the management of the collection, source separation, storage, transportation, processing, treatment, recovery, and disposal of hazardous wastes," 75-10-403(9), MCA.

Wastes generated as part of active coal mining at the Rosebud Mine are handled under Westmoreland Rosebud's Waste Management Program, which consists of a Solid and Hazardous Waste Management Plan (SHWMP; Western Energy 2009), a Spill Prevention Control and Counter Measure Plan (SPCCMP), and a Contingency and Emergency Response Plan (CERP; Western Energy 2017). Information summarized below was taken from Westmoreland Rosebud's Application and the SHWMP.

3.16.2.1 Existing Rosebud Mine Operations

The Rosebud Mine is a Large Quantity Generator (LQG), as defined under RCRA, due to its generation of greater than 2,200 pounds of waste per month. According to the SHWMP, the mine typically generates less than 2,200 pounds of waste per month; however, this volume fluctuates based on operations. **Figure 71** displays the Rosebud Mine and associated solid or hazardous waste features.

3.16.2.2 Nonhazardous Waste

Nonhazardous waste is collected in Dumpsters throughout the Rosebud Mine and transported to the Rosebud County Landfill (located about 4 miles north of Colstrip on Highway 39) by truck for final disposal. Mining-related nonhazardous waste such as nontreated wood, wooden pallets, concrete, and dragline cable and wooden cable spools can be disposed of in a controlled manner in a designated portion of the permit area in accordance with ARM 17.24.507. On a case-by-case basis, other nonhazardous construction, mining, or agricultural debris may also be placed within the mine pits if approved by DEQ.

Paper and cardboard waste is collected throughout the mine office buildings and delivered to Westmoreland Rosebud's AB Warehouse, where it is prepared for shipment to a recycler in Billings, Montana (Western Energy 2009).

Petroleum-contaminated soil generated by tank removals, spills, or sump cleanouts is hauled to Permit Area A, located directly to the north-northeast of the hazardous-waste storage area for treatment by land-farming (**Figure 71**). Land-farming is a process by which petroleum-contaminated soil is bioremediated above ground by stimulating aerobic microbial activity within the soil through aeration or the addition of minerals, nutrients, and moisture. It is a proven, effective technology for reducing concentrations of nearly all the constituents of petroleum products typically found at petroleum-contaminated sites (USEPA 2016). The land-farming practices used by Westmoreland Rosebud consist of regular tilling (weather permitting) and fertilization to accelerate the treatment process. The land-farm soil is sampled annually in late fall for heavy-fuel hydrocarbons, diesel, gasoline, benzene, ethylbenzene, toluene, and total xylenes to evaluate the effectiveness of remediation and to determine if treatment is complete and soil can be removed from the treatment area. The sampling data are summarized and reported annually to DEQ for review. Based on measured soil concentrations, soil-use classifications (Western Energy 2009) are assigned to treated soil. Final use of the treated soil is determined based on these classifications.

Dewatered bottom-ash waste generated from the Colstrip Power Plant has historically been used as a tank or culvert bedding material and a road sanding material on roads and parking facilities at the Rosebud Mine, including the existing Area B permit area. Starting in July 2018, Westmoreland Rosebud indicates that no additional bottom ash will be brought onto the Rosebud Mine (Application).

3.16.2.3 Hazardous Waste

Hazardous wastes generated at the Rosebud Mine include greases, lubricants, paints, flammable liquids, solvents, and any other material that meets the definition of a hazardous waste (40 CFR 261.3). These hazardous wastes are collected in 55-gallon drums at satellite accumulation points located throughout the mine (locations vary depending on mine activity and are not shown on **Figure 71**). Within 3 days of being filled, the waste drums are transported to the hazardous-waste storage area located in Area A (**Figure 71**) for shipment to a treatment, storage, and disposal facility (TSDF) for final destruction or disposal. Accumulation containers are securely closed at all times (except when waste is being added), with at least 2 to 3 inches of headspace to reduce the risk of leakage or seepage due to content expansion from temperature changes. Accumulation containers are labeled to indicate the type of waste contained and the point of generation. Acid or alkaline materials are accumulated in plastic drums or plastic-lined metal drums. Liquids are accumulated in closed-top drums, and solids are accumulated in open-top drums. Waste in dented or leaking drums are transferred into undamaged drums or overpacked in a larger drum. Any spilled material is cleaned up in accordance with the SPCCMP and CERP, and material generated as part of the cleanup process is placed in a drum for determination of its waste characteristics.

The Area A hazardous-waste storage area (**Figure 71**) is a square cement pad with no cover, secured by a barbed-wire fence and surrounded by a dirt berm on all sides to insure leachate and surface runoff associated with the storage will not degrade surface or ground water. Ramps on the east and west sides allow for vehicle access to the storage facility. Within the hazardous-waste storage area, drums are sorted into the following categories: used oil, used rags, used grease, waste solvent, miscellaneous waste streams, and empty drums. No polychlorinated biphenyls are currently used at the Rosebud Mine, and no onsite solvent recycling is currently conducted. In accordance with LQG regulations, the waste for each regulated hazardous waste stream must be shipped to a TSDF within 90 days of the start of accumulation. Drums stored at the waste-storage area are consolidated as necessary and labeled in accordance with regulation guidelines. At least once per year, existing waste streams are reevaluated to verify that the waste stream has not changed.

Westmoreland Rosebud subcontracts for services related to hazardous-waste disposal and transportation services. The waste streams are profiled, and hazardous-waste manifests are generated and completed for shipment. Copies of all related paperwork are kept onsite for at least 3 years from the date the waste was shipped. Westmoreland Rosebud submits an annual hazardous waste report to DEQ no later than March 1 of each year, which documents the previous year's generator activities.

Mine personnel working in the satellite accumulation areas are required to fill out a daily log of the work area, which includes inspection of accumulation drums. Weekly inspections of the draglines, which use parts cleaner containing 140 Solvent, are performed by the operator or oiler of each machine and documented in the Hazardous Materials Inspection Log. Inspection of satellite accumulation areas is performed quarterly by the Hazardous Waste Coordinator (HWC). The HWC inspects the hazardous-waste storage area weekly. Safety Data Sheets are stored in binders in the areas specific to their individual uses.

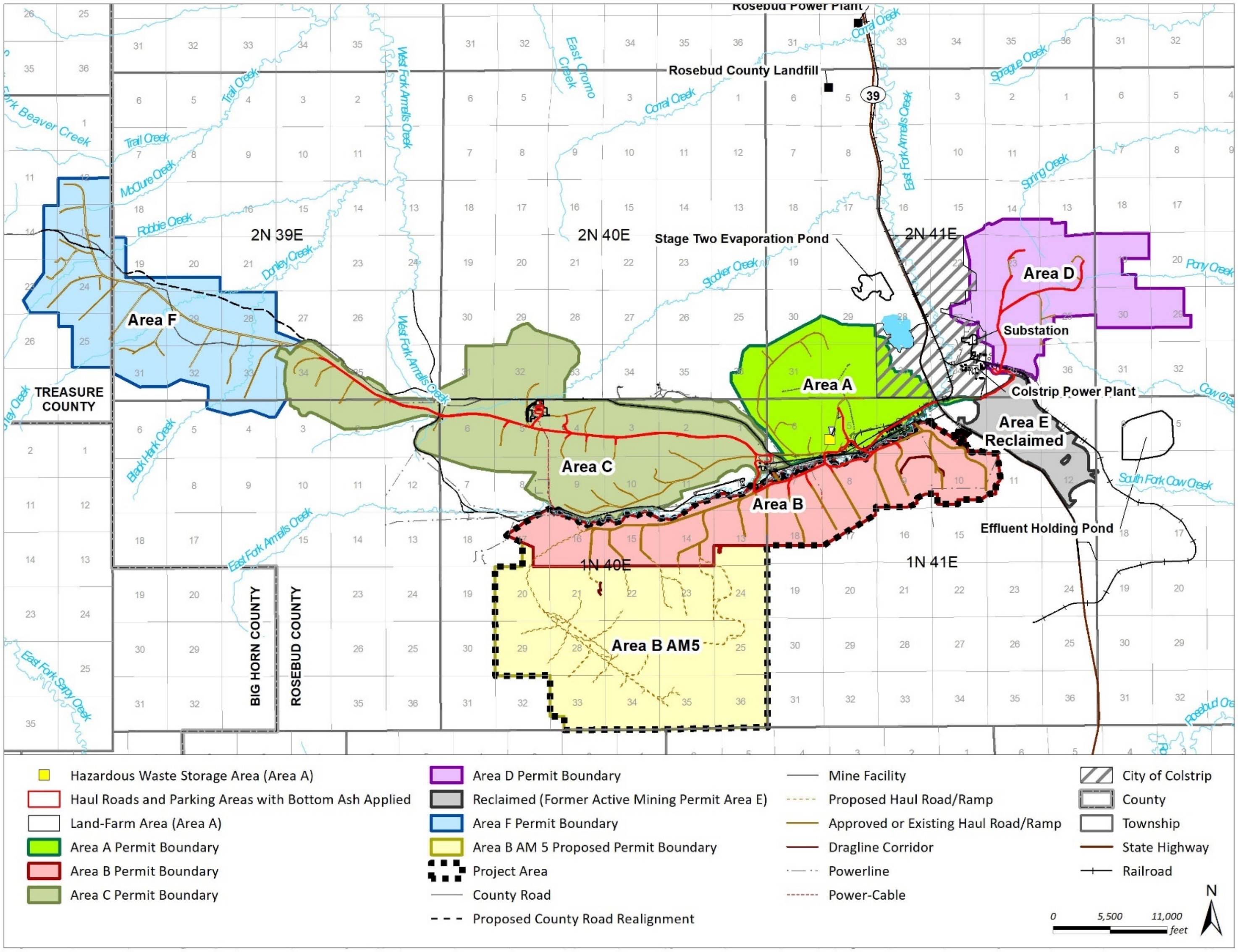

Figure 71. Solid and Hazardous Waste Features in the Analysis Area.

3.16.3 Environmental Consequences

3.16.3.1 Alternative 1 – No Action

Under the No Action Alternative, the AM5 amendment (proposed Project) would not be permitted. Westmoreland Rosebud would complete mining and reclamation in the Area B permit area according to its currently approved operating permit. Mining is permitted in Area B until 2030, and initial stages of reclamation would be completed within 2 years of the cessation of mining. There would be no Project impacts on solid and hazardous waste management described above in **Section 3.16.2, Affected Environment**, because development of the Project would not occur.

