3.1 HUMAN ENVIRONMENT AND RESOURCE USE

The human environment, resource uses, and physical resources will be discussed in this section commensurate with the anticipated level of impact that they may incur as a result of the Proposed Action and alternatives. Where no impacts or minor impacts are expected to occur, only a brief description is provided. When impacts are expected to be more significant, more detailed information is provided, sufficient to make the analysis in Chapter 4, Environmental Consequences and Mitigation, understandable.

3.1.1 Land Ownership and Use

The project area lies within northwestern Mesa County and southwestern Garfield County, Colorado. Federal lands within the project area are administered by the U.S. Bureau of Land Management (BLM) and the U.S. Bureau of Reclamation (BOR). State lands within the project area are administered by the Colorado Department of Natural Resources (DNR) as Highline Lake State Park. Land ownership and jurisdictional boundaries are shown in Figure 1-1, Proposed Action. Private lands are under the jurisdictions of Mesa and Garfield counties.

Land Jurisdictions

Land ownership within the project area is primarily BLM-managed federal lands and private ownership. BLM-managed lands extend north of the Highline Canal to the northern end of the project area, with a few interspersed private holdings. All BLM land within the project area is managed by the Grand Junction Field Office. The North Fruita Desert Planning Area was identified as part of the Grand Valley Intensive Recreation Management Area (IRMA) in the *Grand Junction Resource Area Resource Management Plan* (RMP) in l987 (BLM 1987). This area extends from the Highline Canal north to the Book Cliffs. This area is managed as a Special Recreation Management Area (SRMA) under a Recreation Activity Management Plan (RAMP) (BLM 2004). This area has specific management objectives and emphasis related to recreation.

Private ownership extends from the southern boundary of the project area north to the Highline Canal, with a few parcels interspersed with BLM-managed lands. With the exception of the cities of Mack and Loma, private land use in the project area is very low-density, single-family residential development; agriculture; and open space. There are several parcels of irrigated farmland near the project area south of the Highline Canal.

The BOR has surface jurisdiction over public lands withdrawn for authorized water-control purposes, including flood-control dams, water diversions, and the 2-mile stretch of Highline Canal to its intersection with the Grand Valley Irrigation Company Canal. Administration of BOR operations is shared with the Grand Valley Water Users Association. A 1983 Memorandum of Understanding (MOU) allows for BLM grazing management on BOR withdrawn lands.

Highline Lake State Park is part of the Colorado State Park system. Land ownership within the park is 56 percent state and 44 percent BOR. The park contains 633 land acres and 173 water acres and is managed for recreation. See Section 3.1.4, Recreation, for additional information.

McInnis Canyon National Conservation Area (NCA) is just south of the project area. It was designated by the U.S. Congress in 2000 to be managed under special provisions provided by the legislation that designated the area (BLM 2005).

The State of Colorado owns approximately 960 acres of land outside of the project area, adjacent to McInnis Canyon NCA.

Existing Land Uses

Agricultural activity is the primary land use in the project area. Agricultural lands within the project area consist of both croplands and grazing lands. Livestock grazing is a primary use on public lands; much of the public lands within the project area are divided into grazing allotments. See Section 3.1.2, Grazing, for additional information.

Existing land uses within the project area consist of unincorporated rural communities, mineral exploration and production facilities, oil and gas development and extraction, livestock grazing, transportation and utility corridors, water-control management by BOR, dispersed and developed recreation, agriculture, irrigated farmland, wildlife use, and low-density, single-family residential development on rural private land parcels.

The communities in Mesa County have historically developed in response to the Denver and Rio Grande Railroad and major irrigation. Towns within the project area include Mack and Loma, situated along U.S. Highway 6. The communities in Garfield County were historically established as mining and farming/ranching communities. The western portion of Garfield County within the project area has few inhabitants and no unincorporated or incorporated communities.

A variety of mineral and extractive uses are found within the project area. The McClane Canyon Mining, LLC's McClane Canyon Mine (MCM) is the only active coal mine in the project area. Oil and gas exploration and development are also being conducted in the vicinity of the project area. See Section 3.2.3, Geology and Minerals, for additional information.

Land Use Plans

The management of federal public lands in the project area is directed by the Grand Junction Resource Area RMP (BLM 1987) and the *North Fruita Desert Management Plan* (BLM 2004). The Grand Junction Resource Area RMP made the following designations to BLM-managed lands in the project area:

- BLM-managed parcels of federal land surrounded by private land crossed by transmission line Alternative B are designated as Gd (disposal tracts).
- Part of the proposed railroad alignment crosses through an area identified as sensitive to public utility development. Utility routes in this area should be designed to protect resources of concern from undue damage. Potential resources of concern could include habitat for black-footed ferret, spineless hedgehog cactus, and other sensitive plant species.
- BLM-managed land along the Highline Canal is designated Gw (withdrawals and restrictions).
- Other parts of the railroad and transmission line routes not previously mentioned are in an area designated as suitable for consideration for public utilities.

- All BLM-managed lands in the coal lease area are designated Ce (acceptable for further coal leasing consideration).

The management of State of Colorado lands in the Highline State Park within the project area is the responsibility of the Colorado DNR, Division of Colorado State Parks. Land management decisions are guided by the *Colorado State Parks Five-Year Strategic Plan (2005-2009)* (Colorado DNR 2005). All state lands within the project area are contained within Highline Lake State Park, which is managed for recreational purposes.

Land management decisions on private lands within Mesa and Garfield counties are guided by adopted county land-use plans, a development code, and zoning ordinances and regulations.

The Mesa Countywide Land Use Plan (Mesa County 1996) serves as a planning guide for Mesa County and addresses policies, goals, and implementation strategies on many issues important to county planners and the public. The plan includes a chapter on future strategies for rural areas.

Mesa County adopted the Loma/Mack Area Plan (Mesa County 2004) in August 2004. The five main components of the plan are services, community image character, land use, environmental resources, and recreation/open lands. Goals, policies, and implementation items are identified for each of the five components. Land use within the Loma/Mack planning boundary is taxed as agriculture, business, commercial, industrial, public/quasi-public, and residential (Mesa County 2004). Three future land-use classifications were identified for Mack and Loma: rural community, rural, and agricultural. The vision of the Mack/Loma area emphasizes the rural character of the area.

Garfield County adopted the Garfield County Comprehensive Plan Revision in 2002 (Garfield County 2002). This plan was developed to provide a general statement of direction for land use planning in unincorporated Garfield County. The plan addresses current concerns and shapes policies to reflect the special needs and characteristics of five different study areas. The project area is located within Study Area 5.

Four types of zoning currently overlay Study Area 5, all predominantly rural uses lending themselves to farming, ranching, and resource extraction. Lands within Garfield County that are located in the project area are zoned Open Space (OS) and Resource Lands (RL).

All lands within Mesa County that are within the project area (with the exception of Mack) are zoned Agricultural, Forestry, Transitional (AFT) District. This is primarily intended to accommodate agricultural operations and very low-density, single-family residential development.

Mack, Colorado, contains the following zoning classifications:

- Residential Single-Family District (RSF-1, RSF-4)
- Residential-Multi-Family District (RMF-5)
- Planned Unit Development District (PUD)
- General Industrial District (I-2)
- General Commercial District (C-2)
- Concentrated Business District (B-2)

Rights-of-Way

Railroad Spur

The applicant proposes to construct a railroad spur to connect the Red Cliff Mine to the railroad main line near Mack, Colorado, in order to transport coal to market. The proposed railroad spur would traverse approximately 9.5 miles of BLM land and approximately 5 miles of private land (see Figure 2-1, Rail Alignment Revisions and County Road 10 Realignment). The railroad spur would cross BOR- and BLM-administered lands, which are outside of the proposed coal lease area and therefore require approval of rights-of-way (ROWs) on these federal lands. This approval would be secured before construction of the railroad spur.

The applicant purchased land tracts and easements for the entire length of the railroad spur on private land. Previous land use of the purchased tracts was primarily agricultural. Residences located on land purchased by CAM-Colorado, LLC (CAM) would be relocated prior to construction of the railroad spur.

The proposed railroad spur enters Mack on the northwest side of town. The proposed route crosses County Road (CR) M.8 and passes through areas zoned General Industrial District (I-2).

Transmission Lines

A 69,000 volt (69 kilovolt [kV]) transmission line would be required to supply the required power to the Red Cliff Mine. To reach the Red Cliff Mine, a portion of the transmission line would cross BLM-administered lands. A ROW application for the transmission line has been submitted to BLM by Grand Valley Power (GVP).

The proposed alignment is shown in Figure 2-18, Transmission Line Alternatives. The proposed line will be designed for an underbuild distribution circuit (12kV) from the Uintah substation to a point just south of the Highline Canal. This circuit will distribute electrical power to local businesses and residents. Figure 2-11, Typical Transmission Pole Configuration, depicts a typical transmission pole and conductor facility for the underbuild section. There will be no underbuild circuit north of the Highline Canal on BLM lands.

The applicant would construct a primary substation at the end of the alignment. Pad or pole-mounted transformers would be used as necessary to provide electrical power to the mine facilities.

Water Pipelines

Adequate water resources are not available at the Red Cliff Mine site, so CAM must pipe water to its mining operation using existing water rights. The diversion will be on CAM-owned land, and CAM will file for an alternate point of diversion. While CAM has rights to 3 cubic feet per second (cfs), the estimated yearly diversion is approximately 1 cfs.

A water-diversion structure would be constructed in Mack Wash and connected to a meter and water pipeline. The water pipeline would be buried along the railroad spur alignment (Figure 2-1, Rail Alignment Revisions and County Road 10 Realignment) and would extend to a water tank above the mine portals. Land ownership and jurisdiction would be the same as described for the railroad spur.

Roads

Access to the Red Cliff Mine site will be via State Highway (SH) 139. At approximately mile marker 12, CR X (a.k.a. Mitchell Road or Power Line Road) intersects SH 139. A portion of CR X would be widened and graveled or paved to provide access to the mine site. Other roads would provide access to the unit train loadout, coal preparation plant, waste rock pile, and the mine portals. Beginning at about the location of the proposed coal preparation plant, the portal road would divert from the CR X alignment. The upgraded CR X would be approximately 2.4 miles long, and the portal road would be approximately 2.2 miles long. Public use of CR X would not be restricted except for temporary restrictions during road construction.

3.1.2 Grazing

BLM grazing allotments exist in the area for livestock use. The study area included in this discussion includes the mine facility site, railroad spur alignment, and transmission line alternatives.

The proposed project is located mostly within the BLM East Salt grazing allotment (allotment 16602), which is under an Allotment Management Plan. This allotment extends from the Highline Canal on the south to Douglas Pass on the north and is approximately 6.5 miles wide, roughly centered on SH 139 within the proposed project area. This allotment is permitted for cattle grazing from March 1 through February 28 (year-round), with 9,928 active Animal Unit Months (AUMs) of forage per year. An AUM is the amount of forage one cow consumes in a one-month period. For the desert portion of the allotment (between the Highline Canal and the base of the Book Cliffs), approximately 20 acres are required to provide one AUM of forage (Fowler 2007). The desert portion of the allotment is used mostly during the winter months.

Range improvements present on the allotment include fences along the allotment boundaries, internal pasture fences, and several stock ponds. The distribution and volume of water available for livestock use is a challenge for livestock management on the desert portion of the allotment. The allotment is used by two permittees, one using the west side of SH 139 and the other the east side.

A portion of the proposed transmission line would be located within the allotment just east of the East Salt allotment. This would presumably include some pole locations and access to the pole locations for construction and maintenance of the transmission line, although alignment has not been finalized.

Vegetation within the allotment is described in Section 3.2.10, Vegetation, and soils are described in Section 3.2.5, Soils. Due to the very limited annual precipitation and desert soils of this allotment, the vegetation is considered to be very sensitive to surface disturbances and susceptible to fire. Prevention of fire, limitation of disturbance, and appropriate reclamation of disturbed areas are concerns in these vegetation types. The related potential for the spread of non-native invasive species that could affect grazing is also a concern (Fowler 2007).

3.1.3 Wilderness and Special Designations

"Wilderness" is a legal designation designed to provide long-term protection and conservation of federal public lands. Wilderness is defined by the Wilderness Act of 1964 (Wilderness Act) (16 *United States Code* [U.S.C.] 1131-1136, 78 Stat. 890), which states that wilderness areas are established "to assure that an increasing population, accompanied by expanding settlement and growing mechanization, does not occupy and modify all areas within the United States and its possessions, leaving no lands designated for preservation and protection in their natural condition."

The project area does not contain wilderness, or wilderness study areas (WSA). The wilderness closest to the project area is The Black Ridge Canyons Wilderness. It is approximately 10 miles west of Grand Junction and 1 mile south of Fruita, and approximately 2 miles south of the project area.

A WSA is a roadless area that has been inventoried and found to have wilderness characteristics as described in the Federal Land Policy and Management Act (FLPMA) and the Wilderness Act. In addition, WSAs often have special qualities such as ecological, geological, educational, historical, scientific, and scenic values. The project area does not contain WSAs. The Little Book Cliffs WSA consists of 29,010 acres and is east of the project area. The Demaree WSA is approximately 5 miles northwest of the proposed mine portal west of SH 139 and includes 21,050 acres of public lands.

The 1971 Wild and Free-Roaming Horse and Burro Act (16 U.S.C. 1333) provides for the management, protection, and control of all unbranded and unclaimed horses and burros on public lands administered by the BLM. The project area does not contain Wild Horse Areas. The Little Book Cliffs Wild Horse Range encompasses 36,113 acres in the Book Cliffs just east of the project area. Though wild horse herds live in many parts of the western U.S., the Little Book Cliffs Wild Horse Range is one of only three areas in the nation set aside specifically for them. The Little Book Cliffs WSA makes up about two-thirds of the range.

A study to determine Wild and Scenic River study eligibility has not been done for the Grand Junction Field Office Area. It is scheduled to be done in conjunction with the Grand Junction RMP Revision scheduled for completion in 2011. The only stream likely to meet the criteria for study within the project area would be East Salt Creek. The closest river mandated for study by the Wild and Scenic Rivers Act is the segment of the Colorado River from its confluence with the Dolores River in Utah, upstream to a point 19.5 miles from the Utah/Colorado border in Colorado, approximately 3 miles south of the project area (16 U.S.C. 1271-1287).

There are no Areas of Critical Environmental Concern (ACECs) within the project area. The closest ACEC is Badger Wash. Badger Wash consists of an entire small watershed in the barren adobe badlands at the foot of the Book Cliffs, located approximately 5 miles west of the project area. The area has been used for hydrologic research for more than 50 years, and it contains high-quality examples of a cold desert shrubland vegetative community and rare plant species (Colorado DNR 2007, and Robertson 2008).

The project area is just north of the BLM-managed McInnis Canyons NCA. An NCA is the designation given by the U.S. Congress to special lands managed by the BLM. There are 10 NCAs in the nation, and each is managed in accordance with the special provisions provided by the legislation that designated the area. Specifically, Congress designates an NCA to

permanently protect and conserve identified resource values of national interest. McInnis Canyons NCA is managed for activities including boating on the Colorado River; big-game hunting for mule deer, elk, mountain lion and waterfowl; off-highway vehicle (OHV) use in Rabbit Valley; domestic livestock grazing; fossil viewing; sightseeing; wildlife photography; hiking; horseback riding; and mountain biking; as well as dispersed camping (BLM 2007).

The 72,656 acres of public land in the North Fruita Desert SRMA were identified as part of the Grand Valley IRMA in the Grand Junction Resource Area RMP in l987. The North Fruita Desert Management Plan was released in 2004. The goal of the management direction presented in this plan is to afford protection to the resources present in the North Fruita Desert SRMA while still allowing for a variety of recreational and commercial opportunities (BLM 2004).

3.1.4 Recreation

Recreational opportunities within the project area include OHV use, vehicle driving for pleasure, mountain biking, horseback riding, camping, hiking, hunting, shooting, and viewing scenery and natural features. The area is nationally renowned for mountain bike opportunities.

Much of the project area is within the BLM North Fruita Desert SRMA (BLM 2004) (Figure 3-1, Recreational Trails within the North Fruita Desert SRMA). The North Fruita Desert SRMA is commonly used by Mesa County residents due to its proximity to Fruita and Grand Junction and easy, low-elevation, year-round access. The local population uses this area heavily for casual OHV and target-shooting recreation. The North Fruita Desert mountain biking trails and the McInnis Canyons NCA trails are nationally recognized, quality recreation opportunities. They are destination travel locations, and the City of Fruita places great emphasis on and identifies with these sites.

Recreational Opportunities

Dispersed recreational uses occur throughout the public lands administered by the BLM, the State of Colorado, and the BOR. As previously mentioned, the project area north of SH 6 and SH 50 to the Book Cliffs is contained within the North Fruita Desert SRMA. The BOR has on-the-ground jurisdiction over public lands withdrawn for authorized water-control purposes, which include flood-control dams, water diversions, and the 2-mile stretch of the Highline Canal to its intersection with the Grand Valley Irrigation Company Canal.

Highline Lake State Park is adjacent to the North Fruita Desert SRMA. Highline Lake State Park offers camping, biking, fishing, swimming, jet skiing, water skiing, boating, birding, picnicking, hunting, hiking, wildlife viewing, volleyball, ice fishing, and ice skating. Highline State Park is open year-round, including camping areas. The park has 31 campsites (Colorado DNR 2007).

The project area is just north of the BLM-managed McInnis Canyons NCA. McInnis Canyons NCA recreational activities include boating on the Colorado River; big-game hunting for mule deer, elk, mountain lion, and waterfowl; OHV use in Rabbit Valley; domestic livestock grazing; fossil viewing; sightseeing; wildlife photography; hiking; horseback riding and mountain biking; and dispersed camping. The Loma Boat Launch is south of Interstate 70 (I-70) at the Loma exit (BLM 2007).

Kokopelli's Trail is a 142-mile mountain bike trail that begins in the McInnis Canyons NCA just south of the Loma, Colorado, exit (I-70 exit 15) (Colorado Plateau Mountain-Bike Trail Association et al. 2006). The Mack Ridge Trailhead is just south of the Mack exit (I-70 exit 11) (Colorado Plateau Mountain-Bike Trail Association et al. 2007).

The Little Book Cliffs Wild Horse Range is east of the project area. The range encompasses 36,113 acres in the Book Cliffs, about 8 air miles northeast of Grand Junction. The Little Book Cliffs WSA (29,010 acres) makes up about two-thirds of the range. Recreational opportunities include hiking and horse travel. There is no vehicular access to the Little Book Cliffs Wild Horse Range or the Little Book Cliffs WSA from the project area (BLM 2005).

The Dinosaur Diamond Prehistoric Highway (Dinosaur Diamond) is a 512-mile loop located in eastern Utah and western Colorado. The segment within Colorado was designated the Dinosaur Diamond Scenic and Historic Byway by the Colorado Transportation Commission on October 27, 1997 (Dinosaur Diamond Partnership n.d.). It includes SH 139 that runs through the project area.

Overall, the North Fruita Desert SRMA attracts about 50,000 recreational visits each year (BLM 2004). The goal of the management direction presented in this plan is to afford protection to the resources present in the North Fruita Desert SRMA while allowing for a variety of recreational and commercial opportunities (BLM 2004). Primary recreational use within the planning area includes OHV use, vehicle driving for pleasure, mountain biking, horseback riding, camping, hiking, hunting, shooting, and viewing scenery and natural features.

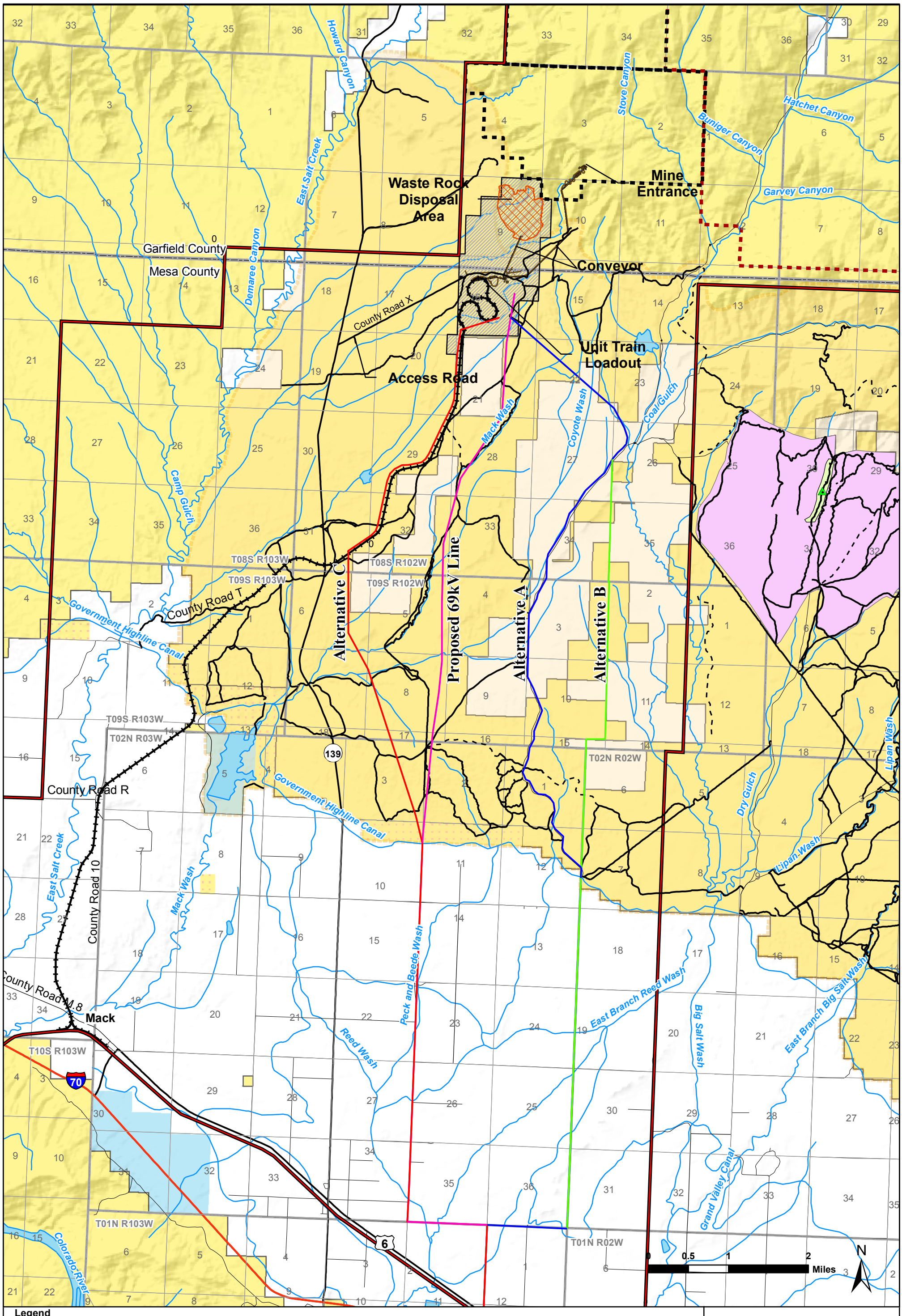
3.1.5 Socioeconomics

Introduction/Regional Setting

The proposed Red Cliff Mine and facilities would be located in Mesa and Garfield counties, about 11 miles north of the communities of Mack and Loma (Figure 1-3, Red Cliff Mine Project Location). The greatest socioeconomic impacts from the project would occur in Mesa County, because most of the employees would live in Mesa County and because all of the produced coal would pass through the county. One exception would be the property tax generated, which would flow in large measure to Garfield County; most of the coal to be mined is located there.

Mesa County is the most populous county in western Colorado, and Grand Junction, the county seat, is the largest city between Denver and Salt Lake City. The broad valley in the center of the county, called the Grand Valley, extending along the Colorado River for 25 miles, is the location of most of the county's population and economic activity. In addition to Grand Junction, principal communities are Fruita, Palisade, DeBeque, Collbran, and Whitewater.

First settled in 1882, Mesa County was "carved out of Gunnison County" in 1883. Grand Junction had been established the year before at the junction of the Gunnison and Colorado rivers (at that time, the Grand River). A narrow-gauge railroad reached the valley from Gunnison in 1882, and the standard-gauge Denver and Rio Grande reached the valley in 1887. With the construction of the Grand Valley and Highline Canals between 1886 and 1912, a substantial agricultural economy emerged. Initially, there was valley-wide production of orchard



Legend

- Alternative A
- Alternative B
- Alternative C
- Proposed 69Kv Transmission Line Route
- North Fruita Desert Planning Area

Trails

- New Construction
- Proposed New Construction
- Existing Open Trails

- Campground
- Camping Area
- Horse Area
- Bicycle Area

- Project Area
- Proposed Rail Spur
- Substation
- Existing Lease
- Coal Lease Application

- Proposed Land Use Application Area

Land Ownership

- BLM
- BOR
- STATE

Red Cliff Mine EIS

Figure 3-1
Recreational Trails within the North Fruita Dessert SRMA

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crops—apples, pears, and peaches—that, although less extensively, still thrive today. Because of its central location, its benign climate, and the presence of the railroad and then a major national highway, Grand Junction became a regional economic and population center. In addition to its agricultural base, mining activity in western Colorado and eastern Utah added to the activity as demand for energy minerals increased periodically. As mining activity peaked and subsided, it produced respective booms and busts, most notably the uranium boom and bust of the 1950s and the oil shale boom and bust of the 1980s (Ubbelohde et al. 1982, Sexton 1986).

Today, Mesa County is the home of a large and diverse economy based on the Grand Valley's role as a regional transportation, service, and supply center for western Colorado and eastern Utah. Recently, the growth of the area's recreation activity, the increasing attraction of the area to retirees, and the explosive growth of the oil and gas industry in northwestern Colorado have caused the county's economy and population to grow at a strong and sustained rate.

Affected Community

The primary affected community is described as an area adjacent to Mack, Colorado, roughly bounded by I-70 on the south, Mack Wash on the east, the Highline Canal on the north, and public land near CR 6 on the west (see Figure 3-2, Socioeconomic Affected Community).

The Highline Canal, completed around 1912, also serves as the approximate boundary between BLM land to the north and the affected community environs to the south. The community in this area was named New Liberty in the first part of the 20th century and is still referred to as such by some.

The affected community area consists of private land located in the Grand Valley, approximately 15 miles west of Grand Junction and about 1.5 miles west of SH 139, which runs north from Loma, Colorado, over Douglas Pass. This community area lies approximately 9.5 miles southwest of the Red Cliff Mine site, with the proposed railroad spur bisecting the community area over approximately a 5-mile route.

The community area can best be described as "rural agricultural," and as "in transition to low-density, rural residential".

- The land-use patterns of irrigated fields/pastures and a commercial nursery demonstrate that, over the past ten decades, it has been rooted in agricultural production and an associated rural lifestyle. The availability of irrigation water via the Highline Canal is a strong feature of the historical land use pattern.
- As viewed from the county roads in the area (such as CR 8 and CR 10 on a north/south axis and CRs R, S, and T on an east/west axis), there are large agricultural fields and older homesteads in the area. Vistas at a distance of a mile or more from the county roads are dominated by agricultural lands (irrigated pastures and hay fields), with mesa, cliffs, and mountains in the distant background (approximately 10 to 15 miles away).
- Properties that front the county roads themselves are being subdivided into smaller residential lots, populated with a wide array of housing types from stick-built to manufactured homes.

- Between old Highway 6&50 and I-70 near the junction of CR M.8, a new large-lot subdivision has been platted where about a dozen estate-sized homes have been recently built.
- In the community of Mack on the north side of the old highway, a fairly new small-lot subdivision contains over 100 manufactured homes.

The three primary results of the analysis of the affected community are the following descriptive characterizations:

1. The area has for some time been predominantly agricultural in character, with its inhabitants possessing, valuing, and fostering a traditional, rural lifestyle;
2. The area is already experiencing a degree of residential growth, brought about by migrants seeking a rural-community atmosphere and values, some of whom commute to employment sites in the more urban sectors of Mesa County around Grand Junction, 25 to 30 minutes to the east; and
3. The current trend toward residential growth in and around this historically agricultural community appears to be driven, at least in part, by public land-based recreational opportunities and associated scenic and quality-of-life values, of which there is a broad array in western Colorado.

Map Extent:

Waste Rock Disposal Area

Garfield County

Mesa County

County Road X

Access Road

County Road T

County Road 10

139

County Road M.8

Mack

70

Legend

Primary Social Impact Area

Proposed Rail Spur

69kV Transmission Line Route

Proposed Land Use Application Area

Coal Lease Application

Existing Coal Lease

Project Area

Land Ownership

BLM

BOR

STATE

PRIVATE

0.5 0.25 0 0.5 1 Miles

Red Cliff Mine EIS

Figure 3-2
Socioeconomic Affected Community

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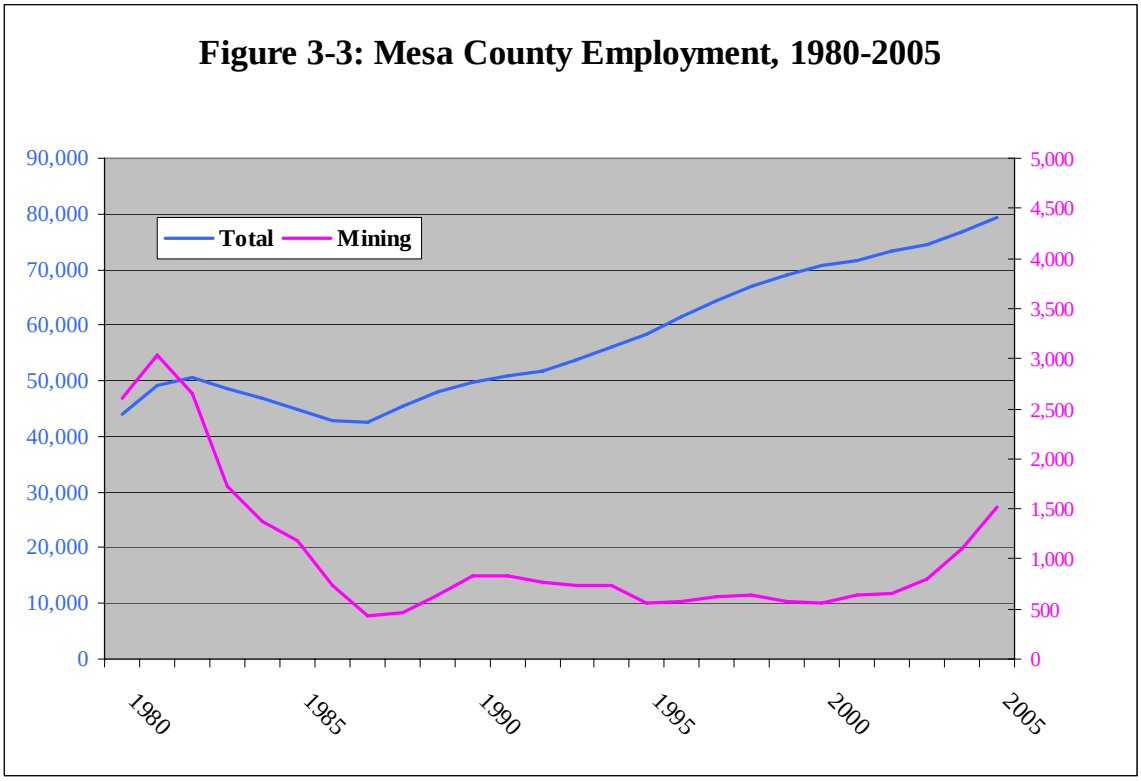
Employment and Income

As a regional economic center, employment in Mesa County has historically been greater than in other parts of western Colorado. Figure 3-3, Mesa County Employment, 1980-2005, displays Mesa County total and mining sector employment reported by place of work from 1980 to 2005 (USBEA 2007a). Total employment increased 80 percent during the period, from 43,853 to 79,284. Mining employment, shown on the scale on the right, is only a small fraction of total employment and declined over the 25-year period, from 2,600 to 1,518. The rise and then sharp decline in both total and mining sector employment in the 1980s was a reflection of the oil shale boom and bust. The recent increase in mining employment is related to the growth of the oil and gas industry in western Colorado.

Figure 3-3: Mesa County Employment, 1980-2005



Source: USBEA 2007a.

Mesa County's economy is dominated by the services, retail trade, and government sectors. These three sectors account for about 63 percent of total employment. This is characteristic of diverse economies and is similar to the makeup of the overall Colorado economy. Even with the recent increase in oil and gas activity, the 1,518 employees of the mining sector (which includes oil and gas development activities) represent less than 2 percent of total employment. The influence of oil and gas development projects is probably greater than indicated by the statistics, as workers supporting oil and gas development activities are employed in the construction, transportation, and other sectors. Employment related to coal mining in Mesa County is fewer than 100 workers. An estimated 47 miners are employed by the MCM , near the site of the proposed Red Cliff Mine.

Unemployment rates in Mesa County have tended to be higher than the rate for Colorado, especially during the oil shale bust. From 1982 to 1987, the Mesa County unemployment rate was never below 11 percent. In recent years, the county's rate has been slightly lower than the state's, averaging 4.8 percent from 2001 to 2006, compared to the state average of 5.1 percent. In 2006, the last year for which annual data are available, 2,945 jobseekers in Mesa County were unemployed, an unemployment rate of 3.9 percent.

Total personal income in Mesa County approached $4 billion in 2005, as shown in Table 3-1, Total and Per Capita Income in Mesa County. Per capita income has recently been increasing at about 3 percent annually and stood at $28,854 in 2005. This average was almost 25 percent below the per capita income for all of Colorado, a disparity that has been in place for about two decades.

Table 3-1
TOTAL AND PER CAPITA INCOME IN MESA COUNTY

	1980	1990	2000	2005
Total (million $)	807,155	1,436,713	2,928,138	3,743,737
Per Capita ($)	9,749	15,324	24,920	28,854
Per Capita as % of State	90.7	78.3	74.7	76.9

Source: USBEA 2007b.
Notes:
$ = dollars
% = percent

Demographic Characteristics

Table 3-2, Population of Mesa County and Incorporated Communities, 1980-2005, displays the population totals for Mesa County, the incorporated communities in the county, and the unincorporated parts of the county. The table also shows the percent change that occurred between 1980 and 2005, the latest year for which population estimates are available, and between the years 2000 and 2005. The county grew at a slightly slower pace than Colorado as a whole over the 25 years from 1980 to 2005, 60.3 percent compared to the state's 63.4 percent. The period of economic decline after the oil shale bust in 1982 probably accounts for most of the difference. Since 2000 however, Mesa County has grown at a more rapid pace than the state, 12.4 percent compared to the state's 9.8 percent. Within the county, Fruita has shown the most rapid rate of growth, at about four times the rate for the county as a whole. Grand Junction, Palisade, and DeBeque have also outpaced the county rate. The portion of the county's population living outside incorporated communities is declining over time as the city and town boundaries grow.

Table 3-2
POPULATION OF MESA COUNTY AND INCORPORATED COMMUNITIES, 1980-2005

Year	Mesa County	Collbran	DeBeque	Fruita	Grand Junction	Palisade	Unincorporated
1980	81,530	344	279	2,810	27,956	1,551	48,590
1990	93,145	258	257	4,042	32,893	1,871	53,824
1995	105,406	300	300	4,669	41,728	2,218	56,191

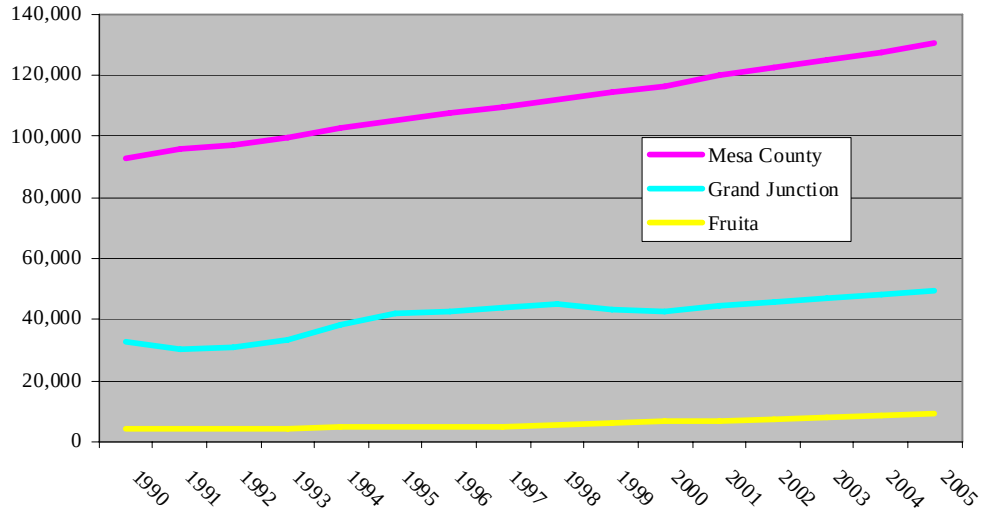
Table 3-2
POPULATION OF MESA COUNTY AND INCORPORATED COMMUNITIES, 1980-2005

Year	Mesa County	Collbran	DeBeque	Fruita	Grand Junction	Palisade	Unincorporated
2000	116,255	662	451	6,478	42,879	2,579	63,206
2005	130,662	642	504	9,393	49,422	2,842	67,859
Percent Change							
1980-05	60.3%	86.6%	80.6%	234.3%	76.8%	83.2%	39.7%
2000-05	12.4%	-3.0%	11.8%	45.0%	15.3%	10.2%	7.4%

Source: CEDIS 2007.

Figure 3-4, Population of Mesa County and Incorporated Communities, 1990-2005, displays the population data graphically for the period 1990 through 2005. The graph demonstrates the sustained nature of the population increases. Note that the scale of the graph veils the remarkable growth in the City of Fruita between 1995 and 2005, a period during which the city's population almost doubled, growing from 5,006 to 9,393.

Figure 3-4: Population of Mesa County and Incorporated Communities, 1990-2005



Source: CEDIS 2007.

The area along the proposed railroad spur south of the Highline Canal is populated (see Figure 1-1, Proposed Action). Data for the 2000 Census indicate that over 400 area residents were located in census blocks that are at least partially within 1 mile of the proposed spur. The number grows to over 500 if the railroad spur corridor is expanded to 2 miles. Many of those residents already live within 1 mile of the existing railroad line along Highway 6&50. A recent

count of houses in the area indicates that the population living within 1 mile of the proposed railroad spur but more than 1 mile from the existing Union Pacific Railroad, is about 110 people.

Property Values

The railroad spur would pass through about 5 miles of private property after crossing the Highline Canal and proceeding south along East Salt Creek to the Union Pacific Railroad. Once the site of numerous large ranch holdings, subdivision has, over time, led to an increase in the number of smaller properties. While still agricultural in character, the East Salt Creek drainage below the Highline Canal is transitioning to a rural-residential character. Residents of the area include those who commute to work elsewhere (principally in Grand Junction and other communities in the Grand Valley), those who still rely on farm and ranch sales as their primary source of income, those who mix agricultural pursuits and outside work, and, increasingly, retirees who may also participate in farming and ranching. The residents of the area value its agricultural character, the quiet and openness of a rural area, and the low population density that allows them to know most of their neighbors (Moore 2007).

This area has participated in the rapid escalation of real estate values that has been ongoing throughout the Grand Valley over the past seven years. In particular, as population densities have increased in the central part of the Grand Valley, more remote areas, like that west of Mack, have become sought-after by retirees and by those who wish to avoid the pressure of residential and commercial development and yet live within an easy commute to the central valley.

Local Government Facilities and Services

The major government facilities and services in Mesa County absorbed a population increase of 14,407 from 2001 through 2005, an average of about 2,900 new residents annually. The community infrastructure, including domestic water, sewage treatment, police and emergency services, social services, and the school districts, is large and well-developed and has been dealing with a high level of growth for some time. Each of the systems or services has excess capacity, has plans to increase its capacity, or is in some fashion addressing the strains of population growth.

Public Finance

All of the mine production equipment, facilities for cleaning and handling coal, and the railroad spur from the mine to the railroad are properties subject to property taxation just as other commercial, industrial, and residential properties are. In addition, the mineral estate is subject to taxation based on the amortized value of the coal in the ground. The railroad spur and part of the facilities at the mine portal are within Mesa County, and property taxes generated on those facilities would flow to jurisdictions within Mesa County. A portion of the coal reserves are located within Mesa County as well and would also be taxed when those reserves are mined. Most of the production equipment and some of the portal facilities are within Garfield County and would be taxed by Garfield County. The largest portion of the coal reserves and the part that would be mined first are also in Garfield County and would, over time, generate substantial property tax revenue for that county.

Because of the remote location of the proposed mine, there are a limited number of taxing authorities imposing a property tax mill levy. The county governments themselves and the

school districts whose boundaries the mine is within are the principal beneficiaries. Table 3-3, Selected Public Revenue Categories, Mesa and Garfield Counties, 1999-2003, displays revenue data for the Mesa and Garfield County governments and individual school districts in each county from 1999 to 2003, the last five years for which data are available.

Table 3-3
SELECTED PUBLIC REVENUE CATEGORIES,
MESA AND GARFIELD COUNTIES, 1999-2003

Category	1999	2000	2001	2002	2003
($ 000's)					
Mesa County					
Total Revenue	75,075	80,283	87,658	90,263	97,238
Property Tax Revenue	16,230	17,268	18,062	19,591	20,408
Resource-Related Revenue	9,839	11,056	13,498	12,083	12,718
School District 51					
Total Revenue	117,296	123,864	128,147	138,833	148,708
Property Tax Revenue	NA	32,487	30,287	33,771	34,570
Garfield County					
Total Revenue	27,043	29,354	33,014	37,392	43,152
Property Tax Revenue	6,672	7,809	8,275	11,079	12,085
Resource-Related Revenue	6,786	4,601	4,794	4,944	6,787
School District 16					
Total Revenue	4,733	3,533	7,143	8,395	8,789
Property Tax Revenue	NA	1,297	1,373	2,596	2,773

Source: DLG 2007.
Notes:
$ = dollars
NA = not applicable

Colorado, like most states, imposes a tax on the severance of certain nonrenewable resources from the earth, specifically metals, molybdenum, coal, oil and gas, and oil shale. In the case of coal, annual production of coal above 1,200,000 tons is taxed at a rate of 0.54 per ton. For underground coal, the resultant tax is reduced by 50 percent. Severance tax monies are distributed equally between the State Trust Fund and the Local Impact Assistance Fund. Counties receive 15 percent of the amount distributed to the Local Impact Assistance Fund directly on the basis of the number of "resident production employees." The remaining 85 percent of the amount distributed is available to impacted communities as grants and loans.

The U.S. is the owner of the coal that would be mined at the proposed Red Cliff Mine, and it charges a royalty of 8 percent on underground coal (12.5 percent on surface-mined coal). The mineral royalty revenue generated is disbursed equally between the U.S. treasury and the State of Colorado, including state school funds and local jurisdictions. Colorado has a complex formula for distributing those monies to the State School Fund and to local jurisdictions.

The "Resource-related Revenue" line in Table 3-3, Selected Public Revenue Categories, Mesa and Garfield Counties, 1999-2003, is a catchall line item but includes much of the severance tax and federal mineral royalty monies that end up in the hands of local jurisdictions as direct payments or as grants from the state.

Environmental Justice

Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice in Minority and Low-Income Populations* (*Federal Register* 1994), requires federal agencies to achieve environmental justice by identifying and addressing disproportionately high and adverse human health and environmental effects, including the interrelated socioeconomic effects of their programs, policies, and activities on minority populations and low-income populations in the U.S. Such impacts are to be avoided or minimized to the extent feasible.

Minorities are defined as individuals who are members of one or the following population groups: Hispanic; African-American; Asian, or Pacific Islander. "Minority populations" are those either (a) where the identified population in the affected area exceeds 50 percent or (b) the minority population in the affected area is meaningfully greater than the minority population in the general population. "Low-income populations" are those that exceed the poverty threshold (Council on Environmental Quality 1997).

Table 3-4, Mesa County, Race/Ethnicity and Poverty Level, describes the ethnicity and racial components and poverty levels in the area likely to be affected by the proposed Red Cliff Mine project. Data are described for Mesa County, the city of Grand Junction, and Colorado. Mesa County and Grand Junction have minority populations that are less than the corresponding populations in the state. The percent of the Mesa County population with personal income below the poverty level is slightly higher than the state average. These data suggest that there are no environmental justice populations in the impact area likely to be adversely affected by the project.

Table 3-4
MESA COUNTY, RACE/ETHNICITY AND POVERTY LEVEL

Area	Race/Ethnicity, Percent of Population, 2005					Percent Below Poverty Level, 2004
	White	Hispanic	African-American	American Indian	Asian-Pacific	
Mesa County	86.1[1]	11.0	0.7	0.9	0.7	10.8
Grand Junction[3]	91.8	10.9	0.6	0.9	0.9	11.9[2]
Colorado	72.1	19.5	4.1	1.1	2.7	10.2

Source: U.S. Census Bureau: State and County Quick Facts 2007.
Notes:
[1] White persons not Hispanic
[2] 1999.
[3] 2000.

No people live within about 6 miles of the proposed mine and loadout facilities, so no one would be directly affected by them. There are a number of dispersed residences along the proposed railroad spur south of the Highline Canal. An examination of the population data for the area

within 2 miles of the proposed spur indicates that the minority population there is much smaller than the county average.

3.1.6 Transportation

Roadway Characterization

SH 139 is the primary access road for ingress and egress into the proposed project. This two-lane is maintained by the Colorado Department of Transportation and classified as RA – Regional Highway near the entrance into the Red Cliff Mine property. The purpose of this highway is to provide for interregional, intra-regional, and intercity travel needs. These roads typically have the capacity for medium to high speeds, and relatively high traffic volumes over medium to long distances. This highway is 72 miles long and starts at I-70 and ends at SH 64, near Rangely, Colorado. Near the Garfield/Mesa County line, the current average daily traffic (ADT) volume is 1,000 vehicles per day (vpd) of which 23 percent are trucks (CDOT 2007). Due to the low traffic volumes, the road is not capacity constrained, as determined by analytical methods prescribed in the Highway Capacity Manual 2000 (Transportation Research Board 2000).

CR M.8 and CR 10 are two-lane, rural, minor arterials with low traffic volumes that may require an at-grade railroad crossing as a result of the proposed project. Each road serves local or "destination" traffic only, because there is limited regional connectivity to other major highways. Traffic counters were placed on these county roads to determine the daily traffic volumes. In May 2006, the traffic count session determined that ADT volumes for CR M.8 and CR 10 were 640 and 380, respectively.

Emergency Response

Increased emergency response time can be a concern for residents living in suburban areas. The Family Health West medical facility located in Fruita, Colorado, serves this area. This is a full-service hospital with an emergency room open 24 hours per day, 7 days per week. Medical response times to areas near Mack, Colorado, are estimated to be 10 minutes. Emergency response times to areas north of Mack near the intersection of CR 10 and CR R require an additional 6 minutes.