The No Action Alternative would not change the status of the existing Area B permit area or other permit areas, including Area F, of the Rosebud Mine (**Section 2.2, Existing Operating Permits, Disturbance, and Reclamation**), nor would it affect the federal coal lease MTM 80697 (tracts in Areas B and C) modification application, which is currently being evaluated by the Bureau of Land Management (**Section 3.1.4.2, Related Future Actions**). Impacts from solid and hazardous waste due to current and future mining and reclamation in the existing Area B permit area and other permit areas of the Rosebud Mine would continue.

3.16.3.2 Alternative 2 – Proposed Action

Under the Proposed Action, Westmoreland Rosebud is expected to mine an estimated 104.3 million tons of coal from the Project area. The operational life (active mining and development) of the Project area is expected to be 30 years (**Figure 4** in **Chapter 2**) and would extend the operational life of the Area B permit area by 15 years and life of the Rosebud Mine and associated facilities, including those used for solid and hazardous waste, by 7 years.

Direct Impacts

Under the Proposed Action, Westmoreland Rosebud does not propose to construct any facilities or storage areas in the Project area, since any that would be needed already exist and are available for use in other permit areas (see **Figure 71**). As is current practice for Area B and other permit areas, hazardous wastes would be collected in 55-gallon drums at satellite accumulation points within the Project area (the number of satellite accumulation points and drums would be based on the waste stream generated); within 3 days of filling, the waste drums would be transported to the hazardous-waste storage area located in Area A for shipment to a TSDF.

Final disposal of non-coal solid wastes, if encountered, would be either at the Rosebud County Landfill or in the mine pits in an approved landfill site for solid wastes. Mining-related nonhazardous waste such as nontreated wood, wooden pallets, concrete, and dragline cable and wooden cable spools would be placed in the mine pits in accordance with ARM 17.24.507. On a case-by-case basis, other nonhazardous construction, mining, or agricultural debris would also be placed within the mine pits if approved by DEQ (Application; ARM 17.24.507). Any waste materials meeting the definition of “hazardous” would be handled in accordance with applicable regulations (see **Section 3.16.1.1, Regulatory Framework**). Excess waste liquid not used within the Rosebud Mine would be handled under Westmoreland Rosebud’s Waste Management Program.

Under all alternatives, Westmoreland Rosebud would not use bottom ash for any purpose within the Project area.

Secondary Impacts

No secondary impacts are anticipated. Unanticipated spills would be handled according to Westmoreland Rosebud's SPCCMP and CERP.

3.16.3.3 Cumulative Impacts

The analysis area for evaluation of cumulative impacts related to solid and hazardous waste includes all permit areas of the Rosebud Mine, including past and ongoing mining areas, the Rosebud County Landfill where solid waste would be sent, and the disposal area where hazardous wastes generated would reside.

Mining at the Rosebud Mine has contributed to the generation of solid and hazardous waste, and mining of the Project area would add to the total amount of solid and hazardous waste already generated. Solid or hazardous waste as a result of the Proposed Action would have a cumulative impact on the landfill and disposal areas receiving solid or hazardous waste from the mine. Relatively small quantities of these wastes would be generated relative to past and future amounts received at the disposal areas from other permit areas of the Rosebud Mine.

3.16.3.4 Unavoidable Adverse Impacts

Short-term unavoidable adverse impacts on solid and hazardous waste would occur during mining. After reclamation activities, no unavoidable adverse impacts would be anticipated for solid and hazardous waste.

3.16.3.5 Irreversible and Irretrievable Impacts

There is no irreversible or irretrievable commitment of resources related to solid or hazardous waste because waste is not considered a resource.

3.17 NOISE

3.17.1 Introduction

The sections below provide an overview of existing noise sources in the analysis area and the regulatory authorities governing noise. The analysis area for noise is defined below in **Section 3.17.1.2, Analysis Area and Methods** and definitions of noise and the types of noise metrics associated with it are described in **Section 3.17.1.3, Terminology**.

This section also analyzes the environmental consequences, including the direct, secondary, and cumulative impacts, of the No Action Alternative (Alternative 1) and the Proposed Action (Alternative 2) with respect to noise.

3.17.1.1 Regulatory Framework

Federal Requirements

There are no known federal noise requirements applicable to this Project.

State Requirements

MSUMRA's implementing rules do not regulate noise per se but do include regulations related to the use of explosives. Specifically, ARM 17.24.623(1-2) states:

> (1) The operator shall publish a blasting schedule at least 10 days, but not more than 20 days, before beginning a blasting program in which blasts that use more than 5 pounds of explosive or blasting agent are detonated. The blasting schedule must be published once in a newspaper of general circulation in the locality of the blasting site. (2) Copies of the schedule must be distributed by mail to local governments and public utilities and by mail or delivered to each residence within 1/2 mile of the permit area described in the schedule. For the purposes of this section, the permit area does not include haul or access roads, coal preparation and loading facilities, and transportation facilities between coal excavation areas and coal preparation or loading facilities, if blasting is not conducted in these areas. Copies sent to residences must be accompanied by information advising the owner or resident how to request a preblasting survey.

Local Requirements

There are no known local noise requirements applicable to this Project.

3.17.1.2 Analysis Area and Methods

Analysis Area

The noise analysis area includes the existing permit areas of the Rosebud Mine and the 15,153-acre proposed Project area, but also extends to the nearest noise-sensitive areas (i.e., residences) and the city of Colstrip. The noise analysis area is shown in **Figure 72** along with the residential locations where mining noise is described in this EIS.

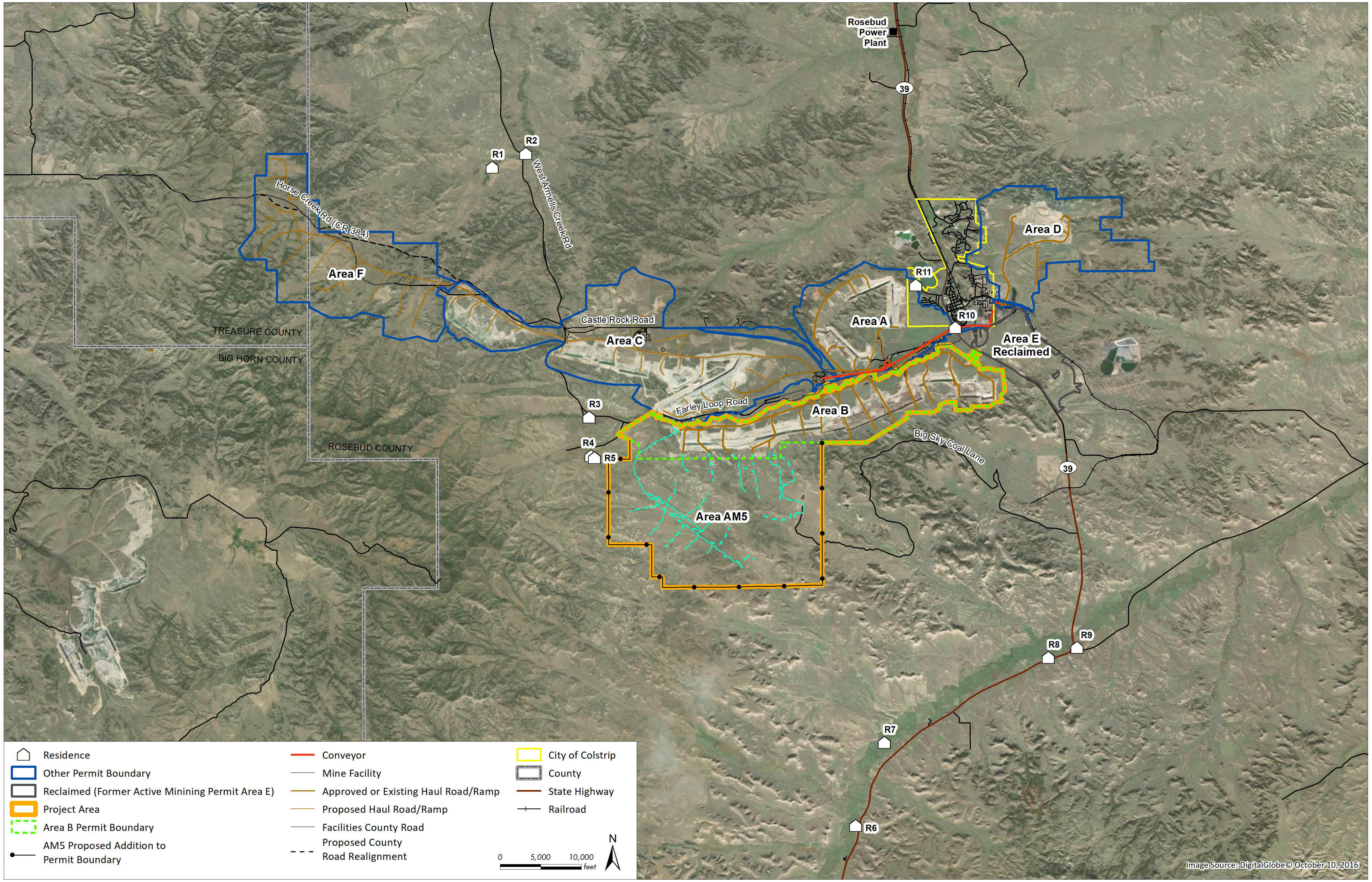

Figure 72. Noise Analysis Area and Location of Residences Analyzed for Noise Impacts.

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Analysis Methods

Noise for the proposed Project is qualitatively described in this EIS as there are no applicable objective standards. This includes a general description of noise (overpressure) resulting from blasting and the noise generated from the remainder of the mining activities such as excavating and hauling. More specifically, the expected blast noise or overpressure was estimated and compared to commonly known nuisance levels, and the change of all other mining noise was estimated based on changes in distance to the activities.

3.17.1.3 Terminology

Sound or noise levels are most commonly reported in decibels (dB). The dB scale is logarithmic (a nonlinear scale used when there is a large range of quantities) and matches the way a human's ear interprets sound pressures. The human auditory system is not equally sensitive to all frequencies; thus, for environmental noise, the A-weighted decibel (dBA) is used to measure sound the same way the ear hears it (Beranek 2006). Perceptible noise levels generally range from about 0 dBA (threshold of hearing) to about 140 dBA (painful) with a normal conversation being around 60 dBA and construction equipment being around 85 dBA at 50 feet away. **Table 98** shows typical average A-weighted sound levels for commonly encountered noises. With regard to the subjective response to changes in noise levels, humans can barely perceive a difference in a noise level when it changes by 3 dB, most everyone can detect a 5 dB change, and a 10 dB change sounds like the noise level has doubled or has been cut in half. Because dBs are logarithmic, a change of 3 dB within an environment, such as that from a highway, would require the traffic volume to double for the noise level to increase by 3 dB.

Table 98. Typical Noise Levels.