McClane Canyon Mine Traffic

The MCM currently employs 30 workers per day during each of its three work shifts. Coal mined from this site is loaded into semi-trailer trucks that travel south on SH 139 to facilities for power generation. The traffic generated from the MCM site is estimated to be 100 vpd, of which 46 percent are semi-trailer trucks. The current access from the mine to SH 139 is stopped controlled, and is not considered an accident prone intersection.

3.1.7 Utilities

Information on existing and planned utilities is obtained to support preliminary design of the proposed project, identify potential conflicts, and set the stage for necessary coordination with utility companies during later stages of the project. Known major utilities in the project area

include overhead and underground electric transmission lines, buried fiber optic lines, buried water and gas lines, and irrigation ditches.

Minor distribution systems (natural gas, electrical, water, and telecommunication lines) may be present within the project area, likely in and near Mack and other residential areas. Existing roads such as SH 139 and CR 10 are likely to have utilities running alongside them such as fiber optic cable.

Replacement or relocation of existing utility infrastructure within the project ROWs may occur. Additionally, new utility infrastructure such as a new transmission line may be developed along new alignments. Before any construction commences, the following utility companies will be contacted and utility infrastructure design and installations will be assessed.

- Electric providers:
  - Grand Valley Power
  - Xcel Energy
- Water providers:
  - Ute Water
  - Private well owners
- Natural gas provider:
  - Xcel Energy
- Telecommunications providers:
  - AT&T
  - Frontier Net
  - Qwest Communications

(Western Colorado Economic Alliance n.d.)

3.1.8 Visual

The description of current visual conditions includes the evaluation of the existing scenic quality, visual sensitivity, and BLM Visual Resource Management (VRM) classes. The inventory of visual resources was based on guidelines contained in BLM Manual 8410-1, Visual Resource Inventory (BLM 1986). Data were collected from several sources, including the Grand Junction Field Office RMP (BLM 1987), the North Fruita Desert Management Plan (BLM 2004), topographic maps, aerial photographs, and field photographs.

Scenic Quality

The scenic characteristics of the project area are created by the influences of landform, vegetation, and water on the line, form, color, and texture of the landscape. The proposed project is located primarily in the Canyon Lands section of the Colorado Plateau physiographic province, which is characterized by canyoned plateaus with areas of strong relief (Fenneman 1931). The project area, which extends from just north of the Colorado River north to the Book Cliffs, can be broken down into three general areas of common visual character with similar

visual patterns and landscape modifications. These areas can be described as: (1) irrigated valley, (2) undeveloped range land, and (3) the Book Cliffs.

The southern portion of the project area is located in the more developed area of the Grand Valley, south of the Highline Canal. This area is mostly irrigated farmland with scattered rural residential development. The terrain is generally flat, except for the side slopes of Mack Mesa, located north of the town of Mack. Vegetation cover and color of the landscape are influenced to a large extent by irrigated agriculture. The scattered rural residences, the I-70 corridor, and the small town of Mack give this area a common landscape character.

North of the Highline Canal, BLM is the primary land owner. This area is open range land with few developments. Terrain is varied, consisting of alluvial fans, terraces, steep-sided arroyos, and areas of generally flat to rolling rangeland. The area is dry with scattered desert brush and few water features. The vegetative cover adds some visual variety in the scenery, although the overall visual impression is a landscape that is common in the region and has no substantial or unique visual interest.

The Book Cliffs are the dominant landform in the area and are viewed as a background feature from most roadways and towns within the project area. The cliffs rise over 1,000 feet from their base to the top of the escarpment. Colors in the landform are dramatic, including a buff color to yellow/brown to shades of red. The cliffs are mostly sandstone bedded with gray colored shale and darker coal seams.

Visual Sensitivity

Visual sensitivity is a measure of the public concern for scenic quality. There are several factors to consider in assessing visual sensitivity, including the type of users, amount of use, public interest, and special areas. The distance from the viewer to the project is also a factor in determining the potential visual sensitivity of a project.

Specific areas of public/agency concern for the visual environment were identified by the BLM. Within the project area and surrounding vicinity, the following areas were identified as being visually sensitive to change:

- Communities and residential areas. The southern portion of the project area includes the town of Mack and scattered residences that would be sensitive to visual change in the landscape.
- Recreation areas. Highline Lake State Park is located along the Highline Canal, about 1.3 miles west of SH 139, and 3.4 miles north of Mack. This park is heavily used during the boating season. The North Fruita Desert Management Plan (BLM 2004) identifies and describes recreation use areas in the general vicinity of the proposed project, mostly related to mountain biking/hiking trails. There is also a BLM-managed primitive camping area south of the project area at the end of CR 18, adjacent to the Book Cliffs. This camping area is used almost exclusively for mountain bike and OHV recreation. Visitors to both Highline Lake State Park and the North Fruita Desert recreation areas would be sensitive to changes in visual quality.
- Travel routes. SH 139 is a designated National Scenic Byway. Negative visual influences as viewed from the byway would reduce its scenic driving quality.

- The undeveloped desert between the Highline Canal and the foot of the Book Cliffs has some man-made visual impacts. The North Fruita Desert Management Area has over 200 active and inactive gas wells. These wells are serviced by roads and gas collection lines that have associated surface disturbance. Existing transmission line corridors cross the same visual plane. Recreationists and BLM have created a system of roads and trails, and livestock grazing permittees have constructed fences and water collection ponds. All of these objects are visible, in addition to county roads and an increasing number of rural residences on private property within the project area.

BLM Visual Resource Management Guidelines

In response to the FLPMA and National Environmental Policy Act (NEPA), the BLM developed and instituted the VRM system in the mid-1970s to document and manage visual resources on public lands. The VRM system identifies management classes that permit various levels of landscape alteration. VRM classes are determined based upon the scenic quality of the landscape, viewer sensitivity to the landscape, and the distance that the landscape would be viewed.

Overall, there are four BLM VRM Classes – Class I through IV. The objectives of these classes vary from very limited activity (Class I) to activity that allows major landscape modifications (Class IV). Much of the project area lies within the North Fruita Desert Management Plan (BLM 2004) planning area. This planning area includes a variety of visual resources ranging from the barren desert landscape north of the Highline Canal, to the piñon-juniper forest at the toe of the slope to the sandstone cliffs overlooking the area. The North Fruita Desert Management planning area south of the Book Cliffs is in an undesignated VRM category. That portion of the planning area in the Book Cliffs is designated as VRM Class III. The objective of this class is to partially retain the existing character of the landscape.

The project area outside of the North Fruita Desert SRMA is in an undesignated VRM category. Private lands (generally located south of the Highline Canal) are not classified by the BLM.

3.1.9 Noise

In order to define the boundary of the affected environment for "noise" as a resource, the potential receptors must be identified. The very action of identifying receptors necessitates an initial assessment of noise that will be created by proposed project features. Therefore, there is some overlapping discussion of noise impacts in the affected environment section. A railroad noise analysis was completed for the two proposed at-grade railroad crossings on CR M.8 and CR 10 in Mesa County, Colorado. These locations could experience noise from locomotive horns and audible railroad warning signals in the future. The noise analysis was based on procedures documented in the Federal Transit Authority (FTA) *Transit Noise and Vibration Impacts Assessment* (FTA 2006). A noise assessment was completed for the existing condition to determine baseline levels needed in the noise impact analysis (see Section 4.1.9, Noise).

The FTA has established noise impact criteria used by the Federal Railroad Administration (FRA) and applicable to heavy rail projects. This criterion was founded on research regarding community reaction to noise and rates noise exposure using a sliding scale. This limits the amount of change in overall noise that transit/rail projects may make if existing noise levels increase.

The basis of a rail noise impact is the comparison of existing outdoor noise levels with predicted future outdoor noise levels. The evaluation of noise impacts considers both absolute criteria (activity interference caused by the rail project), and relative criteria (annoyance due to the change in the noise environment caused by a rail project).

Sound levels are measured in logarithmic units called decibels (dB). A measurement of sound energy in a single decibel value describes the total sound environment, including frequencies or pitches. The human ear, however, does not hear or sense all frequencies in the same manner. The "A" weighted decibel scale (dBA) was developed to closely approximate the way the human ear perceives the magnitudes of sounds at various frequencies. All noise measurements and predicted noise levels are expressed in dBA.

The FTA established noise impact criteria for three sensitive land use groups, as described in Table 3-5, Land Use Categories and Metrics for Transit Noise Impact Criteria.

Table 3-5
LAND USE CATEGORIES AND METRICS FOR TRANSIT NOISE IMPACT CRITERIA

Land Use Category	Noise Metric (dBA)	Description of Land Use Category
1	Outdoor L_{eq} (h)*	Tracts of land where quiet is an essential element in the intended purpose. This category includes land set aside for serenity and quiet and land uses such as outdoor amphitheaters, concert pavilions, and National Historic Landmarks with significant outdoor use. Also included are recording studios and concert halls.
2	Outdoor L_{dn}	Residences and buildings where people normally sleep. This category includes homes, hospitals, and hotels where nighttime serenity is assumed to be of utmost importance.
3	Outdoor L_{eq} (h)*	Institutional; land uses with primarily daytime and evening use. This category includes schools, libraries, theaters, and churches where it is important to avoid interference with activities such as speech, meditation, and concentration on reading material. Places for meditation or study associated with cemeteries, monuments, museums, campgrounds, and recreational facilities can also be considered to be in this category. Certain historical sites and parks are also included.

Source: FTA 2006.
* L_{eq} for the noisiest hour of transit-related activity during hours of noise sensitivity

Noise levels for Category 1 and 3 land uses are expressed as $L_{eq}(h)$, which represents the equivalent sound level for a one-hour period. Noise levels for a Category 2 land use are expressed in L_{dn}, which corresponds to a day-night level in dBA. The noise level is derived by averaging time varying sound energy over the daytime, with the time varying sound energy over the nighttime. An additional 10-decibel weighting is applied to the nighttime hours from 10:00 p.m. to 7:00 a.m. Nighttime weighting of noise levels is done to reflect the increased sensitivity to nighttime noise. The noise category land use at each proposed railroad crossing is Category 2.

The railroad noise impact evaluation will determine if the Proposed Action will have No Impact, a Moderate Impact, or a Severe Impact. Moderate Impact can vary according to the existing noise level or the predicted project noise level and is determined by threshold at which the percentage of people highly annoyed by the project noise becomes measurable. The criteria for a Severe Impact varies according to the existing noise level or the project noise level but is

determined by a higher, more significant percentage of people highly annoyed by the project noise. For noise land use Category 2, the U.S. Department of Housing and Urban Development (HUD) has developed noise standards, criteria, and guidelines to ensure a suitable living environment. The HUD acceptability standards for a site are 65 dBA as the onset for a normally unacceptable noise environment and 75 dBA as the threshold for an unacceptable living environment. A Moderate Impact for land use category 1 and 2 is considered to occur when the L_{dn} equals or exceeds 65 dBA, and a Severe Impact occurs when the L_{dn} equals or exceeds 75 dBA.

A screening level analysis was performed in accordance with FTA procedures to identify potentially noise-sensitive areas. For this project, occupied residences located within an unobstructed distance of 1,600 feet from a railroad crossing were considered for noise impacts. The screening level analysis determined that eight residences should be evaluated for railroad horn noise impacts. Three residences are located near the CR M.8 crossing, and the remaining five residences are located near the CR 10 crossing. Figure 3-5, County Road M.8/Railroad Grade Crossing Noise Sensitive Areas, and Figure 3-6, County Road 10/Railroad Grade Crossing Noise Sensitive Areas, depict the location of the proposed railroad crossings and potentially noise-sensitive areas. Yellow-shaded parcels are owned by CAM and were not assessed for noise impacts. Any dwelling units that may exist on these parcels are assumed to be unoccupied after the railroad is constructed.

Noise measurements were taken near these proposed crossings on a calm, dry, cool, sunny day in October 2007. The ambient background noise measurements near CR M.8 and CR 10 were 51.7 L_{dn} and 54 L_{dn}, respectively. The FTA noise impact criteria have been included as Table 3-6, Noise Levels Defining Impact for Transit Projects, and are applicable to this project.

Table 3-6
NOISE LEVELS DEFINING IMPACT FOR TRANSIT PROJECTS

Existing Noise Exposure* $L_{eq}(h)$ or Ldn (dBA)	Project Noise Impact Exposure, *			$L_{eq}(h)$ or Ldn(dBA)		
	Category 1 or 2 Sites			Category 3 Sites		
	No Impact	Moderate Impact	Severe Impact	No Impact	Moderate Impact	Severe Impact
<43	< Ambient +10	Ambient +10 to 15	>Ambient +15	<Ambient +15	Ambient +15 to 20	>Ambient +20
43	<52	52-58	>58	<57	57-63	>63
44	<52	52-58	>58	<57	57-63	>63
45	<52	52-58	>58	<57	57-63	>63
46	<53	53-59	>59	<58	58-64	>64
47	<53	53-59	>59	<58	58-64	>64
48	<53	53-59	>59	<58	58-64	>64
49	<54	54-59	>59	<59	59-64	>64
50	<54	54-59	>59	<59	59-64	>64
51	<54	54-60	>60	<59	59-65	>65
52	<55	55-60	>60	<60	60-65	>65
53	<55	55-60	>60	<60	60-65	>65
54	<55	55-61	>61	<60	60-66	>66

Table 3-6
NOISE LEVELS DEFINING IMPACT FOR TRANSIT PROJECTS

Existing Noise Exposure* L_{eq}(h) or Ldn (dBA)	Project Noise Impact Exposure, *			L_{eq}(h) or Ldn(dBA)		
	Category 1 or 2 Sites			Category 3 Sites		
	No Impact	Moderate Impact	Severe Impact	No Impact	Moderate Impact	Severe Impact
55	<56	56-61	>61	<61	61-66	>66
56	<56	56-62	>62	<61	61-67	>67
57	<57	57-62	>62	<62	62-67	>67
58	<57	57-62	>62	<62	62-67	>67
59	<58	58-63	>63	<63	63-68	>68
60	<58	58-63	>63	<63	63-68	>68
61	<59	59-64	>64	<64	64-69	>69
62	<59	59-64	>64	<64	64-69	>69
63	<60	60-65	>65	<65	65-70	>70
64	<61	61-65	>65	<66	66-70	>70
65	<61	61-66	>66	<66	66-71	>71
66	<62	62-67	>67	<67	67-72	>72
67	<63	63-67	>67	<68	68-72	>72
68	<63	63-68	>68	<68	68-73	>73
69	<64	64-69	>69	<69	69-74	>74
70	<65	65-69	>69	<70	70-74	>74
71	<66	66-70	>70	<71	71-75	>75
72	<66	66-71	>71	<71	71-76	>76
73	<66	66-71	>71	<71	71-76	>76
74	<66	66-72	>72	<71	71-77	>77
75	<66	66-73	>73	<71	71-78	>78
76	<66	66-74	>74	<71	71-79	>79
77	<66	66-74	>74	<71	71-79	>79
>77	<66	66-75	>75	<71	71-80	>80

Source: FTA 2006.
Notes:
***** L_{dn} is used for land use where nighttime sensitivity is a factor; L_{eq} during the hour of maximum transit noise exposure is used for land use involving only daytime activities.
> = greater than
< = less than
dBA = "A" weighted decibel scale

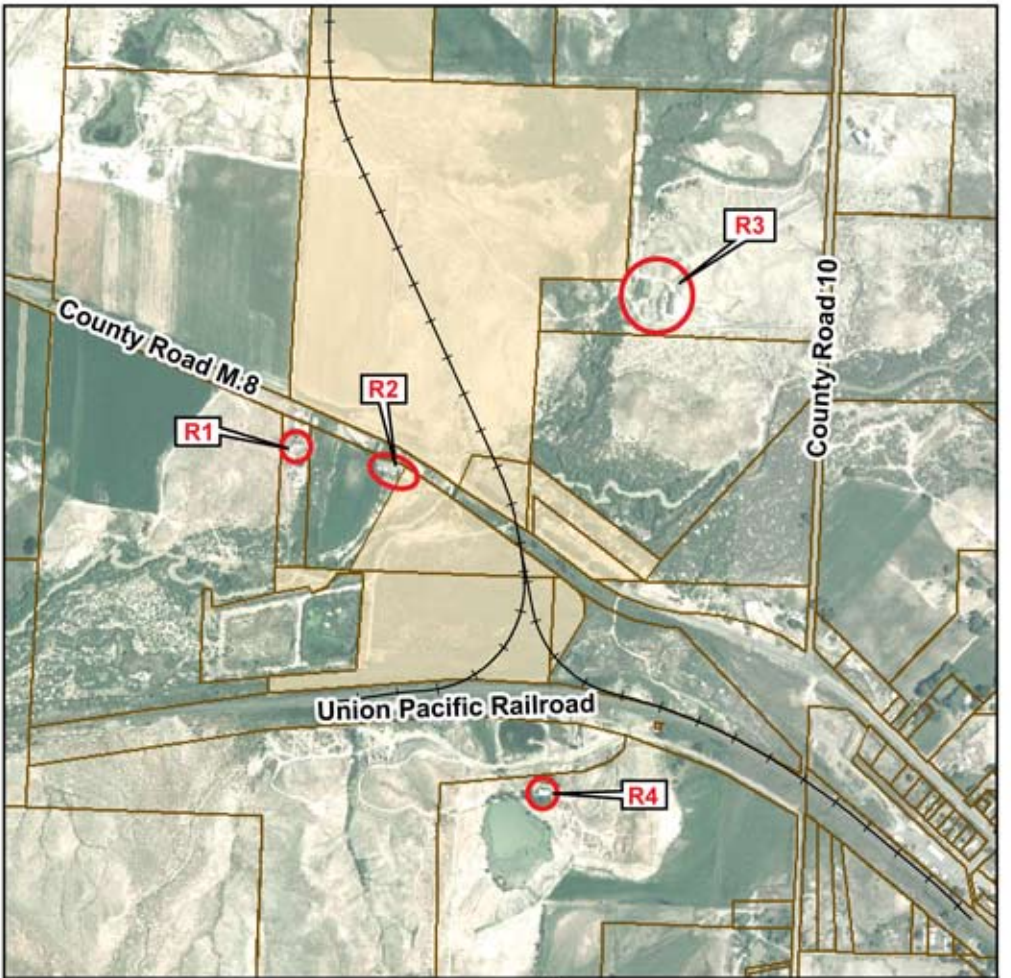
3.1.10 Hazardous Materials

Potential sources of hazardous or solid waste materials in the project area would include spilling, leaking, or dumping of hazardous substances, petroleum products, and/or solid waste associated with coal exploration and development or agricultural or livestock activities. No such hazardous materials are known to be present on the proposed Red Cliff Mine site at this time. Once the coal mine is in production, petroleum products and solvents would be used as part of general operations. Use of these products would comply with all applicable state and federal regulations, as described in this section.

Hazardous wastes produced by current mining activities at the MCM farther north of the Red Cliff Mine site are handled in compliance with regulations promulgated under the Resource Conservation and Recovery Act, Federal Water Pollution Control Act (Clean Water Act), Safe Drinking Water Act, Toxic Substances Control Act, Mine Safety and Health Act, Department of Transportation, and the federal Clean Air Act (CAA). Mining operations must also comply with all state rules and regulations relating to hazardous material reporting, transportation, management, and disposal. In Colorado, the Colorado DNR, Division of Reclamation, Mining and Safety (DRMS) has dual jurisdiction with the Colorado Department of Public Health and Environment (CDPHE) for the disposal of coal combustion waste (CCW) in mines. In addition, CCW is defined as industrial solid waste, and its disposal in a mine requires a solid waste permit issued by local government entity under the authority of the CDPHE.

Disposal requirements for waste rock/ore derived for coal mining operations are based on whether the waste material is determined to be acid-forming and/or toxic-forming. If the material is determined to be non-acid-forming or non-toxic-forming, there are generally no restrictions on disposal. The material may be stockpiled within the permit area or disposed of per the Disposal of Excess Spoil, Coal Mine Waste Bank, or Coal Mine Waste Regulations (2 CCR 407-2.2.04.09 – 407-2.2.04.11). Acid-forming and toxic-forming waste material must be disposed of in accordance with 2 CCR 407-2.4.05.8 (Acid-forming and Toxic-forming Spoil), 2 CCR 407-2.4.10.1 (Coal Mine Waste Banks General Requirements), and 2 CCR 407-2.4.14.3 (Covering Coal and Acid- and Toxic-Forming Materials).

A search of available environmental records was conducted by Environmental Data Resources, Inc. (EDR) for the project area on September 5, 2007. The EDR report presents the results of a search of federal and state databases that includes addresses of sites with known underground storage tanks (USTs); landfills; hazardous waste generation; and subsurface contamination in the surrounding area up to within one mile of the center of the MCM site. No hazardous material findings were identified in this report (EDR 2007). There is a gas station with two gas tanks and one diesel storage tank currently in use near the proposed railroad spur in the town of Mack (COSTIS 2007). Due to poor or inadequate address information, EDR is not always able to map all sites that have environmental concerns. These listed but unmapped properties are referred to as orphan sites. All orphan sites identified in the EDR report were located around the town of DeBeque, outside the project area.



Red Cliff Mine EIS

Figure 3-5
County Road M.8 / Railroad Grade Crossing
Noise Sensitive Areas

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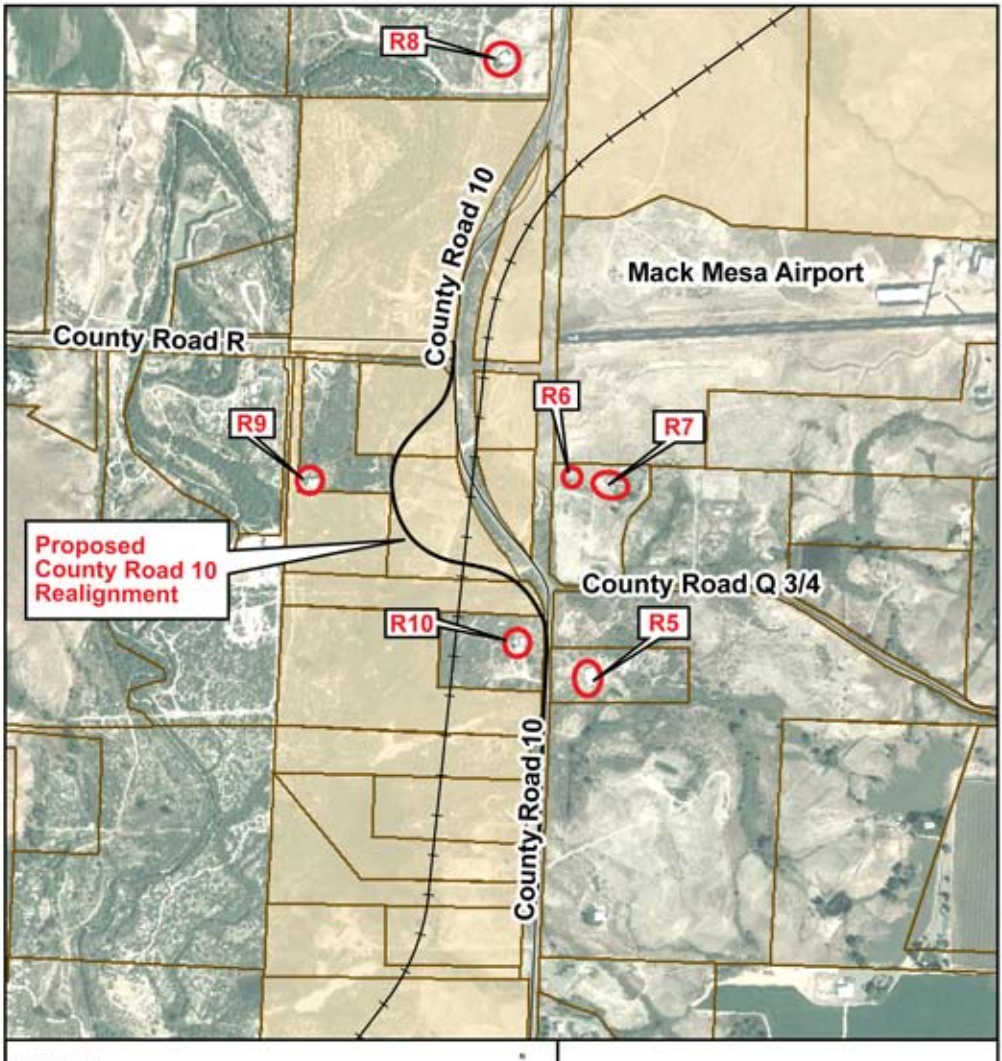

Legend

R1 Sensitive Noise Location

Revised Proposed Rail Alignment

Parcels

County Road 10 Realignment

CAM Ownership

0 500 1000 ft

Red Cliff Mine EIS

Figure 3-6
County Road 10 / Railroad Grade Crossing
Noise Sensitive Areas

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3.1.11 Health and Safety

Existing health and safety concerns in and near the Red Cliff Mine project include hazards associated with coal mine exploration and operations. Workers are generally exposed to occupational hazards associated with underground coal mine operations. The Mine Safety and Health Administration (MSHA) administers the federal Mine Safety and Health Act. The act requires all mines to be registered with MSHA and for MSHA inspectors to inspect each surface mine at least twice a year and each underground mine at least four times a year (seasonal or intermittent operations are inspected less frequently). Inspections determine whether there is compliance with health and safety standards or with any citation, order, or decision issued under the Mine Act, and whether an imminent danger exists. If violations of safety or health standards are found, inspectors will issue citations to the mine operators (MSHA 2007).