Noise Source	Noise Level (dB)
Jet engine at takeoff	140
Emergency vehicle siren	115
Motorcycle (riding)	100
Passing diesel truck	85
Vacuum cleaner	75
Conversational speech	60
Light traffic	50
Babbling brook	40
Whisper	30
Rustling leaves	20
Threshold of hearing	0

Source: Noise Help 2015.

Environmental noise levels generally fluctuate with time as noise sources move and environmental factors change. Thus, environmental noise is reported as the equivalent noise level (L_{eq}), which is a measure of the exposure resulting from the accumulation of sound levels over a particular period of interest (e.g., an hour, an 8-hour workday, nighttime, or a full 24-hour day). It is a way of assigning a single number to a time-varying sound level. Another noise metric is the day-night average noise level (L_{dn}), which reflects a 24-hour A-weighted noise dose. L_{dn} is equal to a 24-hour A-weighted L_{eq}, with one important adjustment: noise occurring at night (from 10 p.m. through 7 a.m.) is "factored up" by adding 10 dB to all nighttime noise contributions. This 10 dB adjustment accounts for our greater sensitivity to nighttime noise and the fact that noise events at night tend to be more intrusive due to lower ambient noise levels (Beranek 2006). Finally, low-frequency noise from blasting activities is called overpressure (or blast overpressure) and is assessed using flat-weighted decibels (dB) rather than dBA. This is because the primary concern with

overpressure noise is the potential to cause structural damage from vibration, and dBA filters out most low frequencies.

3.17.2 Affected Environment

The analysis area for noise includes the rural areas surrounding the Rosebud Mine to the north, south, and west, and residential areas to the east in Colstrip. As shown on **Figure 72**, the city of Colstrip is surrounded by permit areas A, B, and D of the Rosebud Mine. The existing Area B permit area is just south of the Colstrip city limits, and the AM5 expansion area would be 4.3 miles from city limits. The nearest Colstrip residences to the Project area are anywhere from 1 to 2 miles away from active mining operations in Areas A, B, C, and F. However, coal conveyor systems from Areas A and C pass directly through Colstrip (**Figure 72**), and commuting workers, haul trucks, and supply trucks drive through Colstrip on Highway 39 and associated mine access roads (see **Section 3.15, Transportation**). Within the Colstrip city limits, noise sources include traffic on Highway 39 and other local roads, the activities of residents, operation of the Colstrip Power Plant and the Rosebud Power Plant (the Rosebud Power Plant is about 6 miles to the north of Colstrip), and the coal conveyors. At night, local traffic is minimal, except for periods during shift changes at the mine. The nearest major highway (I-94) is more than 30 miles to the north and does not contribute to the noise. Noise occurring at night comes primarily from the Colstrip Power Plant; therefore, noise levels at night primarily depend on the distance between the Colstrip Power Plant and residences, which varies from about 0.5 to 1.5 miles. Existing outside nighttime noise levels are estimated to range from 30 to 60 dBA depending on proximity to the Colstrip Power Plant (Hankard 2012; Bradley 1985). Noise levels inside a typical residence with all windows and doors closed would be about 25 dBA lower (USEPA 1978).

Table 99 provides a list of residences and the approximate nearest distance to the proposed Project area; distances were calculated using Google Earth. The nearest residences to the AM5 expansion area are R4 and R5 off Airport Road and are about 0.4 mile away. These same residences are currently within 0.8 mile of the existing Area B permit area.

Table 99. Approximate Distances from Residences to Mining Areas.

Residence	Location	Direction from Project Area	Nearest Distance (miles)	
			Project Area (Area B or AM5)	Existing Mine (Area ID)
R1	Armells Creek Rd	Northwest	7.0	2.5 (Area C or F)
R2	Armells Creek Rd	Northwest	7.0	2.5 (Area C or F)
R3	Airport Rd	Northwest	0.75	0.75 (Area B)
R4	Airport Rd	West	0.40	0.8 (Area B)
R5	Airport Rd	West	0.40	0.8 (Area B)
R6	SH 39	South	5.5	9.0 (Area B)
R7	SH 39	South	4.0	7.0 (Area B)
R8	SH 39	Southeast	5.5	6.4 (Area B)
R9	SH 39	Southeast	6.2	6.6 (Area B)
R10	Colstrip	Northeast	4.0	0.5 (Area B)
R11	Colstrip	Northeast	4.3	0.1 (Area A)

Currently, excavation and hauling of coal from the Rosebud Mine occur within Areas A, B, C, and F. Reclamation activities are occurring in Area D. Two existing conveyor systems that transport the coal from Areas A and C to the Colstrip Power Plant pass within 100 feet of residences on the south edge of Colstrip. The conveyor from Area C (4.2 miles long) would be used for Project area coal transport as well. Typical heavy equipment that is used in existing Area B and other active permit areas would also be

used in the AM5 expansion area including various trucks, haulers, tractors, loaders, drills, and one dragline.

Coal blasting generally occurs 1 to 3 days per week, with overburden blasting four to six times per month. No blasting occurs within 5,000 feet of any major structure outside the permit area. It is estimated that blasting overpressure levels of about 120 dB occur at a distance of 450 feet from the blast for 1 or 2 seconds (Marcus 2014). The Office of Surface Mining, Reclamation, and Enforcement (OSMRE) recommends keeping overpressure noise levels from a blast below 120 dB to minimize human annoyance and complaints. The U.S. Bureau of Mines and MSUMRA considers 134 dB to be safe for residential structures (USDI 1987).

3.17.3 Environmental Consequences

3.17.3.1 Alternative 1 – No Action

Under the No Action Alternative, the AM5 amendment (proposed Project) would not be permitted. Westmoreland Rosebud would complete mining and reclamation in the Area B permit area according to its currently approved operating permit. Mining is permitted in Area B until 2030, and initial stages of reclamation would be completed within 2 years of the cessation of mining. There would be no Project impacts on the noise analysis area described above in **Section 3.17.1.2, Analysis Area and Methods**, because none of the disturbances associated with development of the Project would occur.

The No Action Alternative would not change the status of the existing Area B permit area or other permit areas, including Area F, of the Rosebud Mine (**Section 2.2, Existing Operating Permits, Disturbance, and Reclamation**), nor would it affect the federal coal lease MTM 80697 (tracts in Areas B and C) modification application, which is currently being evaluated by the Bureau of Land Management (**Section 3.1.4.2, Related Future Actions**). Noise impacts due to current and future mining and reclamation in the existing Area B permit area and other permit areas of the Rosebud Mine would continue.

3.17.3.2 Alternative 2 – Proposed Action

The proposed Project would bring mining activities closer to some residences in the analysis area and extend the duration of mining noise by 15 years (until 2045 instead of 2030).

Direct Impacts

The primary sources of noise from surface coal mining are blasting operations and the excavation and hauling of the coal offsite. Although there are no directly applicable noise level limits for blasting, common guidelines are 120 dB to minimize human annoyance and 134 dB to protect against damage to residential structures (USDI 1987). There are also no applicable noise level limits for excavating or all other nonblasting mining sources, but a general rule of thumb is that an increase of 3 dB is just perceptible to humans, an increase of 5 dB is readily perceptible, and an increase of 10 dB is perceived as doubling of the sound level. The following describes the expected noise from each operation and the potential noise impacts on the nearest residences in each direction from the site.

Blasting within the Project area, including the AM5 expansion area, is expected to occur with similar frequency to what is ongoing today in the existing Area B permit area and other actively mined permit areas. A typical schedule includes coal blasting 1 to 3 days per week and overburden blasting four to six times per month. **Table 100** provides the predicted air overpressure levels at different distances to the largest and most critical expected blast (Marcus 2014). The predicted overpressure limit of 120 dB is reached at a distance of 450 feet from the blast and dissipates to around 105 dB at the nearest two

residences, which are about 0.4 mile to the west. Only locations within 450 feet of blasting are predicted to result in any human annoyance. These predicted levels are considered to be conservatively high at large distances because terrain, which can impede noise propagation, was not taken into account. No air overpressure impacts are expected from blasting in any noise-sensitive areas.

Table 100. Predicted Air Overpressure Levels from Blasting at AM5.

Distance to Blast (feet)	Distance to Blast (miles)	Pounds per Delay (pounds)	Scaled Distance (feet / pounds $^{1/3}$)	Predicted Audible Air Overpressure (dB)
450	0.09	30,030	15	120
1,242	0.20	30,030	41	110
3,424	0.60	30,030	114	100
9,441	1.80	30,030	314	90
26,030	4.90	30,030	867	80
71,768	14.00	30,030	2,390	70
197,874	37.00	30,030	6,589	60
545,570	103.00	30,030	18,166	50
1,504,220	285.00	30,030	50,086	40

Source: Marcus 2014.

As with blasting noise, other mining-related noise, such as excavating and hauling, currently exists in the analysis area. In general, a noise source decreases by 6 dB per doubling of distance. As shown in **Table 99**, the Project area is generally no closer to many of the residences than existing noise sources, and in some cases the Project area is further away than existing noise sources. As a result, noise from mining activities in the Project area would be expected to remain the same or become less for these residences. For the residences at R4 to R7, the worst-case mining noise could become 5 to 6 dB louder than it has been in the past when no barriers are between the source and the receiver.

The impact of mining noise on wildlife is described in **Section 3.10, Fish and Wildlife Resources**.

Secondary Impacts

Secondary impacts were assessed at residences near the Rosebud Power Plant and the Colstrip Power Plant. Overall, noise from the power plants, Highway 39, other local roads, and the coal conveyors are the primary noise sources in the analysis area. Although noise levels from these sources would not be expected to increase due to the Proposed Action, noise from these sources would be expected to be ongoing for an additional 15 years as the power plants continue to operate and the city of Colstrip remains active.

3.17.3.3 Cumulative Impacts

The analysis area for cumulative impacts is the same as the analysis area for direct and secondary impacts. Past, present, and related future actions under concurrent consideration that could contribute to cumulative impacts from noise sources include:

- Past, ongoing, and future permitted mining at the Rosebud Mine
- Agricultural operations
- Airport operations
- Operations of the Colstrip and Rosebud Power Plants
- Rail transportation

Of these sources of noise, the only continuous noise sources include mining operations at the Rosebud Mine and operation of the Colstrip Power Plant and the Rosebud Power Plant. All other cumulative noise sources are intermittent or substantially distant from the noise-sensitive areas.

Noise sources including the Rosebud County airfield (located between Areas B and C of the Rosebud Mine), operation of the Colstrip Power Plant, and existing coal mining and reclamation of Areas A, B, and C have contributed to the cumulative noise level in the area surrounding the Rosebud Mine. Although mining in the Project area would result in noise impacts on the immediate area, operations are not expected to contribute cumulatively to regional noise due to the distance from these activities. The only continuous noise source in proximity to any residences is the Colstrip Power Plant and the Rosebud Power Plant. All other cumulative noise sources are substantially distant from residences.

Therefore, noise as a result of Alternative 2 would have long-term cumulative impacts on the Colstrip residences directly west of the Colstrip Power Plant, to a lesser extent on the other residences in Colstrip, and to the least extent on the more distant residences more than 2 miles away. All other related past, present, and future actions identified in this section would have minimal short- and long-term cumulative impacts on noise under Alternative 2.

3.17.3.4 Unavoidable Adverse Impacts

No unavoidable adverse impacts are associated with noise.

3.17.3.5 Irreversible and Irretrievable Impacts

No irreversible or irretrievable impacts are associated with noise.

3.18 SOIL

3.18.1 Introduction

This section describes soil resources that occur in the analysis area and their suitability for use in reclamation and revegetation after mining operations. The analysis area for soil is defined below in **Section 3.18.1.2, Analysis Area and Methods**. The regulatory authorities governing soil resources are also discussed in this section.

This section also analyzes the environmental consequences, including the direct, secondary, and cumulative impacts, of the No Action Alternative (Alternative 1) and the Proposed Action (Alternative 2) with respect to soil resources in the analysis area.

3.18.1.1 Regulatory Framework

Federal Requirements

There are no applicable federal regulations within or near the analysis area.

State Requirements

Surface-mining operations are required by MSUMRA (82-4-231 and 232, MCA) and its implementing rules (ARM 17.24.701 and 702) to salvage all topsoil and subsoil suitable for reclamation. Salvaged soil must be placed on graded land meeting postmine topography or temporarily stored and protected from loss due to wind or water erosion. All salvaged soil and substrates must be replaced after mining to support revegetation. **Table 101** summarizes the applicable rules.

Table 101. Applicable Soil Rules and Statutory Requirements.

Applicable Administrative Rules of Montana	
ARM 17.24 Subchapter	**Summary of Requirement**
3	Contains requirements of the surface mine permit application, including gathering soil baseline information (ARM 17.24.304 and 306) and requirements of the reclamation plan (ARM 17.24.313).
5	Contains backfilling and grading requirements.
6	Lists performance standards for drainage reclamation (ARM 17.24.634) and sediment-control measures (ARM 17.24.638).
7	Includes the requirements of soil removal (ARM 17.24.701); soil stockpiling and redistribution (ARM 17.24.702); soil-stabilizing practices (ARM 17.24.714); use of soil amendments, management techniques, and land use practices (ARM 17.24.718); establishment of vegetation (ARM 17.24.711); soil/spoil monitoring plan (ARM 17.24.723); postmining land use (ARM 17.24.762); and cropland reclamation (ARM 17.24.764).
Applicable Requirements under Montana Strip and Underground Mine Reclamation Act	
82-4, MCA Subpart	**Summary of Requirement**
222	Contains requirements of a mine permit application, which include a plan for the mining, reclamation, revegetation, and rehabilitation of land and water to be affected by the operation.
231	Requires submission of and action on the reclamation plan and inclusion of a plan of grading, backfilling, highwall reduction, topsoiling, and reclamation for the area of land affected by the operation.
232	Contains specifications for soil removal, storage, replacement, and reconstruction on prime farmlands and nonprime farmlands.
233	Contains requirements for planting of vegetation after grading of a disturbed area.

DEQ has outlined its procedures and methods to protect the soil resources that would be disturbed by coal-mining operations and to enhance the potential of achieving successful reclamation in its Soil, Overburden, and Re-graded Spoil Guidelines (DEQ 1998). These guidelines are based on the requirements and objectives of MSUMRA and its implementing rules (**Table 101**) and include soil-suitability criteria for determining salvage depths and volumes of suitable soil and soil materials for use as a plant-growth medium.

Local Requirements

There are no applicable local regulations within or near the analysis area.

3.18.1.2 Analysis Area and Methods

Analysis Area

The soil analysis area corresponds to the 15,153-acre Project area, which includes the existing 6,045-acre Area B permit area and the proposed 9,108-acre AM5 expansion area. Within the Project area is an 11,202-acre disturbance area where proposed Project activities could disturb a maximum of 5,711 acres (about 5,547 acres in the AM5 expansion area and 167 acres in the existing Area B permit area). **Figure 73** shows the analysis area and the new proposed disturbances, which include mining areas, soil stockpiles, spoil storage areas, scoria pits, the Area B “Richard” haul road, the Lee haul road, and ramp roads.

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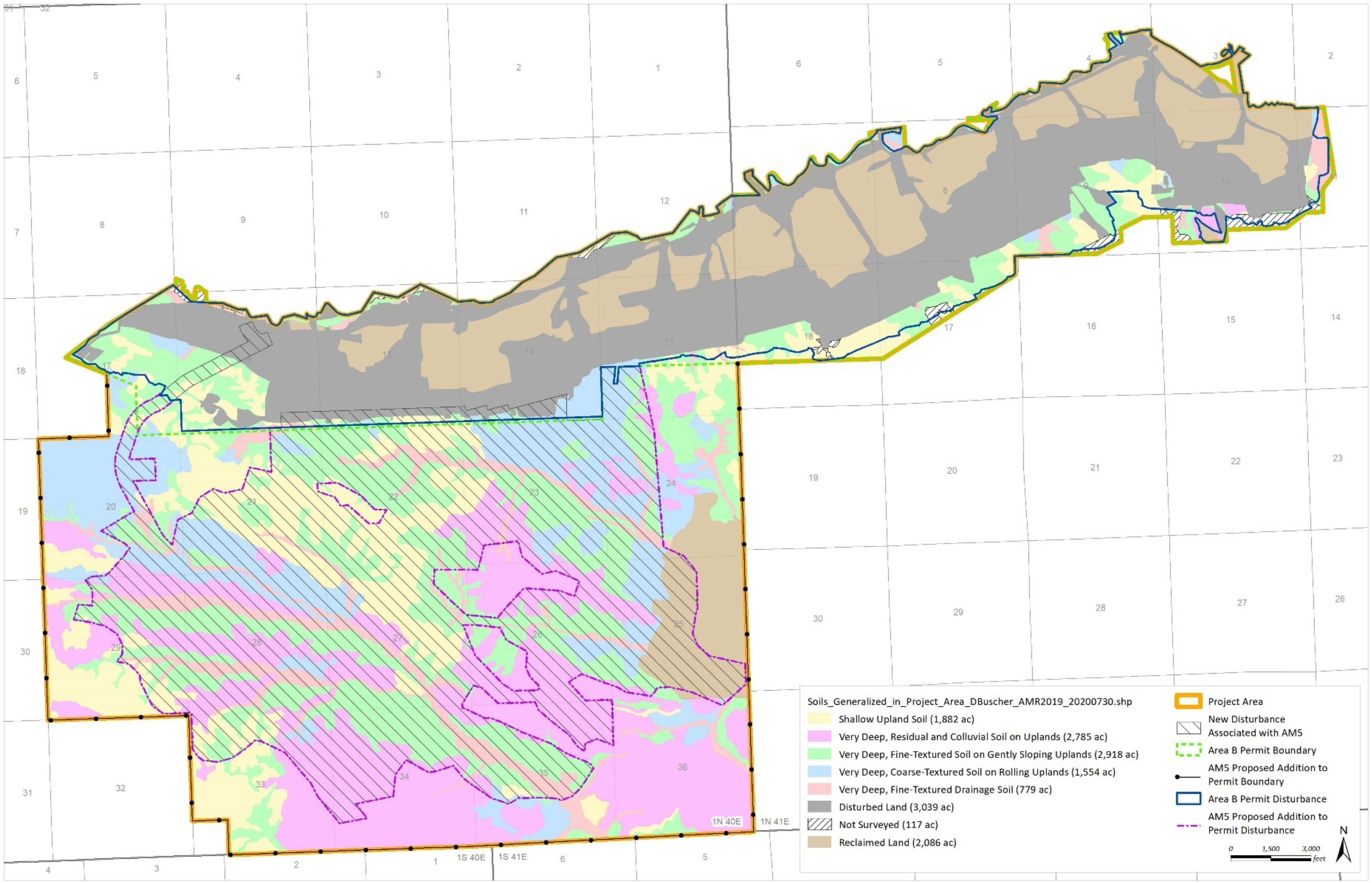

Figure 73. Generalized Soil Map.

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Analysis Methods

Soil investigations for the analysis area were conducted for Western Energy (predecessor to Westmoreland Rosebud) in 1985 by Jim Meshnik and in 2016 by James Nyenhuis (Application Appendix G). The soil investigations provide descriptions of field, laboratory, and interpretation methods. The 1985 soil investigation encompassed the existing Area B permit area, which is in the northern portion of the analysis area, and the 2016 investigation encompassed the AM5 expansion area. Thirty-one soil map units and four miscellaneous map units were identified and delineated within the analysis area during the soil baseline studies (Application Appendix G) using standard Natural Resources Conservation Service (NRCS) soil-survey methods. These map units were grouped into six generalized soil map units and two miscellaneous map units to simplify the discussion in the EIS. The groupings of the generalized soil map units are based on soil depth, parent material, landscape position, and the physical and chemical properties of the soil. Small map unit polygons that were surrounded by different map units and too small to be included separately on the generalized soil map were lumped into an adjacent map unit. The generalized map units (**Figure 73**) include (1) shallow upland soil; (2) very deep, residual and colluvial soil on uplands; (3) very deep, fine-textured soil on gently sloping uplands; (4) very deep, coarse-textured soil on rolling uplands; (5) very deep, fine-textured drainage soil; and (6) reclaimed land. The miscellaneous map units are disturbed land, which includes active mining areas, stockpiles, and other mining related disturbances, and not surveyed.

An analysis of soil suitability for reclamation and of salvageable depths and volumes is provided and was based on DEQ guidelines and the physical and chemical characteristics of the soil. The generalized map units are described below; the descriptions were taken from the baseline soil studies (Application Appendix G) with minor modifications.

As part of the 1985 and 2016 soil investigations, laboratory analyses were performed for selected physical and chemical parameters of the soil according to criteria outlined in DEQ guidelines (1998) and included the following: particle size distribution (soil texture), rock content, percentage organic matter, soil pH, electrical conductivity, saturation percentage, sodium adsorption ratio, and selenium. These parameters were used to determine volumes of salvageable soil for use in reclamation of disturbances.

3.18.2 Affected Environment

Soil varies in depth, texture, percentage rock fragments, and chemical and physical properties. Soil resources are evaluated to determine the volume and suitability available to achieve reclamation success. A suite of chemical and physical parameters—particle size distribution (soil texture), rock content, percentage organic matter, soil pH, electrical conductivity (EC), saturation percentage, sodium adsorption ratio (SAR), selenium, boron, and slope—are used to determine soil suitability for mine and reclamation planning. Soil materials most likely to contribute to reclamation success are designated for salvage and use in reclamation.