MSHA's Coal Mine Safety and Health Division enforces the law and the regulations at underground and surface coal mines. Health and safety regulations developed and enforced by MSHA cover numerous hazards, including those associated with:

- Exposure to respirable dust, airborne contaminants, and noise
- Design, operation, and maintenance requirements for mechanical equipment, including mobile equipment
- Roof falls, and rib and face rolls
- Flammable, explosive, and noxious gases and dust and smoke
- Electrical circuits and equipment
- Fires
- Hoisting
- Access and egress

Existing risks within the project area also include those associated with vehicle travel on improved and unimproved county roads, BLM and mine access roads, firearm accidents, natural events such as flash floods, landslides, earthquakes, and range fires. Biological hazards in the area are associated with ticks; spiders; mosquitoes; snakes; and small biting animals, including domestic animals.

3.2 PHYSICAL RESOURCES

3.2.1 Air Quality

Affected Environment

The air quality of any region is controlled primarily by the magnitude and distribution of pollutant emissions and the regional climate. The transport of pollutants from specific source areas is strongly affected by local topography. In the mountainous western U.S., topography is particularly important in channeling pollutants along valleys, creating upslope and downslope circulation that entrain airborne pollutants and blocking the flow of pollutants toward certain

areas. In general, local effects are superimposed on the general synoptic weather regime and are most important when the large-scale wind flow is weak.

Topography

The project area is located along the Book Cliffs, which form the northern boundary of the Grand Valley in western Colorado. Typical elevations in the region range from approximately 4,400 feet along the valley floor to 7,300 feet on the plateau, with rapid relief along the Book Cliffs. The mine entries would be located at an elevation of approximately 6,400 feet, while the coal preparation plant, train loadout, and other facilities would be located at an elevation of approximately 5,400 feet. The mining operations would be bracketed by two significant drainages: East Salt Creek to the west and Big Salt Wash to the east. These complex terrain features would significantly influence local-scale air flow and pollutant transport.

Climate and Meteorology

The project area is characterized by dry, desert-like, mountainous terrain vegetated by sagebrush or piñon-juniper woodland at lower elevations, and sparse forests vegetated by aspen, mahogany, oak brush, and service berry at higher elevations. The area is generally subject to frontal, convectional, and monsoonal storm patterns. Weather comes predominantly from the west and southwest. Surface winds typically move up valley slopes during the day and down the slopes at night.

Representative temperature and precipitation data were obtained for the region from the Western Regional Climate Center (WRCC 2007). However, because elevation, slope, and aspect affect precipitation and temperatures, the complex terrain results in considerable climatic variability. In the lower elevations of the Grand Valley, precipitation is typically distributed throughout the year at between 0.5 and 1.0 inch per month, with mid-winter receiving the lowest average amounts and spring and fall the highest levels. Total annual rainfall in the valley is usually less than 10 inches. Annual average temperatures typically range from the mid-30s to mid-60s. In the higher elevations, temperatures tend to be lower and more precipitation falls as snowfall rather than rain. Average temperature and annual precipitation measurements for several nearby monitor locations are provided in Table 3-7, Average Annual Temperature and Precipitation.

Table 3-7
AVERAGE ANNUAL TEMPERATURE AND PRECIPITATION

Station Name	Station ID	Annual Temperature		Annual Precipitation		County
		Minimum (°F)	Maximum (°F)	Total (in)	Snow (in)	
Colorado National Monument	051772	40.0	64.4	11.13	31.8	Mesa
Fruita	053146	34.3	66.9	8.81	13.2	Mesa
Grand Junction Walker	053488	40.2	65.4	8.71	21.5	Mesa
Palisade	056266	41.7	67.4	10.00	11.7	Mesa
Altenbern	59265	30.5	63.0	16.42	61.9	Garfield
Demaree	051507	24.74	71.95	12.37	NA	Garfield

Source: WRCC 2007.
Notes:
°F = degrees Fahrenheit
ID = identification number
in = inches
NA = not available

Existing Air Quality

Criteria Pollutants

Although specific air quality monitoring is not conducted throughout most of the project area (see Figure 3-7, Air Quality Monitoring Station Locations), air quality is good due to relatively few air pollutant emission sources. Sources within the vicinity of the project area include limited industrial facilities and small urban areas. Emissions due to energy development in the area are increasing and for some pollutants may become the dominant source of emissions on the Western Slope. Based on the data shown in Table 3-8, Assumed Background Concentrations, the air quality within the vicinity of the project area appears to comply with both the National Ambient Air Quality Standards (NAAQS) and Colorado Ambient Air Quality Standards (CAAQS). These standards have been set for six criteria pollutants: carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter less than 2.5 microns in effective diameter ($PM_{2.5}$), particulate matter less than 10 microns in effective diameter (PM_{10}), sulfur dioxide (SO_2), and ozone. The group of pollutants referred to as volatile organic compounds (VOCs) is not a criteria pollutant, but is one of the precursors to ozone formation. VOCs are included in the emissions inventory, but are not included in the air dispersion modeling analysis.

Table 3-8
ASSUMED BACKGROUND CONCENTRATIONS

Pollutant	Averaging Time[1]	Background Concentration (µg/m³)	NAAQS[2] (µg/m³)	CAAQS[3] (µg/m³)	PSD Class I Increments (µg/m³)	PSD Class II Increments (µg/m³)
CO[4]	1-hour	1,145	40,000	40,000	N/A	N/A
	8-hour	1,145	10,000	10,000	N/A	N/A
NO_2[5]	Annual	17	100	100	2.5	25
Ozone	1-hour [5]	173	235	235	N/A	N/A
	8-hour [6]	145	147	N/A	N/A	N/A
$PM_{2.5}$[7]	24-hour	18	35	N/A	N/A	N/A
	Annual	8	15.0	N/A	N/A	N/A
PM_{10}[4]	24-hour	41	150	150	8	30
	Annual	11	50	50	4	17
SO_2[8]	3-hour	24	N/A	700	25	512
	24-hour	13	365	N/A	5	91
	Annual	5	80	N/A	2	20

Source: Chick 2007.
Notes:
[1] Annual standards are not to be exceeded; short-term standards are not to be exceeded more than once per year.
[2] National Ambient Air Quality Standards
[3] Colorado Ambient Air Quality Standards
[4] Data collected by American Soda, Piceance Basin, 2003-2004
[5] Data collected by the National Park Service at Mesa Verde, 2003
[6] Based on data collected by the CASTNET Network at Gothic and Mesa Verde, CO, and Canyonlands, UT
[7] Data collected in Grand Junction, CO (515 Patterson)
[8] Data collected by Unocal, Piceance Basin, 1983-1984
µg/m³ = micrograms per cubic meter
N/A = not applicable
PSD = Prevention of Significant Deterioration

In addition to the air quality monitoring data provided in this section, in May of 2005 a two-year study was initiated by the Garfield County Department of Public Health Service (documented in a presentation entitled "Garfield County Air Quality Monitoring Study Report June 2005 – May 2007") to collect ambient air quality data for PM_{10} and VOCs. Results from this effort to date generally confirm that PM_{10} and VOC concentrations in the region are low, and no exceedances of the NAAQS were recorded (Garfield County Department of Public Health 2007). The greatest PM_{10} ambient concentrations were found in the Rifle and Parachute urban centers. Comparisons of the Garfield County PM_{10} and VOC concentrations to other areas of Colorado indicate that Garfield County concentrations are similar to or are lower than concentrations in other areas of the state. To obtain additional data, the Garfield County Department of Public Health Service is partnering with the U.S. Forest Service (USFS) on a regional ozone monitoring project.

Known contributors to existing air pollutant concentrations include the following:

- Exhaust emissions from gasoline and diesel engines, including CO, oxides of nitrogen (NO_x), $PM_{2.5}$, PM_{10}, SO_2, and VOCs.
- Dust (particulate matter) generated by vehicle travel on unpaved roads, construction activities, windblown dust from disturbed lands, and heavy road sanding during the winter months.
- Transport of air pollutants from emission sources located outside the project area.

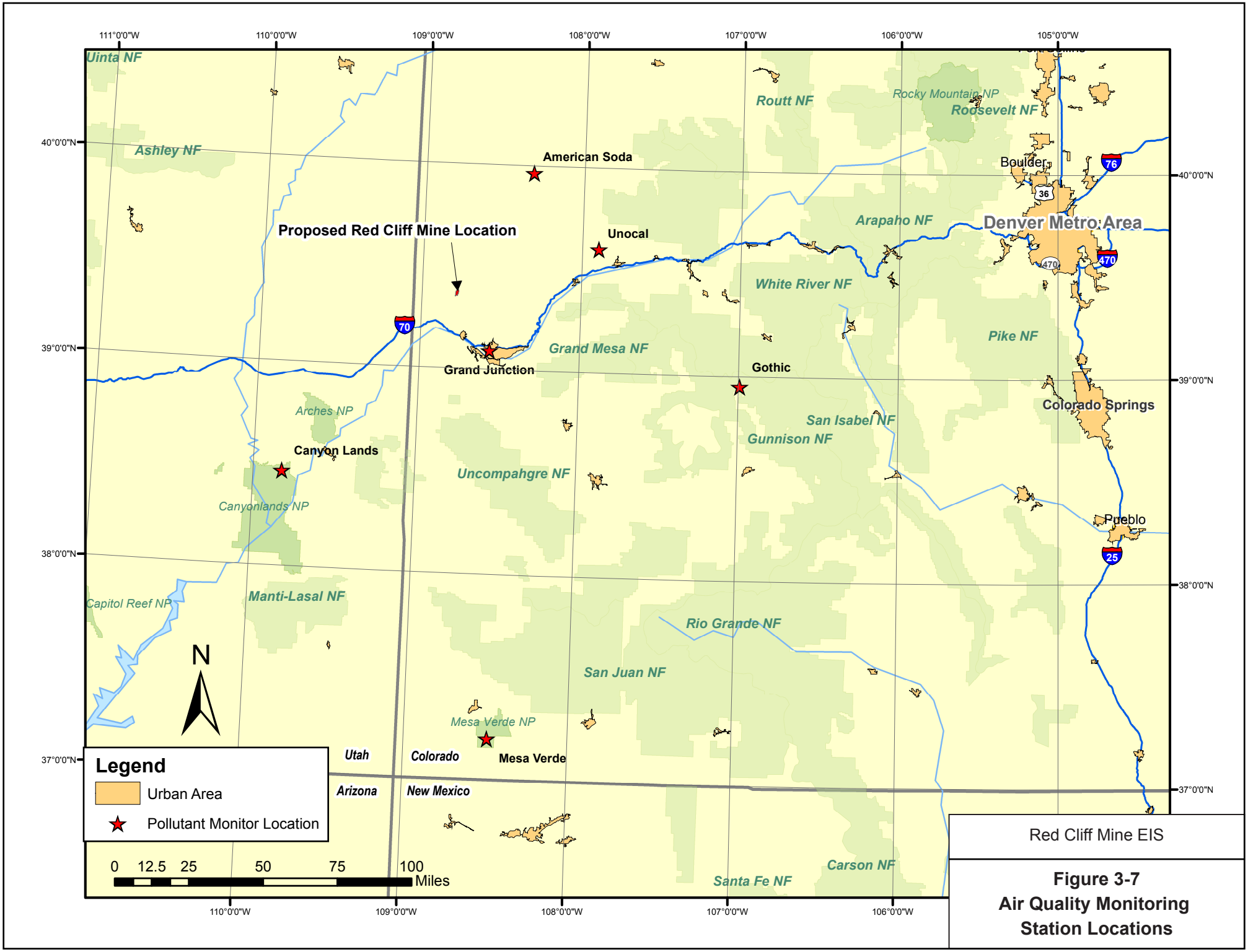
Visibility

Visibility impairment due to regional haze is a complex phenomenon with long-range impacts. Pollutants responsible for regional haze include aerosols that may be emitted directly into the atmosphere or may be formed by chemical reactions taking place within the atmosphere.

Examples of pollutants that directly contribute to regional haze include soot from diesel combustion, smoke from fires, fly ash from coal combustion, and wind-blown dust. Gaseous emissions that reduce visibility through the formation of secondary aerosols via chemical reactions in the atmosphere include emissions of SO_2, NO_x, and VOCs, resulting primarily from fuel combustion.

Visibility is measured in units of deciviews (dv). One dv is defined as a change in visibility that is just perceptible to the average person; this is approximately a 10-percent change in light extinction. In the western U.S., the natural visual range is estimated to average about 8 dv, which is equivalent to a visual range of approximately 110 to 115 miles (Malm 1999).

Visibility is an air quality-related value (AQRV) which is protected at national parks and wilderness areas designated as Class I areas under the CAA or at otherwise sensitive Class II areas. Visibility within the project area is not directly measured under the IMPROVE (Interagency Monitoring of Protected Visual Environments) program. A visibility monitor was operated at the nearby Douglas Pass from September 2003 to April 2006 but has since been removed. Therefore, visibility measurements for the Maroon Bells-Snowmass Wilderness Area (WA), where the closest IMPROVE monitor is located, may act as a surrogate. The Maroon Bells-Snowmass WA IMPROVE monitor is located approximately 100 miles east from the project area. Table 3-9, Natural and Existing Visibility, provides U.S. Environmental Protection Agency (EPA) estimates of expected natural visibility if no human-caused impairment occurred.



Red Cliff Mine EIS

Figure 3-7
Air Quality Monitoring Station Locations

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Values are also given for the 20 percent best days of visibility and for the 20 percent worst days of visibility. EPA's estimated values for the 20 percent best visibility days are slightly worse than actual monitored values for visibility conditions existing during the years 2001 through 2004. However, when the 20 percent worst days are considered, monitored visibility is less than EPA's estimate of natural visibility.

Table 3-9
NATURAL AND EXISTING VISIBILITY

	20% Best Days		20% Worst Days	
	Natural	Existing	Natural	Existing
Visibility (dv)	1.95	0.7	7.1	9.6
Visual Range (miles)	200	227	120	93
Visual Range (km)	322	365	193	150

Source: CDPHE 2006.
Notes:
% = percent
dv = deciview
km = kilometer

Atmospheric Deposition

Air pollutants can affect land and water when they are deposited in terrestrial and aquatic ecosystems. These pollutants can be deposited by rain (wet deposition) or by gravitational settling on surfaces (dry deposition). Substances deposited include:

- Nitrogen and sulfur compounds (nitrates, nitrites, sulfates, and sulfites)
- Acids (sulfuric acid and nitric acid), which are commonly known as acid rain
- Air toxics (such as pesticides, herbicides, and certain VOCs)
- Nutrients (such as nitrates and ammonium)

Deposition can occur via rain, snow, cloud water, particle settling, and gaseous adherence to vegetation. Because deposition varies with precipitation, it also varies with elevation and time. Due to the many deposition mechanisms, the quantity of pollutants deposited on soil, plants, and water is difficult to measure. Deposition is often measured in terms of kilograms of pollutant deposited per hectare per year (kg/ha-yr).

Emissions to the atmosphere of nitrogen and sulfur compounds are regulated by the EPA through existing emission standards. In particular, EPA's Highway Diesel and Nonroad Diesel Rules will decrease the allowable levels of sulfur in fuel used in motor vehicles and locomotives by 99 percent. To the extent that these emissions would be emitted by stationary sources, they would be addressed by the CDPHE–Air Pollution Control Division (CDPHE-APCD) during issuance of any air pollution permit.

Atmospheric deposition and its related effects are also an AQRV which is protected at national parks and wilderness areas designated as Class I areas under the CAA or at otherwise sensitive Class II areas. The closest deposition monitoring station to the project area is part of the Clean Air Status and Trends Network (CASTNET) and is located in Gothic, Colorado, approximately

95 miles southeast of the project area. Total nitrogen and sulfur deposition measured at this monitoring site during 2006 are presented in Table 3-10, 2006 Deposition at Gothic, Colorado.

Table 3-10
2006 DEPOSITION AT GOTHIC, COLORADO

Pollutant	Deposition (kg/ha-yr)
Total Nitrogen	0.89
Total Sulfur	1.88

Note:
kg/ha-yr = kilograms of pollutant deposited per hectare per year

Climate Change

Greenhouse gases (GHGs) such as carbon dioxide (CO_2), water vapor, methane, nitrous oxide, ozone, and chlorofluorocarbons (CFCs), maintain ambient temperatures to sustain life on earth. Water vapor and CO_2 are the most important greenhouse gases. CO_2 is released into the atmosphere by the respiration of all living organisms and is sequestered through the photosynthesis of plants. CO_2 and other greenhouse gases are also released into the atmosphere through human activities including combustion of fossil fuels and other organic materials, deforestation, production of paper, power, and other resources, and mining activities.

The greenhouse effect is the absorption of thermal radiation from the land and the oceans by earth's atmosphere. Atmospheric physicists calculate that the greenhouse effect of the CO_2 in the atmosphere warms the earth 60 degrees Fahrenheit (°F) above what the earth's temperature would be without it (U.S. National Assessment of the Consequences of Climate Change 1998). However, large quantities of greenhouse gas emissions may decrease the amount of heat energy radiated by the earth back to space and upset the global temperature balance. Human activities have greatly intensified the natural greenhouse effect, contributing to global warming (Le Treut et al. 2007). Climate change is strongly affecting many aspects of systems related to snow, ice, and frozen ground (including permafrost); emerging evidence shows changes in hydrological systems, water resources, coastal zones, and oceans (Rosenzweig et al. 2007).

Global mean surface temperatures have increased 0.6 to 1.2 °F between 1890 and 1996 (EPA 1997). According to the consensus of research by international climate scientists, global temperatures are projected to increase by approximately 5.4 °F by 2100, with a range between 2.5 and 10.4 °F due to anticipated increases in greenhouse gases (Intergovernmental Panel on Climate Change 2001).

By 2100, temperatures in Colorado could increase by 3 to 4 °F in spring and fall (with a range of 1 to 8 °F) and 5 to 6 °F in summer and winter (with a range of 2 to 12 °F) (EPA 1997). Garfin (2005) predicts an increase of 2.0 to 3.6 °F in the Colorado River Basin in winter temperatures by 2050. Christensen et al. (2004) predict average annual temperature increases for the Colorado River basin will be between 0.8 and 4.3 °F warmer between 2010 and 2098, relative to the historical climate.

Increased temperatures are likely to lead to increased evapotranspiration and earlier snowmelt and runoff. In the western U.S. there is a strong correlation between elevation and annual precipitation. As a result, the mountain ranges in the Rocky Mountain region capture a disproportionate fraction of the total precipitation falling over the region (U.S. National

Assessment of the Consequences of Climate Change 1998). Snowmelt and runoff provide agricultural, municipal, industrial, and recreational water for the lower elevations. Scientists forecast that Upper Colorado River Basin peak snowmelt runoff will occur 5 to 25 days earlier than average by 2040-2059, and 15 to 35 days earlier than average by 2080-2099 (Garfin 2005). Christensen et al. (2004) predict average annual precipitation for the Colorado River Basin between 2010 and 2098 to be between 1 percent and 6 percent less than for observed historical climate.

A study of potential consequences from global climate change in the Rocky Mountain/Great Basin region was reported in the U.S. National Assessment of the Potential Effects of Climate Change and Variability: Rocky Mountain/Great Basin Region (Rocky Mountain/Great Basin Regional Assessment Team of the U.S. Global Change Research Program 2003). The study concluded that possible climate changes could reduce stresses on the region's water resources due to increased overall precipitation, primarily in the form of rain. However, reduced snowpack and earlier melting could change the timing and availability of water in the region and could adversely affect winter sports. Climate changes could also alter natural ecosystems. Intensification of extreme events would be expected due to climate change, including more frequent and potentially more intense forest and range fires, drought, and floods.

Regulatory Framework

As mandated by FLPMA, any activities occurring on BLM-managed lands must comply with all state and federal regulations, including those related to air quality. The EPA establishes and revises the NAAQS as necessary to protect public health and welfare, setting the absolute upper limits for specific air pollutant concentrations at all locations where the public has access. Although the EPA recently revised both the ozone and $PM_{2.5}$ NAAQS, these revised limits will not be implemented by the CDPHE-APCD until the Colorado State Implementation Plan is formally approved by EPA. Until then, EPA is responsible for implementing these revised standards.

Potential development impacts must demonstrate compliance with all applicable local, state, tribal, and federal air quality regulations, standards, and implementation plans established under the CAA and administered by the CDPHE-APCD (with EPA oversight). Air quality regulations require proposed new, or modified existing air pollutant emission sources (including the proposed project) undergo a permitting review before their construction can begin. Therefore, the CDPHE-APCD has the primary authority and responsibility to review permit applications and to require emission permits, fees, and control devices prior to construction and/or operation.

Additionally, the U.S. Congress (through the CAA Section 116) authorized local, state, and tribal air quality regulatory agencies to establish air pollution control requirements more (but not less) stringent than federal requirements (such as Colorado's 3-hour SO_2 ambient air quality standard). Additional emission control measures (including emissions control technology analysis and determination) may be required by the applicable air quality regulatory agencies to ensure protection of air quality resources. Moreover, under the federal CAA and the FLPMA, BLM cannot authorize any activity that does not conform to all applicable local, state, tribal, and federal air quality laws, statues, regulations, standards, and implementation plans.

The existing air quality of the project area is in attainment with all ambient air quality standards, as demonstrated by the relatively low concentration levels presented previously. Given the project area's current attainment status, future development projects which have the potential to

emit more than 250 tons per year (tpy) (or certain listed sources that have the potential to emit more than 100 tpy) of any criteria pollutant would be required to submit a pre-construction Prevention of Significant Deterioration (PSD) Permit Application, including a regulatory PSD Increment Consumption Analysis under the federal New Source Review and permitting regulations. Development projects subject to the PSD regulations must also demonstrate the use of Best Available Control Technology (BACT) and show that the combined impacts of all applicable sources will not exceed the PSD increments for NO_2, PM_{10}, or SO_2. The permit applicant must also demonstrate that cumulative impacts from all existing and proposed sources would comply with the applicable ambient air quality standards throughout the operational lifetime of the permit applicant's project.

A regulatory PSD Increment Consumption Analysis may be conducted at any time by the CDPHE-APCD or EPA in order to demonstrate that the applicable PSD increment has not been exceeded by all applicable major or minor increment consuming emission sources. The determination of PSD increment consumption is a legal responsibility of the applicable air quality regulatory agency (with EPA oversight).

Sources subject to the PSD permit review procedures are required to demonstrate that impacts to AQRVs will be below Federal Land Managers' AQRV Work Group (FLAG) "Limits of Acceptable Change" (FLAG 2000).[1] The AQRVs to be evaluated include degradation of visibility, deposition of acidic compounds in mountain lakes, and effects on sensitive flora and fauna within the PSD Class I areas. Mandatory federal Class I areas were designated by the U.S. Congress on August 7, 1977, including those existing wilderness areas larger than 5,000 acres and national parks larger than 6,000 acres. The CDPHE-APCD has designated Dinosaur National Monument as a State Category 1 Area, with the same SO_2 increments as a federal PSD Class I area. All other locations in the country where ambient air quality is within the NAAQS (including attainment and unclassified areas) were designated as PSD Class II areas with less stringent requirements. Most of the analysis area is currently designated as PSD Class II; Dinosaur National Monument is a State Category 1 Area, and the Flat Tops Wilderness Area is protected by more stringent NO_2, PM_{10}, and SO_2 PSD Class I increment thresholds.

The CDPHE-APCD also requires various pre-construction and operating permits, including:

1) any emission source with the potential to emit air pollutants in excess of 2 tpy must submit an Air Pollution Emission Notice to CDPHE-APCD;
2) all emission sources with the potential to emit NO_x or CO in excess of 10 tpy, or 5 tpy of PM_{10}, are required to obtain a permit before construction can begin;
3) sources with potential emissions in excess of 100 tpy of CO, 40 tpy of NO_x, or 15 tpy of PM_{10}, must also include a new source modeling analysis in their permit application; CDPHE-APCD modeling guidelines specify the requirements for conducting modeling, including cumulative analyses;

[1] Federal Land Managers, or FLMs, are those Secretaries of departments with authority over federal lands (40 CFR 52.21). Under the CAA, FLMs are charged with "an affirmative responsibility to protect the AQRVs (including visibility) of any such lands within a Class I area." For example, the USFS White River National Forest Supervisor and Rocky Mountain Regional Forester are the Federal Land Managers directly responsible for the lands within the PSD Class I Flat Tops Wilderness Area.

4) all sources with the potential to emit any "criteria" air pollutant in excess of 50 tpy must also provide the opportunity for the public to comment on the permit application; and

5) a Title V (or part 70) operating permit is required for all sources with the potential to emit air pollutants in excess of 100 tpy. Since these preconstruction and operating permit programs are part of the Colorado State Implementation Plan, they have been approved (and are therefore enforceable) by EPA.

With regard to climate change, as of December 2008, no federal or State of Colorado regulations have been issued that address climate change impacts. However, in April 2007, the Supreme Court concluded that GHG's meet the Clean Air Act definition of an air pollutant, and in response EPA issued "Advance Notice of Proposed Rulemaking: Regulating Greenhouse Gas Emissions Under the Clean Air Act" (EPA HQ-OAR-2008-0318, June 2008). The U.S. Department of the Interior (DOI) Secretarial Order 3226 directs the BLM to consider and analyze potential climate change impacts when making major decisions regarding the potential utilization of resources under the DOI's purview. It should be noted that this Secretarial Order holds no regulatory authority.

Conformance to Existing Plans and Policies

Both the CAA and FLPMA require all federal activities (whether conducted directly, or approved through use authorizations) to comply with all applicable local, state, tribal, and federal air quality law, statutes, regulations, standards, and implementation plans. Potential development would conform to these requirements, consistent with existing land use plans.

3.2.2 Cultural Resources/Native American Religious Concerns

Cultural Resources

Cultural resources investigations in the area have yielded surface artifacts and buried materials consistent with the regional cultural history. Evidence from the Paleoindian, Archaic, Formative, Protohistoric, and Historic eras has been found in the area. Types of prehistoric sites that may be located within the region include lithic scatters, hunting sites, kill-butchering sites, hunting racks, quarry sites, temporary and extended camps, single and multiple habitation sites, pit houses, wickiups, rock shelters, granaries, cists, food processing areas, burial sites, petroglyph and pictograph panels, and isolated artifacts. Historic-era resources known from the region include trails, forts, toll and wagon roads, stage stations, hotels, resorts, bridges, homesteads, ranches, railroads, canals, towns, schools, mines, and mills.

NEPA requires agencies to consider the effects of a planned federal undertaking upon the cultural environment that includes cultural resources and traditional cultural properties (TCP). Cultural resources can be sites, buildings, structures, districts, or objects that are more than 50 years old. They are further categorized as either prehistoric or historic, depending upon their relative ages. Those resources from the period prior to permanent settlement by European settlers are categorized as prehistoric, while those from the subsequent period of permanent European settlement are characterized as historic. Any property that is associated with cultural practices or beliefs of a living community that are rooted in that community's history and are important in maintaining the continuing cultural identity of the community is considered to be a TCP.

Besides NEPA, planned federal undertakings must also comply with Section 106 of the National Historic Preservation Act of 1966 (NHPA). Section 106 requires federal agencies to take into account the effects of an undertaking on historic properties. Historic properties are defined as those cultural resources that are included on, or are eligible for, the National Register of Historic Places (NRHP).

The Archaeological Resources Protection Act (ARPA) was enacted "to secure, for the present and future benefit of the American people, the protection of archaeological resources and sites which are on public lands and Indian lands, and to foster increased cooperation and exchange of information between governmental authorities, the professional archaeological community, and private individuals" (16 U.S.C. 470aa – 470mm, Sec. 2(4)(b)).

The reasons behind enactment include recognition that archaeological resources are an irreplaceable part of America's heritage and that they are endangered increasingly because of the escalating commercial value of a small portion of the contents of archaeological sites.

Significant cultural resources or TCPs, which are legally defined as historic properties, include those resources that are listed or considered eligible for listing on the NRHP. The criteria for NRHP eligibility are set forth at 36 *Code of Federal Regulations* (CFR) 60.4:

> The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, building, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and
>
> *(a) that are associated with events that have made a significant contribution to the broad patterns of our history; or*
>
> *(b) that are associated with the lives of persons significant in our past; or*
>
> *(c) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or*
>
> *(d) that have yielded, or may be likely to yield, information important in prehistory or history.*

Historical sites such as buildings and ditches are usually evaluated under the first three criteria, while archaeological sites, if eligible, are usually significant under the fourth criterion. TCPs can be found eligible under any of the criteria, but are usually associated with criteria A. Other cultural resources of local, regional, or state significance may be listed on the State Register of Historic Places, administered by the Colorado Historical Society.

For cultural resources, the study area is termed the Area of Potential Effects (APE). This area is determined through meetings and discussions with State Historic Preservation Officer (SHPO) and other interested parties.

The APE for the proposed mine includes the area to be affected by the construction of the railroad spur and access road with a 120-meter (400-foot) buffer, and the mine facilities area, the transmission line alignment, realignment of CR 10, and those areas that may be subject to secondary or indirect impacts. These areas were intensively surveyed for cultural resources, with the exception of a portion of the proposed railroad spur located on private land, for which

permission to access was not obtained, and areas of extreme terrain, where cultural resources were unlikely to be found and pedestrian survey was unfeasible. The area of land designated as the coal lease area, north and east of the mine facilities area, was not inventoried for cultural resources. This area will be subject to subsidence; however, caving of the immediate roof into mined areas does not always translate into surface subsidence. The type of deformation that occurs and whether the deformation reaches the surface depends on a number of factors, including rock type, percent swell of overlying rock, rock strength, thickness and competence of overlying beds, mine layout, mine depth, mining height, and how far a particular competent horizon lies above the void in the mined area. The magnitude, extent, and duration of subsidence can be minimized by an efficient mine layout, proper barrier and gate road pillar design, and a rapid and efficient mining system (Appendix D, Subsidence).

If deformation reaches the surface, subsidence will typically appear as basins or depressions, pits, and/or open cracks. Subsidence-induced changes in surface slope are generally minor, having a magnitude commonly less than 3 degrees. At the surface, tension cracks can range from small (less than 1 inch), subtle features that are difficult to recognize to fractures that are several feet wide and several feet deep (Appendix D, Subsidence). This type of fissuring could have an adverse effect on archaeological resources, the type of cultural resource that would be anticipated in this area.

The APE for the railroad spur, access road, and mine facilities are detailed in BLM Grand Junction Field Office Cultural Resource Inventory Report 1106-11. A file search of the SHPO database and the Grand Junction Field Office cultural program files were conducted to assess the potential for known cultural resources to be present in the APE. The file searches identified one previously recorded site and two previously recorded isolated finds within the project APE. This site was officially determined as Not Eligible (August 18, 1999). Isolated finds are, by definition, not considered for NRHP listing.

A Class II (sampling) cultural resources inventory was conducted in October – December of 1980 on approximately 6,100 acres of lands included in the McClane and Munger Canyons Mine Plan/Permit area. Two prehistoric sites (5GF741 and 5GF742), one historic site (5GF743), and one “suspect area” were located by this study. The site 5GF741 was considered to be potentially eligible to the NRHP. A rare and undisturbed find, site 5GF742, is considered to be eligible to the NRHP. The historic site 5GF743 is on private land and a determination of eligibility has not been made. The “suspect area” consists of a small overhang containing possible fire-altered sandstone. SHPO will be consulted if there is a potential that the project could have an effect on these resources.

A Class III (intensive) pedestrian survey was conducted to current standards in April, June, and July of 2006 and the results of that study are the basis of this description of the cultural resources in the APE. The survey resulted in nine newly recorded sites and 20 new isolated finds within the project APE.

The recorded sites include three prehistoric open lithic scatters (5GF3876, 5GF3878, and 5ME15397), two prehistoric open camps (5GF3879 and 5ME15398), a slab-lined hearth feature (5GF3880), a historic corral and cabin (5ME15399), and a multi-component site consisting of a prehistoric open lithic scatter and a historic corral (5GF3877). The prehistoric sites range between the Late Prehistoric and the Paleo-Indian periods, spanning approximately 10,000 years.

The historic sites all date to the 1950s or later, based on land patent research. The historic sites all appear to be associated with ranching activities.

Of the nine sites recorded, four were recommended Eligible for the NRHP: 5GF3878, 5GF3879, 5GF3880, and 5ME15398. The remaining five sites were recommended Not Eligible for the NRHP. The BLM consulted with the SHPO on the adequacy of the survey and the determination of eligibility. The SHPO concurred with the BLM's recommendations on January 2, 2007.

The Government Highline Canal (5ME4676) has previously been determined eligible for the NRHP. The Government Highline Canal, completed in 1917, is 55 miles long and carries 1,675 cfs of water. Major features include three tunnels and several major siphons. Twenty segments or features along the canal have been previously recorded, but the segments of the Government Highline Canal where the railroad and transmission line alternatives would cross have not yet been recorded or documented with SHPO. BLM will record these segments at the time the preferred transmission line alternative is surveyed and supplement the Section 106 consultation with SHPO. Though the survey has not been conducted, it is assumed that the segment of the Government Highline Canal where the railroad would cross will be recommended eligible for the NRHP.

Native American Religious Concerns

Section 106 of the NHPA and the Advisory Council on Historic Preservation regulations (36 CFR 800.2[c][2][I]) mandate that federal agencies must involve interested Native American tribes in the planning process for federal undertakings. The American Indian Religious Freedom Act (AIRFA) of 1978 (Public Law 95-341, 42 U.S.C. 1996 and 1996a), as amended, was enacted to protect and preserve the traditional religious rights of Native Americans. The act was passed as a remedy to three general areas of conflict: access to sacred places on public lands, access to restricted ceremonial items, and prohibition of interference with traditional ceremonial practices from federal officials or curious onlookers. Section 2 of the AIRFA directs federal agencies to consult with Native American groups to determine appropriate procedures to protect their inherent rights, as laid out it the act. For activities on federal lands, the Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 (Public Law 101-601, 25 U.S.C. 3001 *et seq.*) requires consultation with "appropriate" Native American tribes (including Alaska Native villages) or Native Hawaiian organizations prior to the intentional excavation, or removal after inadvertent discovery, of several kinds of cultural items, including human remains and objects of cultural patrimony. EO 13007 requires federal land managing agencies to accommodate access to and ceremonial use of Native American sacred sites by Native American religious practitioners and to avoid adversely affecting the physical integrity of such sacred sites. It also requires agencies to develop procedures for reasonable notification of Proposed Actions or land management policies that may restrict access to or ceremonial use of, or adversely affect, sacred sites.

Consultation with a Native American tribe recognizes the government-to-government relationship between the U.S. government and sovereign tribal groups. Federal agencies must be sensitive to the fact that historic properties of religious and cultural significance to one or more tribes may be located on ancestral, aboriginal, or ceded lands beyond modern reservation boundaries. Consulting tribes are offered the opportunity to identify concerns about cultural resources and comment on how the project might affect them. If it is found that the project would impact cultural resources that are eligible for inclusion on the NRHP and are of religious

or cultural significance to one or more consulting tribes, then their role in the consultation process may also include participation in resolving how best to avoid, minimize, or mitigate those effects. By describing the proposed undertaking and the nature of known cultural sites, and consulting with the interested Native American community, the BLM strives to protect areas important to Native Americans.

On February 12, 2008, a certified letter was sent to the following federally recognized tribes with an established interest in the project area, inviting them to participate as consulting parties, documented in Appendix E, Coordination and Consultations:

- Northern Ute Indian Tribe
- Southern Ute Indian Tribe
- Ute Mountain Ute Indian Tribe

Subsequently, each of these tribes was contacted by the BLM staff archaeologist to see if they would be interested in discussing the Proposed Action in person. If new information is provided by Native Americans during the NEPA process, additional or edited terms for mitigation may need to be negotiated or enforced, such as the following:

- If new information is brought forward, any site-specific Native American mitigation measures suggested during notification/consultation would be considered during the implementation of the Proposed Action.
- Strict adherence to the confidentiality of information concerning the nature and location of archeological resources would be required of the project proponent and their subcontractors (16 U.S.C. 470hh).
- The NHPA requires that if newly discovered cultural resources are identified during the Proposed Action implementation, work in that area must stop and the BLM Authorized Officer notified immediately (36 CFR 800.13). The NAGPRA requires that if any inadvertent discovery of Native American remains or objects occurs, any activity must cease in the area of discovery, a reasonable effort made to protect the item(s) discovered, and immediate notice be made to the BLM Authorized Officer as well as the appropriate Native American group(s). Notice may be followed by a 30-day delay (NAGPRA 1990).
- On private lands, laws for Historic, Prehistoric, and Archaeological Resources, and for unmarked Human Graves (CRS 24-80-401 and CRS 24-80-1301) would be adhered to by the project proponent and their subcontractors. These state statutes require that the federal Authorizing Officer be notified immediately of any historic or prehistoric finds or human grave. The find must be protected until the Authorizing Officer indicates that action may continue.

3.2.3 Geology and Minerals

The physiography of the surface features in the general area directly reflects the geologic structure of the strata and the relative resistance of the beds to erosion. The Grand Valley is bounded by the Book Cliffs to the north and by the Uncompahgre Plateau to the southwest. The entire valley is underlain by the easily erodible Mancos shale. Both valley boundaries mark the transition of the Mancos Shale into the more erosion-resistant sandstones that form the Book

Cliffs (Mesaverde Group) and the edge or the Uncompahgre Plateau (Dakota Sandstone) (Schwochow 1978).

Structurally, the regional dip varies, but is generally 3 degrees to the northeast. The nearest mapped geologic structures are the Hunter Canyon and GarMesa Anticlines located to the south and southeast. The smaller Highline Canal Anticline is to the southwest. More locally, faulting at the MCM has identified a small northeast–southwest trending graben.

The surface geology consists mainly of non-marine rocks of the upper Cretaceous Mesaverde Group. The overlying Tertiary Ohio Creek, Wasatch, and Green River Formations are found to occasionally cap the Mesaverde Group at the highest elevations north of the project area. Quaternary sand and gravels occur as alluvium near streams or as thin veneering pediment surfaces. The principle formations in the project area are Cretaceous in age. They are described in descending order (Cashion 1973). (See Figure 3-8, Typical Geologic Cross Section.)

- Hunter Canyon Formation (Mesaverde Group): Buff and gray medium- to coarse-grained massive, cliff forming sandstone and gray to greenish-gray shale.
- Mount Garfield Formation (Mesaverde Group): Buff and gray fine- to medium-grained sandstone and gray shale. Upper part contains very little coal. Lower part contains thick persistent coal beds. The Rollins Sandstone Member is often used as a marker bed and occurs in the coal-bearing sequence at the base of the Cameo zone.
- Sego Sandstone (Mesaverde Group): Buff and light gray fine-grained sandstone and gray shale.
- Mancos Shale: Dark gray to black soft shale with thin sandstone beds at various horizons.

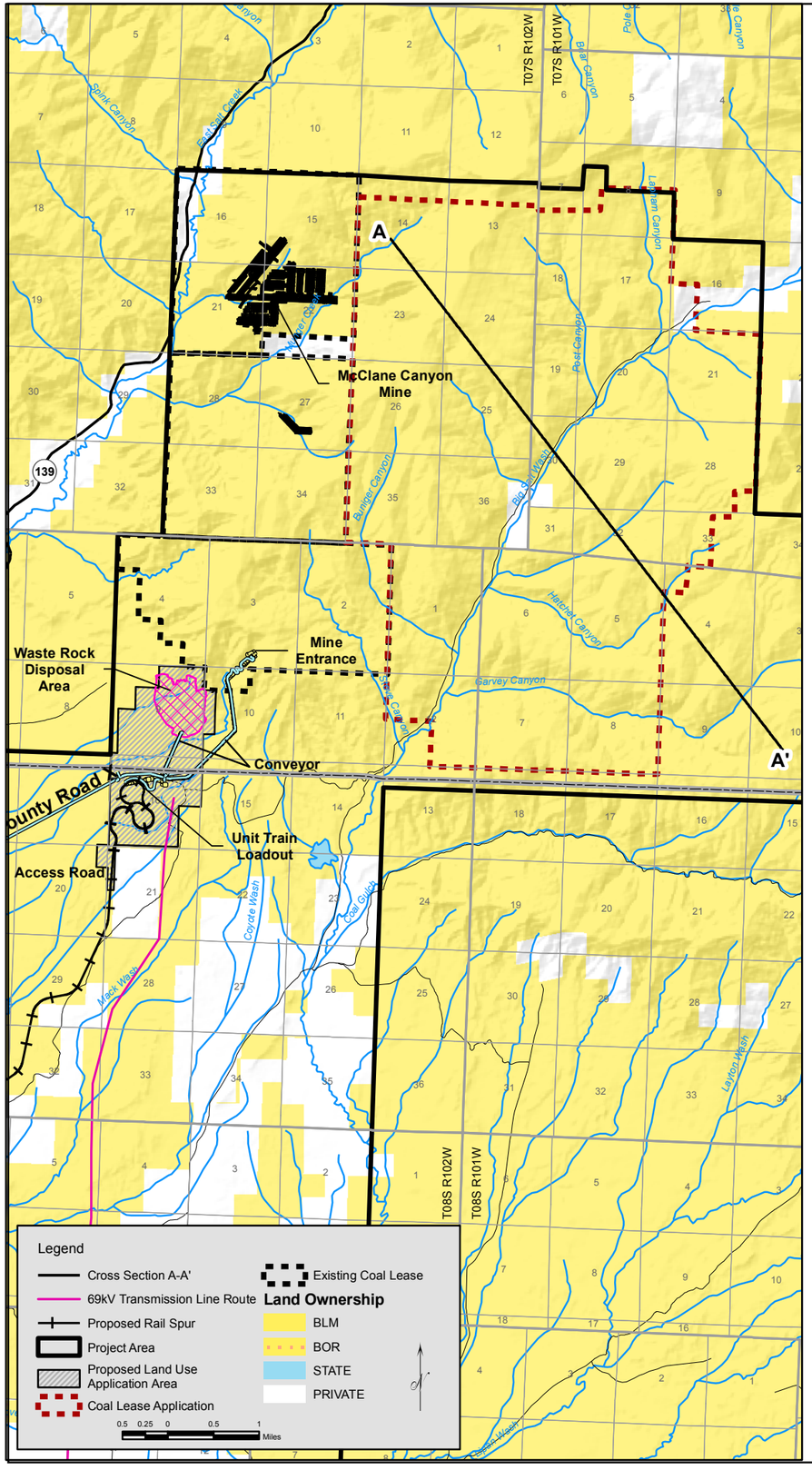
Coal Geology

The project area lies in the Book Cliffs Coal Field. The coal field is on the southwest flank of the Piceance Basin that covers much of west-central Colorado. The Book Cliff Coal Field is bounded on the south by the Colorado River in the Grand Valley and the Book Cliffs bordering the southwest flank of the Piceance Basin.

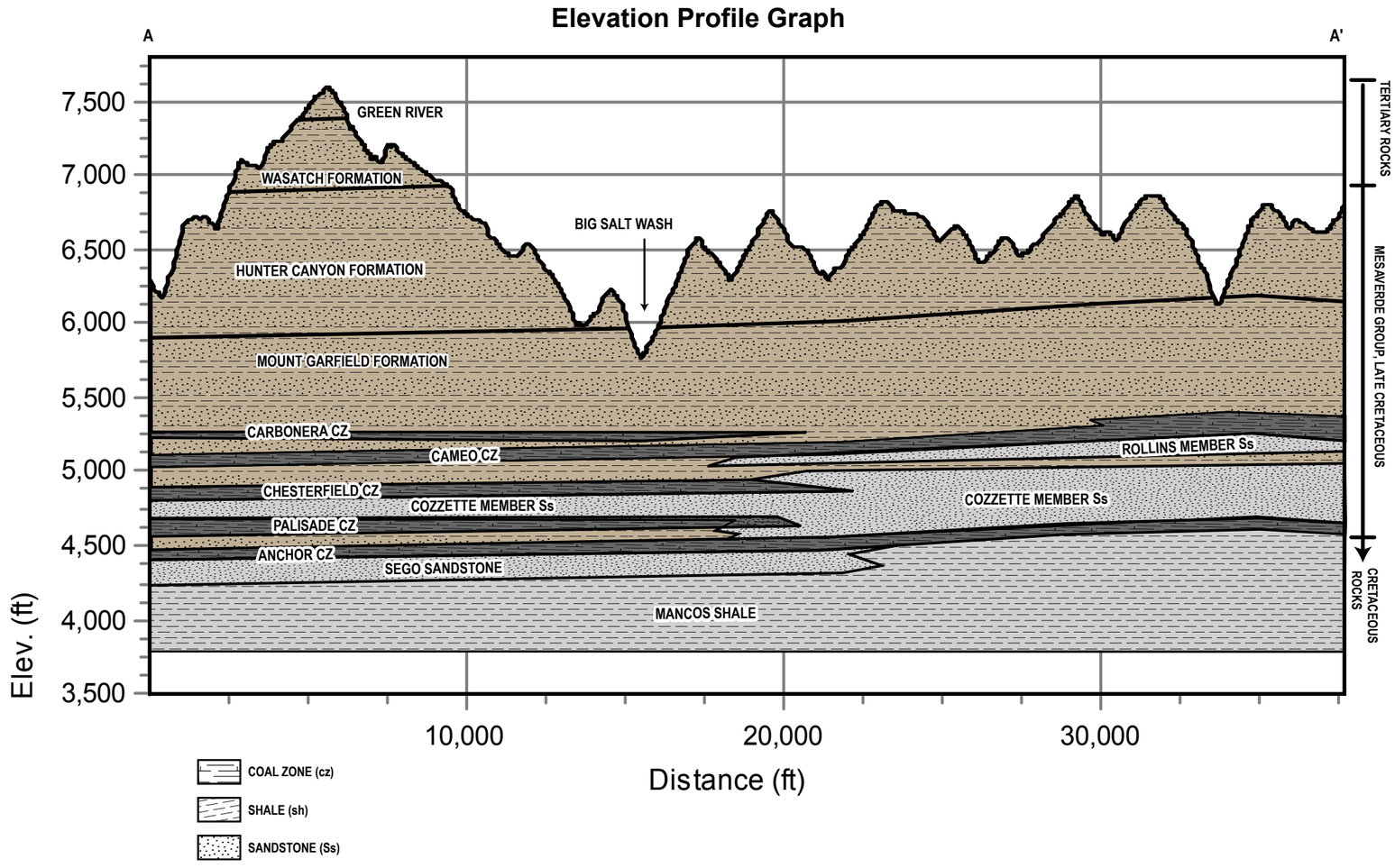
The MCM is immediately west of the proposed lease tract. The MCM began production in the late 1970s. Production since 1978 is 2,866,000 tons from the Cameo zone. One other mine, the Munger Canyon Mine, is located in Munger Canyon and produced approximately 103,000 tons for a short period in 1978 to 1979.