3.18.2.1 Soil Map Units and Descriptions

The analysis area encompasses 15,153 acres, of which 5,711 acres potentially could be disturbed by proposed Project activities. The 5,711 acres is the maximum extent of disturbance. The acreages of the generalized map units within the analysis area and acreages of new maximum mining disturbances are listed in **Table 102**.

Table 102. Acreages of Generalized Soil Map Units.

Soil Map Unit Number	Generalized Soil Map Unit	Analysis Area (Acres)	Maximum Disturbed Acres within Analysis Area
100	Shallow upland soil	1,882	826
200	Very deep, residual and colluvial soil on uplands	2,785	1,290
300	Very deep, fine-textured soil on gently sloping uplands	2,918	1,848
400	Very deep, coarse-textured soil on rolling uplands	1,554	918
500	Very deep, fine-textured drainage soil	779	525
600	Reclaimed land	2,086	234
DL	Disturbed land	3,039	70
NS	Not surveyed	117	0
Total		**15,160***	**5,711**

*Note: 15,160 is the acreage calculated using the generalized soil map units. The total Area B operating permit area as modified by AM5 would be 15,153 acres.

Shallow Upland Soil (Soil Map Unit Number 100)

Shallow upland soil is generally less than 20 inches to bedrock, although some moderately deep soil (20–40 inches to bedrock) and a minor amount of very deep soil (>60 inches to bedrock) are included in this soil map unit. Areas of rock outcrop are also included in the map unit. The soil is well-drained and developed predominantly in shallow residuum from sandstone, shale, or scoria on or adjacent to upland ridges with slopes ranging from 4 to 70 percent. Much of the soil in this map unit contains 20–35 percent rock fragments in its lower profile, which is typical for areas favored by trees. The soil map units from the baseline soil studies (Application Appendix G) that make up this generalized map unit include 84D, 184F, 188E, and 498E (refer to the baseline soil studies in Appendix G of the Application for a description of these map units). This soil map unit makes up about 12 percent of the analysis area (1,882 acres) and 826 acres of the potential mine disturbances.

This soil is generally suitable for salvage and replacement. Some soil on slopes greater than 50 percent may not be salvageable due to equipment operator safety concerns. Some soil may not be suitable for replacement due to excessive rock fragments unless used in areas selected for shrub and tree plantings. The Yawdim soil of map unit 184F commonly has a fine texture (clay or silty clay) at the surface, which is considered unsuitable, and may not be salvaged in the analysis area depending on field judgment.

Very Deep, Residual and Colluvial Soil on Uplands (Soil Map Unit Number 200)

This soil is typically very deep to bedrock (greater than 60 inches), well-drained, and developed predominantly in deep residuum and colluvium from sandstone, shale, or scoria on or adjacent to upland ridges. There is some moderately deep soil (20–40 inches), shallow soil (less than 20 inches), and rock outcrop included in this map unit. The slopes range from 2 to 70 percent. This soil map unit primarily occurs in the AM5 expansion portion of the analysis area. It makes up about 18 percent (2,785 acres) of the analysis area and 1,290 acres of the potential disturbance. The soil map units from the baseline soil studies (Application Appendix G) that make up this generalized map unit include 122D, 127F, 131E, 132D, and 183E.

The upper 24 inches of this soil is generally suitable for salvage and replacement. In places, below 24 inches, the soil is unsuitable for salvage due to elevated pH (greater than 8.5). Some soil on slopes greater than 50 percent may not be salvageable because of unsafe conditions for salvage. Some subsoil may not be suitable for replacement due to excessive rock fragments unless used in areas selected for shrub and tree plantings.

Very Deep, Fine-Textured Soil on Gently Sloping Uplands (Soil Map Unit Number 300)

This soil is generally very deep to bedrock, well-drained, and developed predominantly in fine-textured slopewash alluvium, colluvium, or alluvial fan deposits from mixed sources. There is a minor amount of moderately deep and shallow soil included in this map unit. The soil occurs on gently sloping uplands with slopes typically ranging from 0 to 20 percent. It occurs throughout the analysis area and is the dominant soil map unit, making up about 19 percent (2,918 acres), and it makes up 1,848 acres of the potential disturbance. The soil map units from the baseline soil studies (Application Appendix G) that make up this generalized map unit include 16A, 16C, 27C, 37A, 37C, 37D, 49C, 49D, 59C, 59D, 72B, 92C, 92D, and 372.

The upper 24 inches of this soil is generally suitable for salvage and replacement. In places, this soil is unsuitable for salvage below about 24 inches due elevated pH (greater than 8.5) (Application Appendix G). The Vanstel soil (soil map unit 72B), included in this generalized unit, is unsuitable for salvage below about 20 inches due to an elevated EC (greater than 8.0 mmhos/cm) (Application Appendix G).

Very Deep, Coarse-Textured Soil on Rolling Uplands (Soil Map Unit Number 400)

This soil is very deep to bedrock, well-drained, and developed predominantly in coarse-textured alluvium and sandy eolian deposits on rolling uplands with slopes ranging from 2 to 25 percent. Some moderately deep soil occurs in this map unit. The soil map units from the baseline soil study (Application Appendix G) that make up this generalized map unit include 13C, 13D, and 132E. This soil makes up about 10 percent (1,554 acres) of the analysis area and 918 acres of the potential disturbance.

The upper 24 inches of this soil is suitable for salvage and replacement. In places, below about 24 inches the soil is unsuitable due to elevated pH (greater than 8.5), and below 37 inches, the soil is unsuitable due to elevated EC (greater than 8 mmhos/cm) (Application Appendix G).

Very Deep, Fine-Textured Drainage Soil (Soil Map Unit Number 500)

This soil is very deep to bedrock and well-drained. It developed in alluvium on terraces and channels and in moderately fine-textured deposits in eroded areas adjacent to drainages. The soil map units from the baseline soil studies (Application Appendix G) that make up this generalized map unit include 4B, 7E, and 311. This soil is of limited extent and makes up about 5 percent (779 acres) of the analysis area and 525 acres of the potential disturbance. The soil generally occurs in narrow drainageways with slopes ranging from 0 to 35 percent. A few small, scattered inclusions of hydric soil (13.94 acres) are found within this map unit primarily in drainages. Hydric soil typically supports wetlands. Wetlands within the Project area are described in **Section 3.9, Wetlands**.

This soil is generally suitable for salvage and replacement. In places, this soil has a seasonal high-water table from 0 to 20 inches from April through July (Application Appendix G).

Reclaimed Land (Map Unit Number 600)

This map unit consists of reclaimed land. A very minor amount of disturbed land and rock outcrop occurs in this unit. It makes up about 14 percent of the analysis area (2,086 acres) and 234 acres of the potential mine disturbances. This unit likely has about 24 inches of salvageable soil for reclamation.

There are about 117 acres within the analysis area that was not surveyed and about 3,039 acres within the analysis area that has been disturbed by active mining operations. Of these disturbed acres, a maximum of 70 acres could be redisturbed under the Proposed Action.

3.18.2.2 Suitability for Reclamation

In general, according to the baseline soil studies, the upper 24 inches of the soil in the analysis area is suitable for use in reclamation and revegetation except as noted below. The upper 24 inches of soil is typically nonsaline, nonsodic, and has suitable values for soil pH, EC, SAR, saturation percentage, texture, rock fragments, boron, and selenium. Some soil has elevated pH (greater than 8.5) below 24 inches, and at greater depths, some soil has elevated EC (greater than 8 mmhos/cm) and SAR (Application Appendix G). A couple soil types had elevated selenium (0.1 ppm and greater) deeper in the soil profile; selenium, however, was not tested for in the 1985 soil survey of the existing Area B permit area (Application Appendix G).

The Yawdim soil of map unit 184F commonly has a fine texture (clay or silty clay) at the surface, which is considered unsuitable for salvage and reclamation, and may not be salvaged in the analysis area depending on field judgment. The Vanstel soil (soil map unit 72B), which is included in the generalized map unit 200, is unsuitable for salvage below 20 inches due to an elevated EC (greater than 8.0 mmhos/cm) (Application Appendix G).

Some soil is very rocky and exceeds DEQ's guidelines for rock fragments. This soil can be redistributed in areas selected for shrub and tree plantings. Slopes greater than 50 percent may pose safety concerns for salvage operations.

Thicknesses of suitable soil for reclamation vary across and within the five generalized soil map units. Map unit 100 (shallow upland soil) typically has less than 20 inches, and some very deep soil in map units 200, 300, 400, and 500 has greater than 24 inches of suitable soil. The Area B operations plan currently has a balanced soil budget, and soil-salvage volumes are evaluated annually to ensure there is sufficient soil material to reclaim disturbed areas.

3.18.2.3 Soil Salvage Protocol

Four soil salvage classes, which are shown on **Figure 74**, would be salvaged: lowland soil, upland soil, tree soil, and tree and upland soil. These classes, shown in **Table 103**, are based on suitable topsoil and subsoil thickness, as well as soil texture, and include the generalized soil map units described above. Within the maximum 5,711 acres of Project disturbance, the upland soil-salvage class makes up about 2,694 acres, the lowland class makes up 307 acres, the tree class makes up 1,904 acres, the tree and upland class makes up 502 acres, reclaimed land makes up 234 acres, and land already disturbed makes up 70 acres.

Soil-salvage classes, salvage depths, and salvage volumes are shown in **Table 103**. Soil removal for lowland and upland soil would be done in two lifts: 12-inch topsoil and upper subsoil (lift 1), and 12-inch subsoil (lift 2). Tree soil would be removed in one 24-inch lift. The tree and upland soil would be salvaged in either one 24-inch lift or two 12-inch lifts depending on whether it was tree soil or upland soil. Reclaimed land (map unit 600) also would be salvage in either one 24-inch lift or two 12-inch lifts. Within the new proposed mining disturbances, the lowland soil salvage class has about 1 million cubic yards of salvageable soil, the upland soil salvage class has 8.7 million cubic yards, the tree soil salvage class has 6.1 million cubic yards, and the tree and upland soil salvage class has about 1.6 million cubic yards. These volumes are very approximate because of the inclusions within the salvage classes.

Soil removal would be accomplished by scrapers, dozers, or other excavators; and front-end loaders, loading shovels, and other loading equipment would load articulated dump trucks that would transport and deposit the soil on graded areas or in soil-storage areas. Other mobile equipment such as backhoes, blades, and haul equipment (bottom and/or end-dump) may also be used to assist in the operation. To

ensure that soil is salvaged to an appropriate depth, Westmoreland Rosebud would stake out small areas within the soil-salvage area and observe soil-salvage edges.

Table 103. Soil Salvage Classes, Depths, and Volumes.

Soil Salvage Class	Generalized Soil Map Units Included	Soil Salvage Depths Current Protocol – Proposed Action	Approximate Volume of Salvageable Soil within Proposed Disturbances (cubic yards)
Lowland soil	• Most of the very deep, fine-textured drainage soil (soil map unit 500)	Salvage depth = 12 inches in lift 1 (topsoil/upper subsoil); 12 inches in lift 2 (subsoil)	1.0 million
Upland soil	• Very deep, fine-textured soil of gently sloping uplands (soil map unit 300) • Most of the very deep, coarse-textured soil on rolling uplands (soil map unit 400)	Salvage depth = 12 inches in lift 1 (topsoil/upper subsoil); 12 inches in lift 2 (subsoil)	8.7 million
Tree soil	• Shallow upland soil (soil map unit 100) • Most of the very deep, residual and colluvial soil on uplands (soil map unit 200) • The steeper portions (15-35% slopes) of the very deep, fine-textured drainage soil (soil map unit 500)	Salvage depth up to 24 inches in lift 1	6.1 million
Tree and upland soil	• Includes both upland soil and tree soil (portions of soil map units 200 and 400)	Would be salvaged in one 24-inch lift if tree soil and two 12-inch lifts if upland soil	1.6 million

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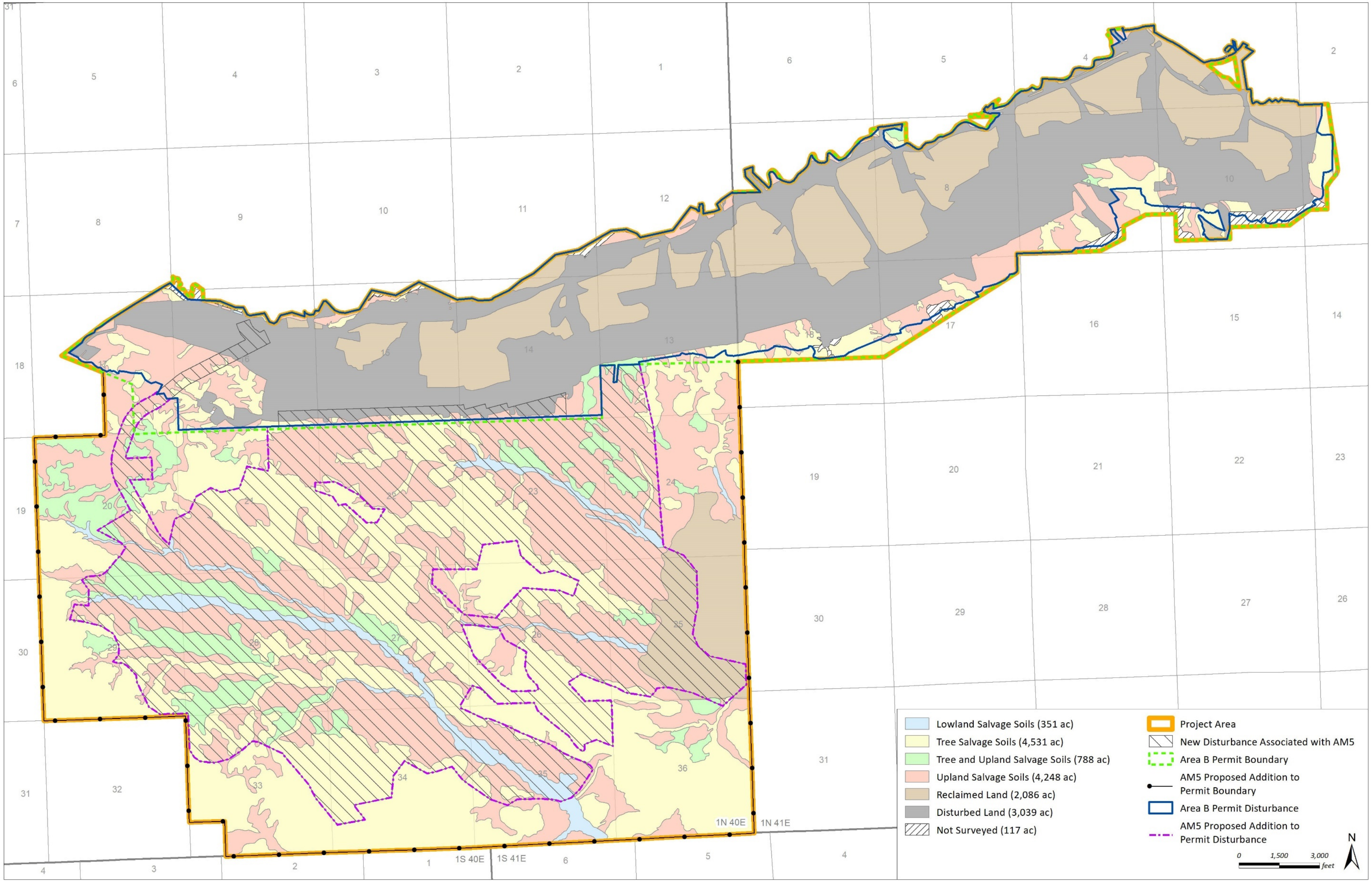

Figure 74. Soil Salvage Classes.

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3.18.3 Environmental Consequences

3.18.3.1 Alternative 1 – No Action

Under the No Action Alternative, the AM5 amendment (proposed Project) would not be permitted. Westmoreland Rosebud would complete mining and reclamation in the Area B permit area according to its currently approved operating permit. Mining is permitted in Area B until 2030, and initial stages of reclamation would be completed within 2 years of the cessation of mining. There would be no Project impacts on soil resources described in **Section 3.18.2, Affected Environment**, because any changes or ground disturbances associated with the proposed Project would not occur.

The No Action Alternative would not change the status of the existing Area B permit area or other permit areas, including Area F, of the Rosebud Mine (**Section 2.2, Existing Operating Permits, Disturbance, and Reclamation**), nor would it affect the federal coal lease MTM 80697 (tracts in Areas B and C) modification application, which is currently being evaluated by the Bureau of Land Management (**Section 3.1.4.2, Related Future Actions**). Impacts on soil due to current and future mining and reclamation in the existing Area B permit area and other permit areas of the Rosebud Mine would continue.

3.18.3.2 Alternative 2 – Proposed Action

Direct Impacts

Under the Proposed Action, a maximum of 5,711 acres could be disturbed by Project activities in the analysis area. Impacts on soil would determine, in part, the potential success of reclaiming the land to postmining uses.

Westmoreland Rosebud's proposed operations plan (see **Section 2.4.4, Operations Plan**), reclamation plan (see **Section 2.4.5, Reclamation Plan**), and measures to control onsite erosion and sediment transport (see **Section 2.4.6, Protection of the Hydrologic Balance**) would mitigate some disturbance impacts and increase reclamation success; however, some direct impacts, which are typical of any operation where soil is removed, would persist.

Some of the soil from the analysis area disturbance would be direct-hauled, and the rest would be stored and later respread. Direct impacts on soil would include:

- Soil erosion in disturbed areas and of salvageable soil through handling
- Changes in physical, chemical, and biological characteristics of soil from salvage, storage, and respreading (leading to reduced soil productivity and decreased soil development)

Soil Erosion

Areas cleared of vegetation would be susceptible to soil erosion from wind and water. Erosion of soil would also occur as a result of soil removal and storage during mine operations and soil exposure during respreading and stabilization. Soil erosion caused by wind and water likely would occur during all phases of the Project. Soil erosion on disturbed areas would likely occur until vegetation is established and surfaces are protected from erosive forces. Based on modeled sediment rates at 75 drainages in Areas A, B, C, D, and E at the Rosebud Mine, pre-mining average annual sediment yields range from 0.002 to 2.34 tons/acre/year with a mean of 0.24 tons/acre/year. Once vegetation reaches 60–80 percent canopy cover, average annual sediment yields would range from 0 to 2.01 tons/acre/year with a mean of 0.065 tons/acre/year (Sjolund 2015a). It typically takes about 2 years for vegetation (much of which consists of

annual plants) on reclaimed sites to provide a sufficient canopy cover to protect the soil from accelerated erosion, and 5–7 years for reseeded vegetation on reclaimed sites at the mine to reach 60–80 percent canopy cover (Sjolund 2015b). Some areas, such as steep slopes (especially south- and west-facing slopes), may require more time for the ground cover to stabilize reclaimed areas. Westmoreland Rosebud is required under MSUMRA (ARM 17.24.723) to monitor vegetation success in reclaimed areas for a minimum of 10 growing seasons to ensure production, cover, and density meet the approved success standards and that a stable landscape has been established consistent with the approved postmining land use (see **Section 2.4.8, Monitoring Plans**). Erosion impacts on soil resources would be short-term and adverse and would return to pre-mine erosion rates within 2 years once vegetation stabilizes the surface.

Existing sediment yield to drainages within the analysis area was estimated using the USDA Water Erosion Prediction Project (WEPP), and postmine sediment yield to drainages within the analysis area was estimated using the Sediment, Erosion, Discharge by Computer Aided Design (SEDCAD) (see **Section 3.5, Water Resources – Surface Water**). Existing annual sediment yields ranged from 0 to 1.804 tons/acre/year, and estimated sediment yields ranged from 0.002 to 0.188 tons/acre/year for postmine conditions once vegetation cover reaches 80 percent (see **Section 3.5, Water Resource – Surface Water** for discussion of sediment yield in drainage basins).

Changes to Physical, Chemical, and Biological Soil Characteristics

Soil characteristics that would be impacted by the Proposed Action include physical and chemical properties and soil biota. Loss of soil structure through mechanical handling followed by tillage to relieve compaction would alter the native soil profile. This soil handling would adversely affect soil/plant interaction due to decreased soil water-holding capacity, loss of aeration and pore space, and increased bulk density (Sharma and Doll 1996). Soil compaction, loss of soil structure, and loss of organic matter due to mixing and storage could lower postmining vegetation production, vigor, and diversity for an extended period of time. Developing root systems, infiltration of biota, and physical processes such as freezing/thawing cycles would restart the soil-forming process and help establish a new natural soil profile over time. These processes start immediately after soil is reapplied and are observable in a single year. However, the processes would possibly require decades to return soil to pre-mine conditions.