Coal zones that have been identified in the Book Cliffs Coal Field are, in descending order, the Carbonera coal zone, Cameo coal zone, Palisade coal zone and Anchor coal zone. Due to problems with seam thickness, coal quality, and overburden; the coal beds of the Cameo zone are of the most potentially mineable (Jones 2006). Depending on location in the area, the Cameo may be split into two seams or may form a single, thick coalesced bed. Where coalesced, the Cameo zone consistently averages between 20 to 25 feet. Where split, the lower Cameo is usually a more consistent thickness and is higher in overall coal quality. Average thickness of the lower seam is 10 to 11 feet.

Generally, the coals rank as high volatile C with some high volatile B. Quality varies within the seam(s), but the quality of the raw coal is expected to average 10 percent moisture, 15 percent ash, 0.5 percent sulfur and 10,600 British thermal units per pound (Btu/lb).



Elevation Profile Graph



Red Cliff Mine EIS

Figure 3-8
Typical Geologic Cross Section

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Coal seam fires have occurred in the area. The Smoky Mountain coal seam fire is outside the study area. It was controlled and remediated approximately three years ago. The Hot Point outcrop fire is located near the southern edge of the existing MCM leases. Remediation is being planned for this fire. The Hot Point fire is shown on Figure 2-8, Initial Mine Plan.

Overburden above the Cameo zone ranges from zero feet at the outcrop to approximately 2,000 feet in the northern areas of the potential leasing area. A complete description of mining operations and subsidence is contained in Appendix C, Mining Operations and Subsidence.

Other Mineral Resources

Oil and gas are the most prominent other mineral resources being explored and/or developed in the vicinity of the project area. The eastern and southern portions of the proposed coal lease tract are mostly covered with active oil and gas leases. There are no current oil and gas leases on the portion of the proposed coal lease tract in Township 7 South, Range 102 West (T7S, R102W), 6th Principle Meridian (P.M.). Much of the remainder of the project area is currently leased or has been leased in the past for oil and gas (BLM 2007). Figure 3-9, Authorized Oil and Gas Leases within the Existing Coal Lease Application, shows the authorized oil and gas leases within the coal lease application and surrounding area. Table 3-11, Authorized Oil and Gas Leases within the Existing Coal Lease Application, contains the location of each authorized oil and gas lease within the coal lease application, the serial number of each lease, and the acreage of each lease.

Table 3-11
AUTHORIZED OIL AND GAS LEASES WITHIN THE EXISTING COAL LEASE APPLICATION

Township	Range	Section(s)	Serial Number	Acres
8 S	102 W	1	COC 063034	586.2
8 S	102 W	2	COC 067500	906.87
8 S	102 W	3, 9, 10	COC 067501	2175.64
8 S	102 W	4	COC 014314	360.0
8 S	102 W	5	COC 065964	586.65
8 S	102 W	11, 12	COC 067503	1200.0
8 S	101 W	4	COC 064210	1592.38
8 S	101 W	5	COC 067584	861.67
8 S	101 W	6	COC 067585	900.41
8 S	101 W	7	COC 067262	1123.29
8 S	101 W	8	COC 0124705A	1080.0
8 S	101 W	8	COC 060771	40.0
7 S	101 W	7, 8, 17, 18	COC 012864	2551.84
7 S	101 W	9	COC 012999	2432.86
7 S	101 W	16, 17, 20, 21, 22	COC 012865	2528.35
7 S	101 W	19, 20, 28, 29, 30, 31, 32	COC 012757	2561.81
7 S	101 W	27, 33	COC 064209	2276.36

Oil and gas exploration and development has occurred throughout the project area. Primarily, the exploration and development has focused on the Cretaceous Dakota Sandstone and the Jurassic Morrison Formation. Other rock units that have either been produced or evaluated include the Mancos Shale, Cozzette Sandstone, and Entrada Sandstone. More recently, there has been some interest in evaluating the coal bed methane potential from the Mesaverde coal seams. There are 10 producing or capable of production wells and seven plugged wells within the potential future coal leasing area (COGCC 2007 and BLM records).

Common variety minerals occurring in the project area include sand and gravel, low-quality clays (e.g., for adobe bricks), and decorative gravel/stone. The designated Red Gravel Community Pit is located in Section 1, T8S, R102W, 6th P.M. along CR 205.

Geologic Hazards

The project area is in the Colorado Plateau seismotectonic province and is considered to be fairly stable. The majority of damaging earthquakes have occurred in the intermountain seismic belt that parallels the Wasatch Mountains in Utah. This belt is approximately 100 miles west of the project area. There have been numerous small earthquakes detected in the Rangely Oil Field attributed to secondary oil recovery operations. The most significant suspected active fault is the Redlands Fault complex about 15 miles to the southeast (Dorchester Mine Permit 1983). The project area is located in Seismic Zone 1 that is generally characterized as possible small earthquakes and minor damage. The earthquake risk is considered low.

Rockfalls, landslides or slumping are primarily associated with steep slopes (Colton et. al. 1975). Slumping and other small movements of unconsolidated material usually occur due to significant precipitation events, fluvial erosion, and alternating freezing and thawing.

An engineering geologic evaluation was done for the proposed mine and railroad spur. High rockfall risk hazards were identified in the northeastern third of the project area. Other steep, potentially unstable slopes with a moderate risk were identified (McDonald 2006).

3.2.4 Paleontology

The Grand Valley near Grand Junction has yielded world-class fossil specimens of major scientific value. Two of the better known sites, Rabbit Valley and the Fruita Paleontological Site are in the vicinity but outside the project area. Fossils occur in many of the geologic formations within the area. Formations or specific areas can be classified to indicate the likelihood of significant fossil occurrence (usually vertebrate fossils of scientific interest).

Potential Yield Classification System for Paleontological Resources on Public Lands

The "Potential Yield Classification System for Paleontological Resources on Public Lands" (PFYC – see WO IM No. 2008-2009) is as follows:

Class 1 – **Very Low**. Geologic units that are not likely to contain recognizable fossil remains.

- Units that are igneous or metamorphic, excluding reworked volcanic ash units.
- Units that are Precambrian in age or older.

(1) Management concern for paleontological resources in Class 1 units is usually negligible or not applicable.

Map Extent:

McClane Canyon Mine

Mine Entrance

Waste Rock Disposal Area

Conveyor

Unit Train Loadout

Access Road

County Road X

Garfield County

Mesa County

T07S R103W

T07S R102W

T07S R101W

T07S R100W

T08S R103W

T08S R102W

T08S R101W

139

Dry Canyon

Cozmo Gulch

Howard Canyon

Fast Gulch

Mudger Canyon

Bunger Canyon

Big Sandwash

Peel Canyon

Deer Creek

East Gulch

Victor Canyon

Garvey Canyon

Dehetre Canyon

Coyote Wash

Coal Gulch

Mack Wash

Legend

- 69kV Transmission Line Route
- Proposed Rail Spur
- Project Area
- Proposed Land Use Application Area
- Coal Lease Application
- Existing Coal Lease
- Authorized Oil & Gas Leases (BLM)

Land Ownership

- BLM
- BOR
- STATE
- PRIVATE

0.5 0.25 0 0.5 1 Miles

Red Cliff Mine EIS

Figure 3-9
Authorized Oil and Gas Leases Within the Project Area

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(2) Assessment or mitigation is usually unnecessary except in very rare or isolated circumstances. The probability for impacting any fossils is negligible. Assessment or mitigation of paleontological resources is usually unnecessary. The occurrence of significant fossils is non-existent or extremely rare.

Class 2 – **Low**. Sedimentary geologic units that are not likely to contain vertebrate fossils or scientifically significant nonvertebrate fossils.

- Vertebrate or significant invertebrate or plant fossils not present or very rare.
- Units that are generally younger than 10,000 years before present.
- Recent aeolian deposits.
- Sediments that exhibit significant physical and chemical changes (i.e., diagenetic alteration).

(1) Management concern for paleontological resources is generally low.

(2) Assessment or mitigation is usually unnecessary except in rare or isolated circumstances. The probability for impacting vertebrate fossils or scientifically significant invertebrate or plant fossils is low. Assessment or mitigation of paleontological resources is not likely to be necessary. Localities containing important resources may exist, but would be rare and would not influence the classification. These important localities would be managed on a case-by-case basis.

Class 3 – **Moderate or Unknown**. Fossiliferous sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence; or sedimentary units of unknown fossil potential.

- Often marine in origin with sporadic known occurrences of vertebrate fossils.
- Vertebrate fossils and scientifically significant invertebrate or plant fossils known to occur intermittently; predictability known to be low (or)
- Poorly studied and/or poorly documented. Potential yield cannot be assigned without ground reconnaissance.

Class 3a **– Moderate Potential.** Units are known to contain vertebrate fossils or scientifically significant nonvertebrate fossils, but these occurrences are widely scattered. Common invertebrate or plant fossils may be found in the area, and opportunities may exist for hobby collecting. The potential for a project to be sited on or impact a significant fossil locality is low, but is somewhat higher for common fossils.

Class 3b **– Unknown Potential.** Units exhibit geologic features and preservational conditions that suggest significant fossils could be present, but little information about the paleontological resources of the unit or the area is known. This may indicate the unit or area is poorly studied, and field surveys may uncover significant finds. The units in this Class may eventually be placed in another Class when sufficient survey and research is performed. The unknown potential of the units in this Class should be carefully considered when developing any mitigation or management actions.

- Management concern for paleontological resources is moderate; or cannot be determined from existing data.

- Surface-disturbing activities may require field assessment to determine appropriate course of action.

This classification includes a broad range of paleontological potential. It includes geologic units of unknown potential, as well as units of moderate or infrequent occurrence of significant fossils. Management considerations cover a broad range of options as well, and could include pre-disturbance surveys, monitoring, or avoidance. Surface-disturbing activities will require sufficient assessment to determine whether significant paleontological resources occur in the area of a Proposed Action, and whether the action could affect the paleontological resources. These units may contain areas that would be appropriate to designate as hobby collection areas due to the higher occurrence of common fossils and a lower concern about affecting significant paleontological resources.

Class 4 – **High**. Geologic units containing a high occurrence of significant fossils. Vertebrate fossils or scientifically significant invertebrate or plant fossils are known to occur and have been documented, but may vary in occurrence and predictability. Surface disturbing activities may adversely affect paleontological resources in many cases.

Class 4a – Unit is exposed with little or no soil or vegetative cover. Outcrop areas are extensive with exposed bedrock areas often larger than two acres. Paleontological resources may be susceptible to adverse impacts from surface disturbing actions. Illegal collecting activities may impact some areas.

Class 4b – These are areas underlain by geologic units with high potential but have lowered risks of human-caused adverse impacts and/or lowered risk of natural degradation due to moderating circumstances. The bedrock unit has high potential, but a protective layer of soil, thin alluvial material, or other conditions may lessen or prevent potential impacts to the bedrock resulting from the activity.

- Extensive soil or vegetative cover; bedrock exposures are limited or not expected to be impacted.
- Areas of exposed outcrop are smaller than two contiguous acres.
- Outcrops form cliffs of sufficient height and slope so that impacts are minimized by topographic conditions.
- Other characteristics are present that lower the vulnerability of both known and unidentified paleontological resources.

(1) Management concern for paleontological resources in Class 4 is moderate to high, depending on the Proposed Action.

(2) A field survey by a qualified paleontologist is often needed to assess local conditions.

(3) Management prescriptions for resource preservation and conservation through controlled access or special management designation should be considered.

(4) Class 4 and Class 5 units may be combined as Class 5 for broad applications, such as planning efforts or preliminary assessments, when geologic mapping at an appropriate scale is not available.

Resource assessment, mitigation, and other management considerations are similar at this level of analysis, and impacts and alternatives can be addressed at a level appropriate to the application. The probability for impacting significant paleontological resources is moderate to high, and is dependent on the Proposed Action. Mitigation considerations must include assessment of the disturbance, such as removal or penetration of protective surface alluvium or soils, potential for future accelerated erosion, or increased ease of access resulting in greater looting potential. If impacts to significant fossils can be anticipated, on-the-ground surveys prior to authorizing the surface disturbing action will usually be necessary. On-site monitoring or spot-checking may be necessary during construction activities.

Class 5 – **Very High**. Highly fossiliferous geologic units that consistently and predictably produce vertebrate fossils or scientifically significant invertebrate or plant fossils, and that are at risk of human caused adverse impacts or natural degradation.

Class 5a – Unit is exposed with little or no soil or vegetative cover. Outcrop areas are extensive with exposed bedrock areas often larger than two contiguous acres. Paleontological resources are highly susceptible to adverse impacts from surface disturbing actions. Unit is frequently the focus of illegal collecting activities.

Class 5b – These are areas underlain by geologic units with very high potential but have lowered risks of human-caused adverse impacts and/or lowered risk of natural degradation due to moderating circumstances. The bedrock unit has very high potential, but a protective layer of soil, thin alluvial material, or other conditions may lessen or prevent potential impacts to the bedrock resulting from the activity.

- Extensive soil or vegetative cover; bedrock exposures are limited or not expected to be impacted.
- Areas of exposed outcrop are smaller than two contiguous acres.
- Outcrops form cliffs of sufficient height and slope so that impacts are minimized by topographic conditions.
- Other characteristics are present that lower the vulnerability of both known and unidentified paleontological resources.

    (1) Management concern for paleontological resources in Class 5 areas is high to very high.

    (2) A field survey by a qualified paleontologist is usually necessary prior to surface disturbing activities or land tenure adjustments. Mitigation will often be necessary before and/or during these actions.

    (3) Official designation of areas of avoidance, special interest, and concern may be appropriate.

The probability for impacting significant fossils is high. Vertebrate fossils or scientifically significant invertebrate fossils are known or can reasonably be expected to occur in the impacted area. On-the ground surveys prior to authorizing any surface disturbing activities will usually be necessary. On-site monitoring may be necessary during construction activities.

Paleontological Classifications in the Project Area

The BLM paleontology files were reviewed. There are general resource inventories (Armstrong and Kihm 1980, Mellett 1982) and project-specific reports (Armstrong 1983, Miller and Hall 1994) covering the project area. Most of the project area is classified as Class 3, with some areas classified as Class 4. One formation has been categorized as Class 5. The following description of the fossiliferous potential for the geologic formations is drawn from these references and is outlined subsequently:

Class 3

Sego Sandstone – Sediments of the Sego Sandstone are of marine and fresh water origin. They were deposited in a shallow sea, near-shore environment. Tracks of worms and other invertebrates have been found. There is little potential for the occurrence of significant fossil remains.

Hunter Canyon Formation – The environment of deposition was dominantly fluvial. Vertebrate fossils have been found in the formation to the north of the project area. To the east of the project area, in DeBeque Canyon, numerous three-toed and four-toed dinosaur tracks have been found as well as imprints of palm tree fronds and trunks. However, due to the steep, rugged nature of the exposures, the potential for finding fossils within the project area is considered low.

Green River Formation – The Green River Formation overlies the Wasatch and Ohio Creek Formation. The depositional environment was a relatively shallow, saline, inland lake. Vertebrate fossils have been found in the formation. However most of the finds have come from the higher Parachute Creek Member at such places as the Douglas Pass area. The lower Douglas Creek Member has limited exposures in the very north and northeast portion of the project area. The potential for the occurrence of significant fossil remains is considered low.

Quaternary Alluvium – These are more recent deposits of silts, sands, and gravels. Within the project area they occur on terraces, along drainage bottoms, and as talus slopes. Vertebrate fossils have been found in Quaternary deposits elsewhere, outside of the project area. A bison skull was found in Holocene deposits during road-widening operations south of Douglas Pass. Due to the favorable preservation nature of some of the deposits in the project area, the potential for finding scientifically significant fossils is considered good.

Class 4

Mancos Shale – The Mancos shale is of marine origin. Vertebrate remains in the form of fish scales and teeth have been found. Invertebrates include marine shells such as pelecypods and baculites. One set of foot bones of a duck billed dinosaur was collected north of Fruita. Other vertebrate finds in the Mancos at the base of the Book Cliffs near the Mesa/Garfield County line near the Utah border include a "*Kritosaurus*"-like juvenile duckbilled dinosaur, and marine reptiles, including a short-necked plesiosaur, and at least two mosasaurs. Another plesiosaur was found at the base of the Book Cliffs north of Walker Field Airport. In general, localities appear to be higher in the Mancos section near the Book Cliffs and near the base of the Mesaverde Group. There is a good potential for finding fossils of scientific interest.

Mount Garfield Formation – The environment of deposition was extremely variable, including marine, brackish, and fresh water at various times. The number and thickness of the coal beds indicates an extensive swamp environment. Fresh water and marine fossils have been found in

this formation. Dinosaur bones, dinosaur tracks, and gastroliths have been reported from coal mines near the area. Plants such as redwood, fig trees, and palms are also represented. The potential for finding scientifically significant fossils is considered good.

Class 5

Wasatch and Ohio Creek Formation – Within the project area, the Wasatch and Ohio Creek Formations are mapped together. They occur at the highest elevations to the north and northeast of the project area. The sediments are stream, floodplain, and swamp deposits. Numerous scientifically significant fossils have been found in the Wasatch Formation elsewhere, particularly to the east of the project area, and the formation has been classified as Class 5. Fossils are more common to the east and become scarce to the west. The formation thins to the west as it nears the Douglas Arch, and perhaps the conditions for fossilization were not as favorable (Armstrong and Kihm 1980). However, given the abundance of fossils found in the formation, the potential for finding scientifically significant fossils is considered good.

3.2.5 Soils

Several resources and resource uses such as livestock grazing, wildlife habitats, and recreation depend on suitable quality soils for sustainability. Thus, the preservation of topsoil and the productivity of public land are a high priority in BLM land management decisions. The soil resources of the project area were investigated via a desktop study conducted during August 2007. The soils that comprise the project area are identified and described within the Douglas-Plateau and Mesa County soil surveys areas of Colorado (NRCS 1978; NRCS 2000). Additionally, electronic soils data was compiled and reviewed using the Web Soil Survey (WSS) (NRCS 2007).

Regional Setting and Geologic Influences

The project area primarily consists of narrow foothill valleys, high rolling plateaus dissected by steep canyons, narrow mountain valleys, and relatively high mountains. Floodplains and basins typify a lesser portion of the area. The project area is drained by the Colorado River and its tributaries. Entisols (i.e., soils that have little or no evidence of development of pedogenic horizons; many Entisols are sandy and vary in depth) occur along the floodplains of major streams. Aridisols (i.e., soils with limited availability of moisture for sustained plant growth) cover plateau tops, older terraces, and alluvial fans. Badlands are extensive in the mountains and on plateaus. The geologic characteristics of steep slopes, rockiness, lack of water, and a short growing season have limited land use suitability classes within the project area (NRCS 2000).

Most of the smaller washes and creeks that originate in the open desert lands (Book Cliffs) and flow through irrigated croplands and residential areas of the Grand Valley were once ephemeral/intermittent systems. Administrative canal spills and irrigation return flows, groundwater, and precipitation from storm events account for the recent recognition of these waters as perennial systems, known to support aquatic life year-round.

Geology has played a dominant role in the types of soils that have developed in this region, and the topography in which they occur. Marine shales and sandstones of the Mancos shale formation are the primary parent materials of soils in this region. The Grand Valley is underlain with Mancos shale. Soils derived from Mancos shale have slow permeability rates, and thus, surface water runoff contributes to increased erosion and sedimentation. Soils derived from

Mancos shale generally have high percentages of silt and clay particles with associated thin, fine sandy loam surface horizons. As the Mancos deposits were laid down by the sea, salt (i.e., calcium sulfate/gypsum) was also deposited. Thus, soils developing in Mancos shale materials typically have high salts and sodium contents that may limit sustained vegetation cover. These soils also harbor high concentrations of selenium, a metalloid that is an essential trace nutrient for aquatic and terrestrial species. Bioaccumulation of selenium by waterfowl and aquatic life at low concentrations is highly toxic. The U.S. Fish and Wildlife Service (USFWS) has documented mortalities, reproductive failure, and deformities in fish and aquatic birds exposed to high concentrations of selenium throughout the United States (Martin 2007).

Sediments and colluvium from the Mesaverde formation, which forms the upper escarpments of the Book Cliffs, have also influenced soil development and characteristics. These soils do not have the high salt/alkali levels associated with the Mancos formation; soil textures are sandier and permeability is much greater. Thus, vegetation cover is greater than on the Mancos-derived soils, which reduces erosion. The sandier Mesaverde derived soils, however, may be subject to more rapid erosion from recreational use due to potential soil displacement and loss of vegetation. In general, there is a three- to eight-fold greater rate of erosion and sedimentation in watersheds from Mancos shale exposures (Badlands) and from moderately to steeply sloping, shallow Mancos shale-derived soils than from less sloping, sandier soils derived from the Mesaverde formation (BLM 2004).