Chemical effects occur in soil stockpiled for prolonged periods. Degradation of chemical properties may include changes in available nutrients, accumulation of ammonium, and the loss of organic carbon through heat and leaching. When the input of organic matter ceases, there is a reduction or loss of nutrient levels (Strohmayer 1999). Changes in biological properties also occur in soil that is stored for prolonged periods—most importantly the loss of soil microorganisms such as mycorrhizal fungi (Abdul-Kareem and McRae 1984). Many plants depend on mycorrhizae, which are important structures that develop when certain fungi and plant roots form a mutually beneficial relationship. They are of great importance to phosphorus nutrition and water uptake in plants (Skujins and Allen 1986). The association of mycorrhizae with plants in southeastern Montana is especially critical because of the semiarid climate and naturally low plant-available phosphorus levels in soil (Muir 1971). The loss of microorganisms in soil stored for prolonged periods could lower plant diversity and vigor, but eventually mycorrhizae would invade reclaimed soil (within a few years to more than a decade, depending on soil conditions). Mycorrhizae seem to be sensitive to soil properties such as organic matter, salts, structure, and water-holding capacity, so when respread soil conditions start improving, mycorrhizae would colonize more quickly. Impacts on physical, chemical, and biological soil characteristics would be long-term and adverse. It would be many years before these soil characteristics return to pre-mine conditions.

Secondary Impacts

A secondary impact on soil resources include the potential for sediment to be transported offsite and to impact offsite resources. In general, the larger the disturbance, the greater the potential for soil erosion. This secondary impact would be unlikely because runoff would be directed to sediment-storage structures, but it could occur during very heavy storm events where disturbances are unprotected.

3.18.3.3 Cumulative Impacts

Related past, present, and future actions under concurrent consideration that have adversely affected or could adversely affect soil in the vicinity of the analysis area include:

- Past, ongoing, and future permitted mining at the Rosebud Mine and other coal-mining operations
- Past, ongoing, and future gravel quarrying
- Past and ongoing actions by federal land management agencies
- Agricultural operations
- Past airport construction

Past and present actions of soil salvage, stockpiling, and replacement at the Rosebud Mine, including Areas D and E, which are currently being reclaimed, Areas A, C, and F, which are active, and about 4,601 acres within the existing Area B portion of the analysis area that have been disturbed by active mining, have increased erosion rates and reduced soil productivity in comparison to undisturbed portions of the mine. Soil erosion rates have a short-term adverse cumulative impact on soil and begin to return to natural conditions in a couple of years once vegetation stabilizes reclaimed areas, something that is already occurring in many of the reclaimed areas at the Rosebud Mine. Reduction of soil productivity is a long-term adverse cumulative impact, likely requiring decades to return to natural conditions. Related future coal-mining activities in existing Rosebud Mine permit areas would continue to have the same types of impacts.

Cumulative impacts on soil from an inactive coal mine in the vicinity of the analysis area, the Big Sky Mine, has also increased erosion rates and reduced soil productivity, resulting in similar impact types as those from activities at the Rosebud Mine. Soil-handling operations at several gravel quarries in the vicinity of the analysis area may also contribute to cumulative impacts on soil, but on a smaller scale.

BLM has authorized actions in the vicinity of the analysis area, such as rights-of-way for powerlines and pipelines, coal leases, mineral material sites, land withdrawals, oil and gas leases, and land sales/exchanges. Many of these activities have involved soil removal, and some have likely involved soil stockpiling and replacement. These operations have likely increased soil erosion and reduced soil productivity, and the cumulative impacts from these activities on soil are similar to those described above.

Cumulative impacts from past agricultural operations where the surface soil is disturbed by tillage have increased erosion rates, especially during times when there is no crop cover protecting the soil from erosion. Most of this farmland is located along the major drainages, such as Rosebud, Armells, and Sarpy Creeks, all in the vicinity of the analysis area. Cumulative impacts on soil from agricultural operations are a function of the agricultural practices and the number of years the practices have been used. If the amount of soil erosion has been severe and ongoing for many years, the cumulative impact on soil would be long-term and adverse. But with standard agricultural practices that protect the soil surface from erosion, the cumulative impact on soil would be minimized. The construction of the Rosebud County

Airport contributed to soil erosion, but preconstruction erosion rates likely returned once vegetation stabilized the soil surface. This adverse impact on soil was short-term.

3.18.3.4 Unavoidable Adverse Impacts

There would be unavoidable adverse impacts from the Proposed Action resulting from a maximum disturbance of 5,711 acres of soil due to Project activities. The impacts on soil stem from soil removal, storage, and replacement and include soil erosion and changes to the physical, chemical, and biological characteristics of the soil. Soil erosion can be mitigated using BTCA and other measures to control erosion outlined in the reclamation plan (see **Section 2.4.5, Reclamation Plan** and **Section 2.4.6, Protection of the Hydrologic Balance**). Erosion impacts on soil resources would be short-term and would return to pre-mine erosion rates within about 2 years once vegetation stabilizes the surface. Impacts on soil resulting from changes to physical, chemical, and biological properties would start to reverse upon soil redistribution. These changes are long-term and possibly require decades to return to predisturbance conditions.

3.18.3.5 Irreversible and Irretrievable Impacts

Some soil would be irreversibly lost under the Proposed Action during soil removal and storage, construction and operation of the mine, and reclamation before the reestablishment of vegetation. In addition, about 12.73 acres of wetland soil may be disturbed and potentially lost under the Proposed Action.

Under the Proposed Action, soil productivity would be irreversibly lost because the lift 1 soil materials would consist of a mix of topsoil and subsoil. Altering the soil profile would deteriorate soil structure and mix more-fertile topsoil with less-fertile subsoil, which would leave less productive soil in the root zone. Granular soil structure, which occurs mainly in the surface layer, increases water and air movement in the soil, and its loss would reduce water and air movement. It would take many years for soil productivity and soil structure to return to pre-mine conditions. This irreversible impact would be magnified in reclaimed areas where respread soil consists of a single-lift salvage of the upper 24 inches (the tree soil salvage class).

Irreversible impacts on soil productivity would also result from prolonged soil storage in stockpiles and at disturbances that would not be reclaimed until the end of mine life in the permit area; under the Proposed Action, the Area B “Richard” haul road, the Lee haul road, and some ramp roads would not be reclaimed for an additional 15 years as compared to the currently approved reclamation plan. These irreversible impacts on soil productivity would take many years to return to pre-mine productivity levels.

3.19 RESOURCES CONSIDERED BUT NOT STUDIED IN DETAIL

As noted in **Section 3.1, Introduction**, the resources chosen for detailed analysis in this EIS were identified through internal agency scoping and comments received during public scoping. One resource, alluvial valley floors (AVFs) in Richard Coulee, was considered but was dismissed from detailed analysis following DEQ's AVF determination (DEQ 2019). The following section includes key language from DEQ's AVF determination and identifies reasons for dismissal.

3.19.1 Alluvial Valley Floors Determination

3.19.1.1 Regulatory Framework

MSUMRA (82-4-201 through 82-4-254, MCA) and its implementing rules (ARM 17.24.301 through ARM 17.24.1309) set forth the process for identifying an AVF located in the arid and semiarid lands of Montana (see specifically 82-4-227(3)(b)(i), MCA, ARM 17.24.301, ARM 17.24.325, and ARM 17.24.805). Any mine proposal or mine-related disturbance within a valley holding a stream, or adjacent to and connected to a valley holding a stream, must have an AVF determination. MSUMRA requires protection of identified AVFs from impacts of coal mining that are adverse to agricultural activities or farming.

An AVF determination consists of three separate evaluations (see ARM 17.24.325). The first evaluation determines the presence and extent or absence of AVFs based on defined criteria. The second evaluation determines the significance of the AVF for adversely affected agricultural or farming operations. The third evaluation determines the essential hydrologic functions of each agriculturally significant AVF. If the first evaluation determines that no AVF is present, then further evaluation is not warranted.

Both geologic and hydrologic criteria must be met to designate an AVF. The key to the existence of an AVF is the presence of both geomorphic characteristics and water availability for agricultural activities or farming (this concept is explained in detail in DEQ 2016).

3.19.1.2 Definition of Alluvial Valley Floors

MSUMRA provides a definition of AVFs in 82-4-203(3)(a), MCA: "the unconsolidated stream-laid deposits holding streams where water availability is sufficient for subirrigation or flood irrigation agricultural activities."

The definition of AVF is further clarified in MSUMRA's implementing rules as "unconsolidated stream-laid deposits holding streams" and "all flood plains and terraces located in the lower portions of valleys which contain perennial or other streams with channels" (ARM 17.24.301(132).

Finally, stream valleys adjacent to proposed mining operations must be evaluated for the presence or absence of AVFs. "Adjacent" is also a defined term under MSUMRA and means in pertinent part, "the area outside the permit area where a resource or resources, determined in the context in which the term is used, are or could reasonably be expected to be adversely affected by proposed mining operations" (82-4-203(2), MCA).

3.19.1.3 Reason for Dismissal

DEQ has made the determination that East Fork Armells Creek and Lee Coulee are not AVFs within the proposed Project area. A portion of the Richard Coulee watershed is in the Project area. Lack of data in the lower portion of the analysis area (downstream of the proposed Area B AM5) complicated DEQ's analysis. Evidence indicating the presence of an AVF in the Project area was found. Based on the presence of an AVF in the Richard Coulee valley, DEQ found that a significance determination was required.

Pursuant to ARM 17.24.325(3)(a)(ii)(A–C), DEQ used existing scientific data and surface operator information to determine if any statutory exclusions were applicable to the significance determination for Richard Coulee. In an AVF determination issued in September 2019, DEQ found that exclusions A and B apply to the analyzed portion of Richard Coulee:

> Under exclusion (A), if the pre-mining land type is undeveloped rangeland that is not significant to farming, the AVF is considered insignificant. Due to the undeveloped nature of most acres identified as AVF in Richard Coulee, those AVF acres are considered insignificant. These acres are generally found upstream of the confluence of Richard and Rape Coulees.
>
> Under exclusion (B), if agricultural acreage is impacted but the acreage is negligible to the farm or ranch operation, the AVF is considered insignificant. Due to landowner statements and the negligible size of impacted agricultural acreage in the potential Richard Coulee AVF, the AVF is considered insignificant to agriculture.

DEQ determined that entire area identified as AVF meets the criteria for statutory exclusions (DEQ 2019). Consequently, Westmoreland Rosebud is not obligated to "submit the information required in ARM 17.24.325(3)(c)(ii)(B) and (C), and the department is not required to make the findings of ARM 17.24.325(3)(f)(ii)(A) and (B)," as stated in ARM 17.24.325(3)(a)(ii).

However, DEQ's sixth round deficiency letter does require Westmoreland Rosebud to install additional alluvial groundwater monitoring locations near the confluence of Richard Coulee and Rosebud Creek (**Section 2.4.8.4, Protection of AVF Monitoring**). The purpose of these monitoring locations is to verify, pre-mining and postmining, that the likely AVF on Rosebud Creek would not be impacted by mining. DEQ requires 1 year of monitoring data to be collected from these wells prior to a permit decision to ensure that baseline data are available for comparison to operational and post-operational data.

CHAPTER 4. REGULATORY RESTRICTIONS

4.1 REGULATORY RESTRICTIONS OF PRIVATE PROPERTY

The Montana Environmental Policy Act requires state agencies to evaluate regulatory restrictions proposed to be imposed on private property rights as a result of actions of state agencies, including an analysis of alternatives that reduce, minimize, or eliminate the regulation of private property (75-1-201(1)(b)(iii), Montana Code Annotated). Alternatives and mitigation measures required by federal or state laws and regulations to meet minimum environmental standards, as well as actions proposed by or consented to by the applicant, are not subject to a regulatory restrictions analysis.

No aspect of the alternatives under consideration would restrict the use of private lands or regulate their use beyond the permitting process prescribed by the Montana Strip and Underground Mine Reclamation Act. The conditions that would be imposed by the Montana Department of Environmental Quality in issuing the permit would be designed to make the Project meet minimum environmental standards or have been proposed and/or agreed to by Westmoreland Rosebud Mining, LLC. Thus, no further analysis is required.

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CHAPTER 5. COORDINATION AND CONSULTATION

5.1 CONSULTATION PROCESSES

During the scoping process as well as consultation and coordination throughout the preparation of this Environmental Impact Statement (EIS), formal and informal efforts were made by the Montana Department of Environmental Quality (DEQ) to involve appropriate federal and state agencies, local governments, tribes, and members of the public. This consultation and coordination with multiple stakeholders was important to ensure that the most appropriate data were gathered for analysis and to ensure that agency and public interests were considered by decision-makers. This chapter provides a summary of the formal consultation processes that occurred during the preparation of the EIS and provides the distribution list for the EIS.

5.1.1 Public Comment Process

Chapter 1 provides a summary of the public scoping process. A detailed accounting of DEQ scoping processes can be found in the Public Scoping Report (ERO 2018), which is available on DEQ's website: http://deq.mt.gov/Public/eis.

Chapter 1 also describes the issue identification process and identifies key issues and nonsignificant issues eliminated from detailed analysis (**Section 1.5.2, Scoping Issue Identification**).

5.1.2 Tribal Consultation

DEQ has initiated tribal consultation with the Blackfeet Nation Tribe, Chippewa Cree Tribe, Confederated Salish & Kootenai Tribes of the Flathead Reservation, Crow Nation, Northern Cheyenne Tribe, Fort Peck Assiniboine and Sioux Tribes, Nakoda and Aaniiih Nations, Little Shell Chippewa Tribe, Fort Belknap Indian Community, and Crow Tribes regarding the identification and impacts on traditional cultural properties (TCPs) and archeological sites of significance to the tribes.

TCPs are protected under Section 106 of the National Historic Preservation Act as historic properties, and when applicable, they have additional protections under the American Indian Religious Freedom Act of 1978 and the Native American Grave Protection and Repatriation Act of 1990. A TCP may be eligible for listing in the National Register of Historic Places because of its association with cultural practices or beliefs of a living community that are (a) rooted in the history of the community or tribe and (b) important in maintaining the continuing cultural identity of the community or tribe. Examples of TCPs include but are not limited to locations where Native Americans have performed ceremonies, traditional locations for resource gathering, and rural community land-use patterns such as farming and ranching.

No TCPs have been identified to date; however, continued tribal consultation may identify such properties. In addition to previous pedestrian survey, the mine is currently conducting an ethnographic study as part of ARM 17.24.304(1)(b) to identify any other potential historical properties or TCPs important to consulting tribal parties.

5.1.3 Federal, State, and Local Agencies

DEQ consulted the following agencies during the development of this EIS:

- Montana Fish, Wildlife, and Parks

- Montana Natural Heritage Program
- Montana State Historic Preservation Officer
- Montana Sage Grouse Habitat Conservation Program
- USDA Forest Service, Custer and Gallatin National Forests
- USDI Bureau of Land Management
- USFWS

5.2 EIS DISTRIBUTION

This EIS has been distributed through the following methods.

- Postcard mailed to the Project mailing list and email sent to the Project email list
- Legal notice published in the Forsyth *Independent Press* and the *Billings Gazette*
- Press release sent to the media outlets listed in **Table 2**
- Published on the DEQ webpage at http://deq.mt.gov/Public/publiccomment

The Project mailing list is available upon request from DEQ. For more information on how to submit comments on this EIS electronically, visit: http://deq.mt.gov/Public/publiccomment.

CHAPTER 6. LIST OF PREPARERS

This chapter provides a list of the interdisciplinary team members that prepared and contributed to the EIS. Interdisciplinary team members work for the Montana Department of Environmental Quality (DEQ) (see **Section 6.1**) and an independent, third-party consulting firm, ERO Resources Corporation, and its subcontractors (see **Section 6.2**).

6.1 MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

Name	*Responsibilities*	*Education*	*Experience (Years)*
Blend, Jeff	Socioeconomics	Ph.D., Agricultural Economics, Resource Economics M.S., Economics	17
Calabrese, Julian	Soil Science/Reclamation	B.S., Land Resource Environmental Science; Minor, Soils	18
Coleman, Ed	Bureau Chief	B.S., Forestry	20
Devaney, Rainie	MPDES Permitting Section Supervisor	B.A., Environmental Science; Minor, Biology	9
Dorrington, Matt	Coal Section Supervisor	M.B.A. B.S., Chemical Engineering	25
Dunkle, Travis	Mine Engineer	P.E. M.S., Environmental Engineering B.S., Chemical Engineering	6
Giri, Poonam	Hydrology	M.S., Geological Sciences B.S., Geosciences	2
Glenn, Michael	Vegetation	B.S., Land Rehabilitation	5
Hayes, Ed	Staff Attorney	J.D.	20
Henrikson, Craig	Air Quality Permitting	P.E. M.S., Civil Engineering, Environmental B.S., Chemical Engineering Certified Safety Professional	28
Hinz, Emily	Hydrology and Geology	Ph.D., Geophysics M.S., Geoscience B.S., Geoscience	6
Kron, Darrin	Water Quality	M.S., Environmental Toxicology B.A., Biology	20
Lane, Jen	Project Coordinator	B.A., Environmental and Social Justice	5
Lucas, Mark	Staff Attorney	J.D., M.S.E.L.	20
Mahrt, Peter	Mine Engineering / Land Use / Transportation	B.S., Mining Engineering	38
McNew, Faye	Wildlife and Wetlands	M.S., Zoology	21
Schmitt, Ben	Wildlife	M.S., Fisheries and Wildlife B.S., Environmental Sciences and Management	8
Smith, Robert	Permit Coordinator	B.S., Occupational Safety & Environmental Health	16
Staldine, Jon	MPDES Permit	M.S., Natural Resources BSLA, Landscape Architecture B.S., Environmental Horticulture & Landscape Design	7

Name	*Responsibilities*	*Education*	*Experience (Years)*
Strait, James	Archaeologist	M.A., Archaeology B.S., Anthropology	21
Van Oort, Martin	Hydrogeologist	M.S., Geological Sciences B.S., Geology	12
Yde, Chris	Coal Section Supervisor and Wildlife	M.S., Fish and Wildlife Management B.S., Fish and Wildlife Management	39

6.2 EIS CONSULTANT TEAM

Name/Firm	*Responsibilities*	*Education*	*Experience (Years)*
Bauman, Nicole ERO Resources Corp.	Project Manager	M.S., Environmental Policy & Management B.S., Communication	22
Beardsley, Ross Ramboll	Air Quality	Ph.D., Environmental Engineering Sciences	4
Brown, Matthew Confluence Water	Surface Water and Water Rights	M.S., Civil Engineering B.S., Civil Engineering	23
Buscher, Dave Buscher Soil and Environmental	Soil and Reclamation	M.S., Ecological Engineering B.S., Geological Engineering B.S., Wildlife Biology	33
Cerjan, Jeff Hankard Environmental	Acoustics	B.S., Aerospace Engineering	18
Corsi, Emily ERO Resources Corp.	Assistant Project Manager and Chapters 1, 2, and 4–6	M.S., Natural Resources Conservation Certificate, Natural Resources Conflict Resolution B.A., Politics	12
Croll, Kathy ERO Resources Corp.	Cultural and Historic Resources	Ph.D., Anthropology M.A., Anthropology	24
Fowler, Aliina ERO Resources Corp.	Scoping, Transportation, Land Use, Recreation, and Socioeconomics	Masters of Urban and Regional Planning B.A., Political Science B.S., Community Development & Applied Economics	6
Henke, Clint ERO Resources Corp.	Fish and Wildlife and Special Status Species	M.S., Environmental Sciences B.S., Biology	18
Hesker, David ERO Resources Corp.	Graphics	B.F.A., Graphic Design	22
Hodges, Wendy ERO Resources Corp.	Geographic Information Systems	M.S., Environmental Policy and Management B.S., Natural Science	11
Larmore, Sean ERO Resources Corp.	Cultural and Historic Resources	M.A., Archaeology B.A., Anthropology	20
Olmsted, Brian ERO Resources Corp.	Topography, Geology, Geochemistry, Ground Water, and Solid and Hazardous Waste	M.S., Geochemistry B.S., Geology	11
Thorn, Emily ERO Resources Corp.	Socioeconomics	ABD (Ph.D.), Sociology M.S., Environmental Science B.S., Biology	11

Name/Firm	*Responsibilities*	*Education*	*Experience (Years)*
Vijayaraghavan, Krish Ramboll	Technical Lead for Air Quality; Project Manager for Ramboll	M.S., Environmental Engineering M.S., Chemical Engineering B.Tech., Chemical Engineering	20
Wall, Kay ERO Resources Corp.	Technical Editor	B.A., Behavioral Science	33
Way, Aimee ERO Resources Corp.	Visual Resources	M.S., Environmental Science B.S., Genetics	13
Worah, Moneka ERO Resources Corp.	Vegetation and Wetlands	M.S., Environmental Science B.A., Environmental Science	14

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CHAPTER 7. REFERENCES

References are listed below in alphabetical order by chapter and by resource, in the case of references used in **Chapter 3**.

7.1.1 Summary

ERO (ERO Resources Corporation). 2018. *Public Scoping Report Western Energy Company Rosebud Mine Area B (AM5) EIS*. May 10, 2018.

7.1.2 Chapter 1

ERO (ERO Resources Corporation). 2018. *Public Scoping Report Western Energy Company Rosebud Mine Area B (AM5) EIS*. May 10, 2018.

OSMRE (Office of Surface Mining Reclamation and Enforcement). 2016. Letter to Robert Smith, Montana DEQ. Rosebud Area B Request for Determination on MR76 Permit No. C19184003B for Federal Coal Lease M-80697. August 22, 2016.

OSMRE and DEQ (Office of Surface Mining Reclamation and Enforcement and Montana Department of Environmental Quality). 2018. *Western Energy Area F Final Environmental Impact Statement*.

7.1.3 Chapter 2

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