Soil Types

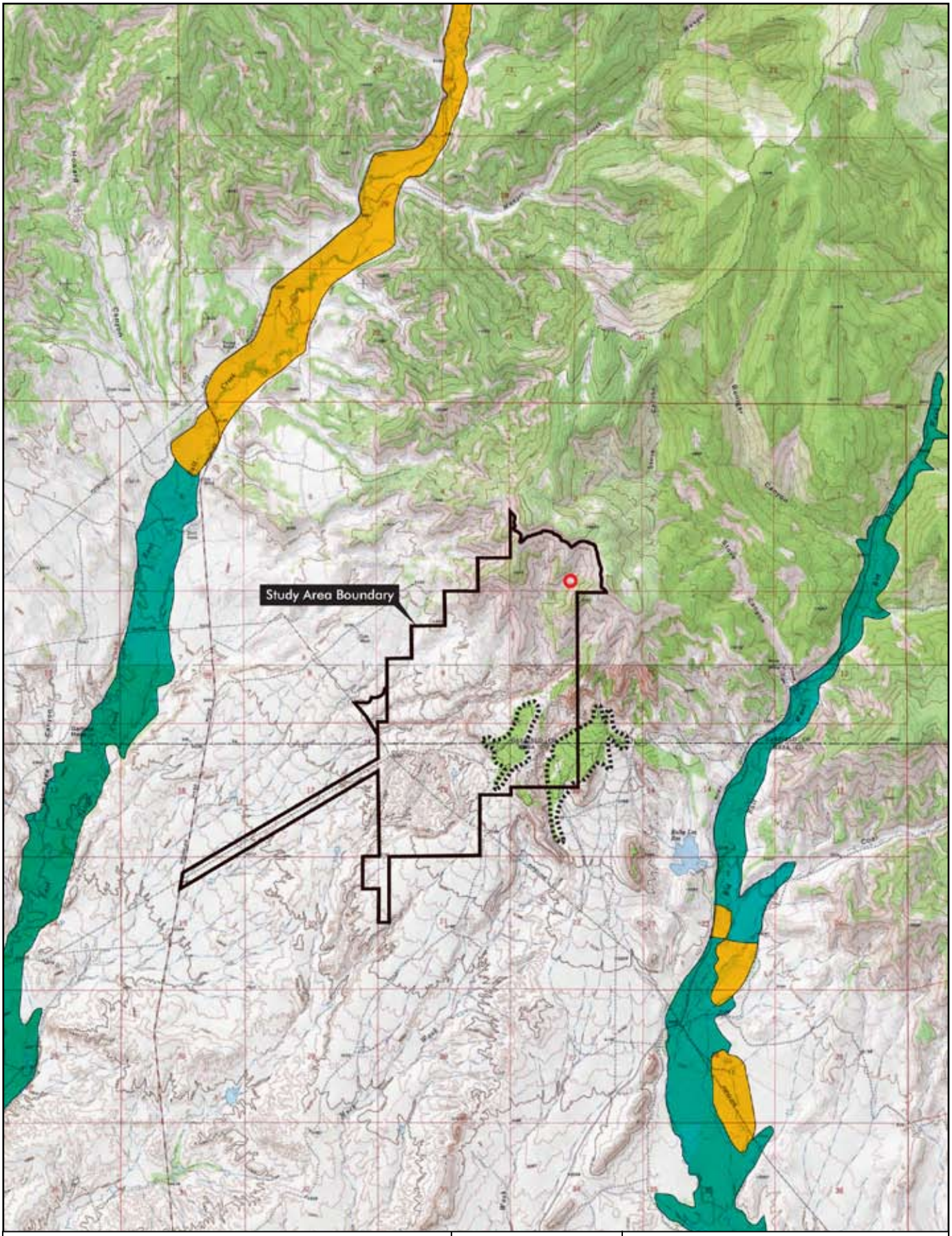
Identification of the soils that comprise the study area is essential for the assessment of reclamation and postmining land use in the affected areas. Appendix F, Soils Data, contains the soil map units within the project area (Figure 1, Appendix F) and corresponding description, relevant chemical and physical characteristics, and important farmland classification. The soils of the project area were divided into three sections according to the location, series types, and geologic formations. The northern section of the project area is proposed for existing and new federal coal extract leases and support facilities. The proposed railroad spur and power supply transmission line occur in the central and southern portions of the project area.

Northern Section

Steeper mountains and ridges dominate the northern section of the project area where active mining and associated facilities are proposed. This portion of the project area is extremely rough and eroded. Most of the soils are shallow and formed in residuum and colluvium derived from sandstone, shale, limestone, or siltstone. Dominant soils series in the northern section are of the Persayo and Mesa-Avalon series interspersed with rock outcrops. Within the northern section of the project area, a waste rock disposal area will be developed. Southeast of this designated use area there are dissected alluvial fans that are poorly suited for waste rock disposal areas. Alluvial fans are shown in Figure 3-10, Remnant Alluvial Fans at Red Cliff Mine Site.

Central Section

The central portion of the project area is dominated by shallow to deep, well-drained soils on hills, terraces, sideslopes, toeslopes, footslopes, and ridges. These soils formed in thin alluvium and residuum sediments weathered from underlying soft sedimentary bedrock such as sandstone and from saline marine shale. The Killpack soil series dominates the central portion.



Undifferentiated AVF

Recent alluvium, portions of which may be subirrigated

Remnant alluvial fans

Approximate location of mine water discharge

0 2666.5 5333 Feet

Scale is approximate

Source:

ERO Resources Corp.
1842 Clarkson Street
Denver, CO 80218
(303) 830-1188
Fax: (303) 830-1199

Red Cliff Mine EIS

Figure 3-10
Remnant Alluvial Fans
at Red Cliff Mine Site

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Southern Section

The southern portion of the study is more gently sloping than the northern and central sections and lies south of the Highline Canal. Soils in the central section are very deep and well drained, they formed in alluvium derived from shale, limestone, and sandstone on stream terraces on valley floors, alluvial fans on valley sides, and summits of mesas. The Fruitvale, Fruita, Fruitvale, and Persayo soil series dominate the southern portion of the project area.

Important Farmlands

Four categories of farmlands are federally regulated by the U.S. Department of Agriculture (USDA) under the Farmland Protection Policy Act: (1) Prime Farmlands, (2) Unique Farmlands, (3) Farmlands of Statewide Importance, and (4) Farmlands of Local Importance. Important farmlands are a distinction made by the Natural Resources Conservation Service (NRCS) as soils that support the crops necessary for the preservation of the nation's domestic food and other supplies, specifically the capacity to preserve high yields of food, seed, forage, fiber, and oilseed with minimal agricultural amendment of the soil, adequate water, and a sufficient growing season. There are several soil series in the project area that are classified as prime farmland if irrigated. Several parcels of irrigated farmland occur in the project area south of the Highline Canal.

Biological Crusts

The presence of biological crusts in arid and semi-arid lands have a very significant influence on reducing soil erosion by both wind and water, fixing atmospheric nitrogen, retaining soil moisture, and providing a living organic surface mulch. These crusts are a complex mosaic of cyanobacteria, green algae, lichens, mosses, microfungi, and other bacteria (Belnap et al. 2001). They can be used as an indicator of rangelands' ecological health. Development of biological crusts is strongly influenced by soil texture, soil chemistry, and successional colonization by crustal organisms. The type and abundance of biological crust can be used by a land manager to determine the ecological history and condition of a site. Biological crusts are generally found where there are openings in the vascular plant cover and protect open areas from wind and water erosion.

Biological soil crusts are known to occur on public lands near and within the project area (BLM 2004). The presence of biological soil crusts were verified during a site visit conducted in April 2005 by URS Corporation. Spatial inventories of these occurrences on public land in the project area for this Draft Environmental Impact Statement (DEIS) have not been performed.

Public Law 98-569, a 1984 Amendment to the Salinity Control Act, directed the Secretary of Interior to develop a comprehensive program for minimizing salt contributions from lands administered by the BLM. The BLM manages 48 million acres in the Colorado River Basin above Imperial Dam, or 40 percent of the Colorado River Basin's area. Of the 48 million, approximately 7.2 million acres, or about 15 percent, contain saline soils (slightly, moderate, and strongly saline soils). Salt enters the Colorado River and its tributaries from groundwater flows, surface runoff, and from point sources such as saline springs and flowing wells. The natural salt load for the Upper Basin (above Lee's Ferry, Arizona) is estimated to be about 5.2 million tpy. Contributions from BLM land are included in this estimate. Surface runoff from BLM-administered lands above Lee's Ferry is estimated to be about 700,000 tpy, or about 14 percent. The remaining 4.5 million tons are contributed primarily by groundwater inflow and saline springs from Federal, Tribal, State, and private lands.

The Colorado River Basin Salinity Control Forum (the Forum) was created by Congress in 1973 to provide the Basin States with the information necessary to comply with the Water Quality Standards for the Colorado River and Section 303 of the Clean Water Act. The Forum has an Advisory Council which was established as part of Section 204 of Public Law 93-320, the Colorado River Basin Salinity Control Act of 1974. The Advisory Council provides annual recommendations to Federal agencies in the form of a report that goes to Congress every year. A recommendation (1998) to BLM in this annual report was to identify "…to the Congress salinity control efforts as a stated measurable goal."

Key Features and Limitations

Key features and limitations of soil in the project area are identified in the table in Appendix F, Soils Data. Most importantly, the potentially problematic soil series are those prone to landslides and active erosion on steep slopes, indicated by gullying and piping processes. The high erosion potential soil series have been identified on Figure 1, Appendix F. Some soils in the project area have moderate to high expansive (high shrink-swell) properties and may contain evaporite minerals that are corrosive to conventional concrete and metal pipes. When wet, soils derived from Mancos shale become sticky and very slippery making unimproved roads virtually impassable. In moist conditions these soils contain excess water and have low bearing strength capacity, which may often result in structural damage if disturbed when wet. Saline or sodic soils may be difficult to stabilize and revegetate upon completion of construction activities, particularly on steeper slopes or slopes greater than 40 percent.

The following section describes the available hydrogeologic data and information on groundwater in the EIS study area. This section culminates with descriptions of the conceptual hydrogeologic model and the simple numerical model used to estimate groundwater flows.

3.2.6 Groundwater

Within the project area, there is alluvial and bedrock groundwater. Alluvial groundwater occurs in unconsolidated deposits of sand and gravel formed along drainage courses. The alluvial aquifer is capable of yielding sufficient water for domestic and stock water uses, and as irrigation water near the Colorado River where the alluvial aquifer is broad and the saturated thickness is greater. Groundwater also occurs in consolidated sandstone, siltstone and shale of the Mesaverde Group. The Red Cliff Mine plans to extract coal from the Cameo coal zone, which is in the lower portion of the Mesaverde Group. Based on borehole drilling logs and hydraulic testing within the project area and within the former Dorchester mine lease, which overlaps much of the CAM coal lease, the Mesaverde sandstones and coal beds are tight and yield small quantities of water. Underlying the Mesaverde Group is the Mancos Group, which is comprised predominantly of marine shale, mudstone and claystone with interbedded sandstone, siltstone, and limestone. Some of the sandstone maybe water-yielding; however, the Mancos Group is generally considered a confining unit that retards vertical and lateral groundwater flow (Robson and Banta 1995).

Alluvial Groundwater

Alluvial groundwater near the Red Cliff Mine occurs in Quaternary age sands and gravels within the East Salt Creek drainage west of the mine and within the Big Salt Wash drainage east of the

mine (Rare Earth Sciences, LLC and ERO Resources Corp. 2007). Saturated alluvium within the proposed mine lease is limited to the headwaters of East Salt Creek and along Big Salt Wash. The width of the two alluvial valleys ranges from as little as approximately 200 feet in the headwaters to as much as 2,000 feet south of the mine near the Colorado River. Remnant alluvial fans (or pediment deposits) border Mack Wash at higher elevations, but the alluvial fans have minimal, if any, water.

Groundwater in the alluvial drainages occurs primarily under unconfined conditions. Localized confined conditions may occur where clay layers are laterally extensive. The direction of groundwater flow in the alluvium is generally parallel or sub-parallel with the axis of the drainage. The hydraulic gradient of the groundwater is expected to be similar to the slope of the land surface within the alluvial valleys ranging from 0.02 to 0.03 in the upper reaches decreasing to between 0.01 and 0.015 in the lower reaches.

Alluvial groundwater is recharged by stream flow in the upper reaches of the drainages where there is more likely to be a separation between the channel bottom and the underlying alluvial water table. Recharge of the groundwater is greatest during precipitation events or snow melt runoff when the stage of the creeks increase and more water is able to infiltrate. A lesser amount of recharge may occur from bedrock formations and from irrigation return flows south of the Highline Canal. In the lower reaches of the drainages generally south of the mine, the alluvial groundwater may discharge to the creeks because of shallow water table conditions. This is evidenced by natural sub-irrigated vegetation, such as cottonwoods and tamarisk, within valley bottoms (Rare Earth Sciences, LLC and ERO Resources Corp. 2007).

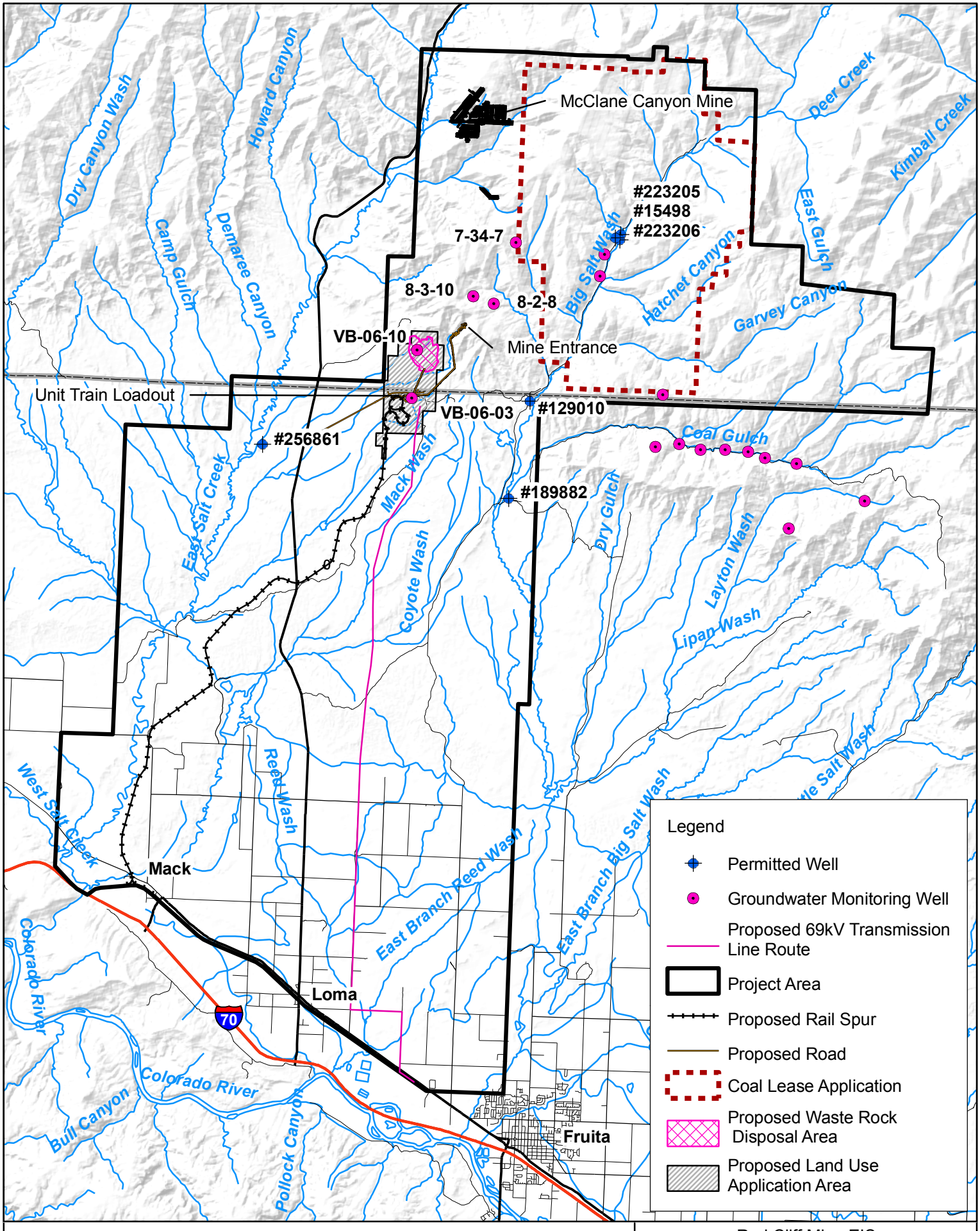
Information on alluvial aquifer characteristics is available from well permits maintained by Colorado Division of Water Resources (2007). Three permitted alluvial wells are within 3-miles radius of the proposed mine surface facilities (see Figure 3-11, Water Wells within the Project Area). Well No. 129010 is approximately 2 miles east of the mine in the alluvium of Big Salt Wash. The well is reported to be 100 feet deep with a pumping rate of 30 gallons per minute (gpm) and depth to water of 35 feet below ground surface. The well is used for stock watering. Another well (No. 189882 on Figure 3-11) is located approximately 3 miles southeast of the mine also in the alluvium of Big Salt Wash. The well is used for domestic water and stock watering; however, well completion information is not available. The remaining well (No. 256861 on Figure 3-11) is located approximately 4 miles southwest of the mine in the alluvium of East Salt Creek. The well is used for domestic water supply and reported to be 109 feet deep with a 12 gpm pumping rate. Based on the available information, the saturated alluvium in two drainages is expected to range from 60 to 70 feet thick and pumping rates may range from 10 to as much as around 40 gpm. Yields to wells are expected to vary depending on the variation in lithology and proximity of wells to the margins of the alluvial aquifers. Historical records from one alluvial well in this study area allow estimation of the hydraulic conductivity of the alluvial aquifer. The pumping and saturated thickness information from Well No. 129010 were used to approximate the hydraulic conductivity based on Darcy's Law. The hydraulic conductivity is estimated to be 9 feet/day (3×10^{-3} centimeters per second [cm/sec]) assuming a groundwater gradient similar to the sloping land surface of 0.02 and a width of saturated alluvium across the valley of 500 feet. The estimated hydraulic conductivity value is similar to values reported for a silty to medium-grained sand (Freeze and Cherry 1979), which is also similar to the Quaternary alluvial deposits in the valleys that is reported to be comprised of silt and sand (Cashion 1973).

In January 1984, the mine permit application for the Fruita Mine proposed by Dorchester Coal Company included baseline hydrologic data required by the State of Colorado [required by Rule 2.04.7(2)] (Kaman Tempo 1984). Even though Dorchester Coal Company's Fruita Mine project did not progress to the mining stage, the baseline hydrology data are useful for characterizing the potentially affected environment for this Red Cliff Mine EIS. The hydraulic conductivity of alluvium sediments has also been estimated based on hydraulic slug tests of two monitoring wells within the former Dorchester Coal Company lease area (Kaman Tempo 1984). The reported hydraulic conductivity values were 16 and 22 feet per day, which is similar to the value estimated based on the historical records from Well No. 129010.

The quality of alluvial groundwater in the upper reaches of the major drainages in the area is generally better than in the lower reaches of the drainages. The progressive increase in ion concentrations in groundwater is due to ion dissolution and ion exchange from the changing nature of bedrock underlying the alluvium (Coffin et al. 1971). The principal ions in the alluvial groundwater are calcium, magnesium, sodium, and bicarbonate. Baseline water quality data for shallow groundwater at the mine is available from two monitoring wells, VB-06-03 and VB-06-10 (Figure 3-11, Water Wells within the Project Area). Well VB-06-03 is within alluvial fan deposits near the proposed train loadout and VB-06-10 is within the proposed waste rock pile, also within shallow alluvial sediments. It is of note that the water in the two wells is not representative of alluvial groundwater present along Big Salt Wash and East Salt Creek. Instead the water may be isolated perched water that is not hydrologically connected to the more prominent alluvial aquifers.

Well VB-06-03 is 50 feet deep and monitors water in alluvial fan deposits. The well was reported to be dry in August and October 2006. The well was sampled in April and June 2007, and the static water levels were measured to be 38.6 and 43 feet below ground surface, respectively. The sometimes-dry conditions in the well suggest that the water may be perched and not part of a continuous water-bearing unit. In June 2007, the well was bailed dry, indicating a very low water yield to the well. Sample water from April and June 2007 was measured for field parameters only, and measurements were similar for each sample. The pH was 7.4, the conductivity was 13,200 micromhos per centimeter (µmhos/cm), and the temperature was 18.4 degrees Celsius (°C). Although chemical analyses were not performed on the samples, the elevated conductivity suggests that the water has a high total dissolved solids (TDS) concentration.

Well VB-06-10 is 29 feet deep and completed in a thin veneer of alluvial sediments on top of the Mancos Shale. Water levels were measured in August and October 2006 and in April and June 2007. Water levels were relatively consistent during these times, ranging from 18.2 to 18.7 feet below ground surface. The two 2007 water samples were analyzed, and the pH was 7.3 and 7.9, and the conductivity was 23,000 and 84,000 µmhos/cm. The water has elevated concentrations of most major ions, and TDS concentrations were reported to be 15,550 milligrams per liter (mg/L) and 56,530 mg/L based on lab analyses of samples collected in August and October, 2006, respectively. The analysis performed on the October 2006 sample showed bicarbonate was 733 mg/L, sulfate was 12,652 mg/L, calcium was 536 mg/L, magnesium was 5,137 mg/L, chloride was 157 mg/L, and sodium was 7,725 mg/L. Some of the dissolved metal concentrations are also elevated including arsenic at 2 mg/L, iron at 95 mg/L, manganese at



Red Cliff Mine EIS

Figure 3-11
Water Wells within the Project Area

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1.3 mg/L, selenium at 0.95 mg/L and zinc at 1.5 mg/L. These chemical analyses indicate that the baseline groundwater quality in the vicinity of the proposed waste disposal area is poor, does not meet drinking water standards for several constituents, and is not usable for most purposes.

Bedrock Groundwater

The regional occurrence of groundwater in the Mesaverde Group is limited to isolated sandstone beds, coal-bearing members, and along faults and fracture zones (BLM/USFS 1999). Water level data from wells at the Red Cliff Mine suggest that this is also the case near the mine. Information on the occurrence of bedrock groundwater at the Red Cliff Mine is available from three monitoring wells monitored by CAM (Stover 2008). Two of the wells (8-2-8 and 8-3-10) are located approximately 0.5 mile northeast of the proposed mine entrance and the third well (7-34-7) is another mile to the northeast (Figure 3-11, Water Wells within the Project Area). CAM plans to recover coal reserves through underground mining in the Cameo coal zone. Thus these wells are monitored to provide information on groundwater near the coal zone in the lower portion of the Mesaverde Group. Completion information for the wells is summarized in Table 3-12, Groundwater Data Near the Red Cliff Mine.

Table 3-12
GROUNDWATER DATA NEAR THE RED CLIFF MINE

Monitoring Well ID	Estimated Collar Elevation (ft)	Total Borehole Depth (ft)	Total Well Depth (ft)	Screened Interval (ft)	Cameo Coal Zone (ft)	Well Construction
8-2-8	6,216	404	404	384 to 394	357 to 375	2-inch PVC
8-3-10	6,439	540	540	492 to 510	492 to 510	2-inch PVC
7-34-7	6,613	971	360	350 to 360	925 to 935	2-inch PVC

Notes:
ft = feet
ID = identification number
PVC = polyvinyl chloride

Water levels in well 8-2-8 measured from May 2006 through June 2007 were relatively consistent at depths ranging from 391 to 394 feet below ground surface or corresponding elevations between 5,822 and 5,825 feet. The water levels are near the bottom few feet of the Cameo coal zone. The borehole log for the well noted that no water was encountered during drilling, which indicates that the bedrock that overlies the Cameo coal zone at this location contains minimal, if any, groundwater and that the Cameo coal zone yields very little water.

Well 8-3-10 water levels have been consistent since June 2006 at a depth of around 535 feet or an elevation of 5,903 feet. Water levels at this depth are 25 feet below the base of the Cameo coal zone. A couple of higher water levels measured in 2006 suggest that the lower portion of the Cameo coal zone may contain groundwater at certain times of the year.

The remaining well 7-34-7 is farther to the northeast and the borehole log noted 1 to 2 gpm of groundwater inflow at a depth of 356 feet and the well was screened across this water-bearing zone. Water levels in the well have been steadily decreasing from a depth of 171 feet in September 2005 to a depth of 311 feet in June 2007. The June 2007 water level corresponds to an elevation of 6,302 feet. Such a large, steady decline in water levels is uncharacteristic of bedrock formations in the area. The declining water level may be drilling water introduced into

the surrounding formation that is draining over time. The water level is expected to further decrease until reaching the water-bearing zone at a depth of approximately 356 feet. It is unclear if the water-bearing zone at 356 feet represents the regional water table, a perched zone, or water within a fracture or fault zone. The hydraulic connection between the water-bearing zone and the Cameo coal zone that is approximately 570 feet lower is also unclear.

Snow melt provides most of the recharge to the bedrock formations and is greatest where sandstone layers are exposed as dip-slopes at higher elevations. Little water recharges the bedrock vertically through the formations, except where alluvial drainages may transmit water to underlying bedrock formations (e.g., Big Salt Wash).

Bedrock formations in the Mesaverde Group transmit little groundwater because of the relatively low transmissivity of the fine-grained sandstone, and interbedded coal and shale (Brooks 1983). Further, the Mesaverde formations are typically not productive water-bearing zones due to poor lateral continuity. The permeability of the Cameo coal zone and surrounding sandstone and shale is generally quite low and testing of wells in the Cameo coal zone show that it produces very little water (Reinecke et al. 1991). Available information from hydraulic tests in the Mesaverde formations in the Piceance Basin of Delta County support a low permeability. Transmissivity values for coal beds in the lower Mesaverde formation range from 1.5 to 16.7 square feet per day (ft^2/day), with corresponding hydraulic conductivity values between 0.003 to 0.03 ft/day (U.S. Geological Survey [USGS] 1983). Additional hydraulic conductivity values for the Cameo coal zone are from pumping tests in monitoring wells within the former Dorchester Mine lease area. The hydraulic conductivity for the Cameo coal zone is low, averaging 0.11 feet per day. Overburden water-bearing zones overlying the Cameo coal zone have also been tested within the Dorchester Mine lease area. The overburden also has a low hydraulic conductivity, with values averaging 0.007 feet per day.

In addition to data from monitor wells provided by CAM, groundwater level data are available from the baseline hydrologic report submitted for the Fruita Mine Permit Application submitted by Dorchester Coal Company (Kaman Tempo 1984). Available groundwater level data in Table 3-13, Groundwater Level Data, have been evaluated to develop the conceptual hydrogeologic model as described in the following text.

Table 3-13
GROUNDWATER LEVEL DATA

Well	Water Elevation (feet msl)	Ground Elevation (feet msl)	Datum Elevation (feet msl)	Data Source	Well Completion Interval
Wells Completed Below Water Table					
8-2-8	5822	6214	6216	Stover 2008	Below Cameo Seam
7-34-7	6354	6611	6613	Stover 2008	Above Cameo Seam
CM-1	5466	5568	5570	Kaman Tempo 1984	Anchor Seam
CM-2	5518	5717	5719	Kaman Tempo 1984	Within Cameo Seam
CM-3	5644	5838	5840	Kaman Tempo 1984	Overburden
CM-7	5489	5638	5640	Kaman Tempo 1984	Interburden (Cameo)
56C	5582	5648	5650	Kaman Tempo 1984	Cameo
580B	5644	5778	5780	Kaman Tempo 1984	Overburden
58C	5548	5778	5780	Kaman Tempo 1984	Cameo
59OB	5758	5961	5963	Kaman Tempo 1984	Overburden

Table 3-13
GROUNDWATER LEVEL DATA

Well	Water Elevation (feet msl)	Ground Elevation (feet msl)	Datum Elevation (feet msl)	Data Source	Well Completion Interval
59C	5690	5961	5963	Kaman Tempo 1984	Cameo
59W/OB	5600	5964	5966	Kaman Tempo 1984	Overburden
59W/C	5569	5964	5966	Kaman Tempo 1984	Cameo
70UA	5986	6192	6194	Kaman Tempo 1984	Overburden
70C	5865	6192	6194	Kaman Tempo 1984	Cameo
Wells Completed in Perched, Interflow Zones					
71OB	5688	6644	6646	Kaman Tempo 1984	Overburden
62OB	5567	6563	6565	Kaman Tempo 1984	Overburden
Dry Wells					
69OB	dry	6200	6202	Kaman Tempo 1984	Upper Aquifer
8-3-10	dry	6437	6439	Stover 2008	Within Cameo Seam Dry at TD, 510 feet below ground elevation.

Notes:
msl = mean sea level
TD = total depth

Information on possible groundwater inflow rates to the Red Cliff Mine may be inferred from the nearby MCM , which is approximately 4 miles north of the proposed mine entrance (Figure 3-11, Water Wells within the Project Area). Based on the annual hydrology reports submitted by CAM, the mine inflows have been as follows:

Water Year	Inflow (gpm)
2001	9.1
2002	9.9
2003	12.4
2004	19.9
2005	31.4
2006	16.4
2007	11.3

Consistent with the available data, a conceptual hydrogeologic model has been developed, and a simple numerical model of groundwater flow has been applied to estimate the future groundwater inflows for this DEIS, as described in later parts of this section.

Groundwater quality in the bedrock formations of the Mesaverde Group varies greatly, depending on geology and elevation. The best water quality (i.e., low TDS) occurs near mountain recharge areas and the poorest quality occurs at lower elevations. The quality of water is poorer with increased depth and distance from outcrops (e.g., recharge locations). As an example, a water sample take from a 5,400-foot-deep well near the central portion of the Piceance Basin within the Cameo Coal Group exhibited a TDS concentration of 15,500 mg/L (EPA 2004). Water quality near the margins of the basin may have sufficient meteoric

groundwater circulation and better quality. Bedrock groundwater quality is poor due to sodium bicarbonate deposits and salt beds. In general, potable water wells in the area extend no deeper than 200 feet, based on well records maintained by the Colorado Division of Water Resources (EPA 2004).

Baseline bedrock groundwater quality at the Red Cliff Mine is available from three monitoring wells. The wells were sampled between three and six times over the 2005 through 2006 period. A summary of the bedrock water quality is contained in Table 3-14, Baseline Bedrock Groundwater Quality for Red Cliff Mine. The minimum, average, and maximum concentrations or values are presented in the table. Bedrock groundwater ranges from slightly basic to slightly acidic, but is generally near neutral with average values in the low 7's. The two wells that monitor groundwater near the base of the Cameo coal zone (8-2-8 and 8-3-10) have notably poorer quality than the well that monitors groundwater above the Cameo coal zone (7-34-7). This is consistent with other observations in the Piceance Basin that show degradation in groundwater quality at greater depths.

The two wells that monitor groundwater near the base of the Cameo coal zone (8-2-8 and 8-3-10) have TDS concentrations ranging from 1,400 to 6,200 mg/L. The waters contain high concentrations of several major cations and anions. Based on the average concentrations in Table 3-14, Baseline Bedrock Groundwater Quality for Red Cliff Mine, the water in well 8-2-8 is a sodium-magnesium-carbonate-bicarbonate-sulfate type and the water in 8-3-10 is a sodium-chloride-carbonate-bicarbonate-sulfate type. Concentrations are elevated for some metals most notably iron, which averages 10 and 59 mg/L in the two respective wells. Other metals with elevated concentrations include arsenic, manganese, and selenium.

The well that monitors groundwater in overburden above the Cameo coal zone (7-34-7) has better water quality. Total dissolved solids have reached a concentration of 2,200 mg/L in one sample, but concentrations are typical between 400 to 500 mg/L in the other samples from the well. The water is rich in several major cations and anions. Based on the average concentrations in Table 3-14, Baseline Bedrock Groundwater Quality for Red Cliff Mine, the water in well 7-34-7 is a calcium-sulfate-bicarbonate type. The water is absent carbonate unlike the groundwater in the other two wells. Average concentrations of metals are generally one to three orders of magnitude less than groundwater in the two wells that monitor the Cameo coal zone.

Groundwater quality in the overburden and Cameo coal zone has been measured in monitoring wells within the former Dorchester Mine permit area, which overlaps into the project area. Sample data are available for the 1981 to 1983 period as documented in the Dorchester Mine permit, and the chemical data are summarized in Table 3-15, Summary of Overburden and Cameo Coal Zone Groundwater Quality from Dorchester Mine Monitoring Wells (1981 to 1983), for selected parameters. Sodium is the major cation in groundwater from the overburden and Cameo coal zone. Sulfate and bicarbonate make up most of the anions. Total dissolved solids are elevated and as high as 3,400 mg/L in the overburden and 4,400 mg/L in the Cameo coal zone. Sulfate tends to be lower in the Cameo coal zone than in the overburden. Concentrations of metals are low; however, elevated concentrations of iron, manganese, and zinc occur in groundwater from the Cameo coal zone.

Table 3-14
BASELINE BEDROCK GROUNDWATER QUALITY FOR RED CLIFF MINE

		Well 8-2-8			Well 8-3-10			Well 7-34-7			Groundwater Standard
		Monitored Zone: Base of the Cameo Coal Zone			Monitored Zone: Below or Near the Base of the Cameo Coal Zone			Monitored Zone: Approx. 570 feet Above the Cameo Coal Zone			
		(Based on May, June, August and October 2006 Samples)			(Based on May, June, and August 2006 Samples)			(Based on September and December 2005; and May, June, August, and October 2006 Samples)			
Laboratory Parameter	**Units**	**Min**	**Ave**	**Max**	**Min**	**Ave**	**Max**	**Min**	**Ave**	**Max**	
pH	su	5.8	7.2	8.1	6.1	7.2	7.8	6.2	7.5	8.3	6.5 to 8.5
Conductivity	µmhos/cm	1,844	1,991	2,254	1,476	3,094	6,100	554	910	2,274	-
Total Dissolved Solids	mg/L	1,399	1,573	1,778	3,050	4,306	6,164	361	741	2,229	-
Total Alkalinity	mg/L	630	717	848	702	941	1,330	154	199	283	-
Bicarbonate	mg/L	630	680	707	702	886	1,165	147	198	283	-
Carbonate	mg/L	75	352	630	83	437	792	2	2	2	-
Hydroxide	mg/L	2	2	2	2	2	2	2	2	2	-
Sulfate	mg/L	309	463	654	218	526	700	37	280	1,129	250
Calcium	mg/L	49.6	67.4	86.8	59.3	152	288	43	68.3	137.8	-
Magnesium	mg/L	72.6	87.6	100.6	27.9	51.6	86.0	15.0	22.4	38.1	-
Ammonia	mg/L	0.2	1.5	3.7	2.1	5.2	11.2	0.0	0.1	0.2	-
Hardness	mg/L	423	548	631	263	592	1073	174	252	427	-
Chloride	mg/L	<0.05	8.7	22.5	<0.5	518.1	1553.2	0.5	33.3	106.1	250
Sodium	mg/L	148	212	301	162	409	841	3	97	329	
Nitrate	mg/L	<0.15	0.33	0.86	0.45	28.3	82.1	NA			10
Nitrite	mg/L	0.01	0.012	0.017	0.01	0.14	0.4	NA			1
Phosphate	mg/L	0.08	0.30	0.86	0.08	1.10	2.52	0.02	0.06	0.15	-
Arsenic - Dissolved	mg/L	0.01	0.31	0.67	0.002	0.23	0.41	0.003	0.09	0.43	0.05

Table 3-14
BASELINE BEDROCK GROUNDWATER QUALITY FOR RED CLIFF MINE

		Well 8-2-8			Well 8-3-10			Well 7-34-7			Groundwater Standard
		Monitored Zone: Base of the Cameo Coal Zone			Monitored Zone: Below or Near the Base of the Cameo Coal Zone			Monitored Zone: Approx. 570 feet Above the Cameo Coal Zone			
		(Based on May, June, August and October 2006 Samples)			(Based on May, June, and August 2006 Samples)			(Based on September and December 2005; and May, June, August, and October 2006 Samples)			
Laboratory Parameter	**Units**	**Min**	**Ave**	**Max**	**Min**	**Ave**	**Max**	**Min**	**Ave**	**Max**	
Cadmium - Dissolved	mg/L	<0.002	0.04	0.08	0.02	0.03	0.04	<0.001	0.004	0.01	0.005
Iron - Dissolved	mg/L	1	7.9	20.3	4.1	15.65	25.6	<0.01	0.02	0.032	0.3
Iron - Total Recoverable	mg/L	1.25	10.2	25.0	8.8	58.5	143.4	0.01	0.09	0.21	-
Manganese - Dissolved	mg/L	0.34	0.40	0.50	0.13	0.25	0.37	0.005	0.008	0.011	0.05
Manganese - Total	mg/L	0.35	0.41	0.51	0.48	1.36	2.88	0.007	0.021	0.04	-
Mercury - Dissolved	mg/L	0.000029	0.000073	0.00011	0.000027	0.00009	0.00018	0.000018	0.000077	0.00023	0.002
Selenium - Dissolved	mg/L	0.0066	0.12	0.20	0.034	0.25	0.51	0.0026	0.081	0.34	0.05
Zinc - Dissolved	mg/L	0.41	0.66	0.91	0.25	0.51	0.87	0.01	0.029	0.07	5

Notes: Analytical results are provided by CAM-Colorado, LLC

Groundwater Standards from Colorado Department of Public Health and Environment Water Quality Control Commission, Regulation No. 41, Basic Standards for Ground Water; Domestic Drinking Water Supply Standards.

< = less than
Ave = average
Min = minimum
Max = maximum
mg/L = milligrams per liter
NA = Parameter not analyzed
su = Standard Unit
µmhos/cm = micromhos per centimeter

Table 3-15
SUMMARY OF OVERBURDEN AND CAMEO COAL ZONE GROUNDWATER QUALITY FROM DORCHESTER MINE MONITORING WELLS (1981 TO 1983)

Selected Parameter (mg/L)	Overburden	Cameo Coal Zone	Groundwater Standard
pH (su)	7.7 to 8.9	7.3 to 8.9	6.5-8.5
Specific conductance (µmhos)	310 to 5,100	250 to 4,600	-
Total dissolved solids	1,200 to 3,400	212 to 4,400	-
Alkalinity	479 to 2,200	130 to 1,800	-
Arsenic	<0.005	<0.005 to 0.014	0.05
Cadmium	<0.005 to 0.04	<0.001 to 0.028	0.005
Copper	<0.01 to 0.38	0.001 to 0.45	1.0
Fluoride	1.2 to 2.9	0.001 to 4.0	4.0
Iron	<0.01 to 6	0.014 to 11	0.3
Lead	<0.01 to 0.18	0.003 to 0.11	0.05
Manganese	0.02 to 0.73	0.005 to 1.13	0.05
Selenium	<0.005 to 0.037	<0.005	0.05
Zinc	<0.001 to 0.37	0.012 to 2.46	5
Chloride	4 to 80	<0.01 to 67	250
Calcium	4 to 238	3 to 48	-
Potassium	2 to 32	4 to 39	-
Magnesium	4 to 150	1 to 134	-
Sodium	500 to 1,000	14 to 3,200	-
Sulfate	8 to 1,930	13 to 829	250
Nitrate	<0.05 to 0.4	0.17 to 1.1	10

Notes:
< = less than
µmhos = micromhos
mg/L = milligrams per liter
su = Standard Unit

Additional baseline bedrock water quality data in the vicinity of the Red Cliff Mine is available from the nearby MCM . Inflow water quality to the Red Cliff Mine is expected to be similar to MCM. Inflow water quality data are available from the first and third quarters of 2006, during which time the underground mine discharge water was sampled (see Table 3-16, Water Quality for McClane Canyon Mine Discharge Water [Underground Samples]). The water is slightly basic, with pH values of 8.4. Total dissolved solids concentrations were 1,600 and 1,700 mg/L. The water is rich in bicarbonate and concentrations are as high as 1,297 mg/L. Based on the first quarter 2006 sample data in Table 3-14, Baseline Bedrock Groundwater Quality for Red Cliff Mine, the discharge water is a sodium-magnesium-bicarbonate-sulfate type. The overall water chemistry is generally similar to the chemistry from wells 8-2-8 and 8-3-10 at the Red Cliff Mine, with the exception of iron, arsenic, and manganese concentrations that are notably lower in the MCM discharge water.

Table 3-16
WATER QUALITY FOR MCCLANE CANYON MINE DISCHARGE WATER (UNDERGROUND SAMPLES)

Parameter/Value	Units	1st Quarter 2006	3rd Quarter 2006
Pumping Rate	gpm	150	--
pH	su	8.42	8.37
Conductivity	µmhos/cm	2,336	2,266
Total Suspended Solids	mg/L	1,700	1,601
Bicarbonate	mg/L	1,297	1,017
Calcium	mg/L	59	9
Carbonate	mg/L	58	9
Chloride	mg/L	25.2	<0.5
Magnesium	mg/L	88	17
Potassium	mg/L	2.9	7.1
Sodium	mg/L	239	298
Sulfate	mg/L	286	326
Aluminum	mg/L	<0.05	<0.05
Arsenic	mg/L	0.007	0.01
Boron	mg/L	0.95	0.85
Copper	mg/L	0.025	0.011
Iron	mg/L	0.07	<0.01
Lead	mg/L	<0.05	0.05
Manganese	mg/L	<0.01	0.057
Selenium	mg/L	0.177	0.34

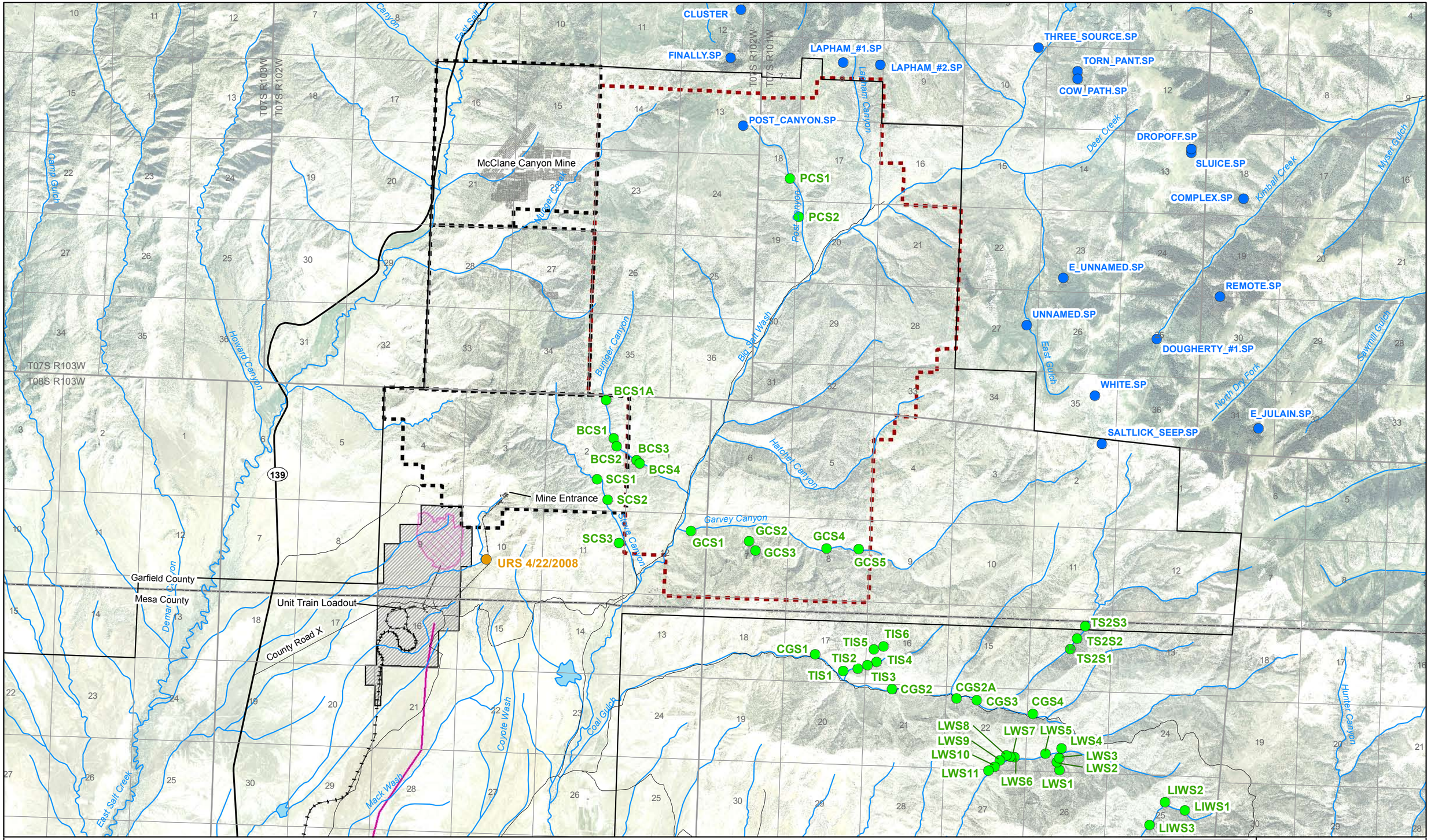
Source: Rare Earth Science, LLC 2007.

Notes:

<	=	less than
µmhos/cm	=	micromhos per centimeter
gpm	=	gallons per minute
mg/L	=	milligrams per liter
su	=	Standard Unit

Springs and Seeps

Springs in the study area have been mapped and described based on data available from the BLM geographic information systems (GIS) database, a hydrogeologic field reconnaissance of the mine facilities area, and historical information collected for Dorchester Coal Company. Even though a comprehensive inventory of all springs has not been completed in all portions of the proposed lease area, a sufficient number of springs have been located, mapped, described, and sampled during previous studies to provide a basis for characterizing the nature of the springs for this DEIS. Detailed spring and seep surveys were conducted in 1982 and 1983 for the Fruita Mine permit application, which was for the mine proposed by Dorchester Coal Company in 1984, but never started. Figure 3-12, Spring Locations, shows the locations of the springs within and surrounding the Red Cliff Mine project area.



Legend

- 69kV Transmission Line Route
- Proposed Rail Spur
- Proposed Road
- Proposed Waste Rock Disposal Area
- Existing Lease
- Coal Lease Application
- Proposed Land Use Application Area
- Project Area
- Spring Observed by URS on 04/22/08
- Springs Surveyed in 1982-1983 (Kaman Tempo, 1984)
- Springs in BLM GIS Database (2008)

N

0 0.5 1 2 3 Miles

Map Extent

Red Cliff Mine EIS

Figure 3-12
Spring Locations

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Descriptions of the springs, flow rates and water quality information are provided in the Fruita Mine baseline hydrologic data report (Kaman Tempo 1984), which is reproduced in Appendix G, Water Data and Information. Those surveys locate and characterize springs and seeps in the area of the existing CAM coal lease, and in the southern and western portions of the proposed coal lease area, along Coal Gulch, Garvey Canyon, Big Salt Wash, and Buniger Canyon. Major findings of the surveys are summarized in the subsequent text.

Springs in this area have very low flows, which vary seasonally. Most springs flow at less than 1 gpm, and dry up during the summer. In many locations, white salt deposits on the sandstone outcrops suggest the presence of intermittent springs. Many of these intermittent springs emerge from sandstone units and fractures exposed on rugged, steep valley walls, and appear to be supported by localized, perched groundwater tables.

The larger, more persistent springs emanate from fractures in sandstone units exposed locally in the incised stream channels of the major drainages. Some springs issue from coal seams, or from alluvium lying along the larger drainage valleys, support surface flow in limited reaches of Garvey Canyon, Coal Gulch, and Hunter Canyon during some portions of the year. These springs are typically obscured by runoff in spring and early summer. In September 1983, some of the larger springs flowed at slightly higher rates than in November 1983, when the largest springs flowed at less than 2 gpm. In September and November, springs in Coal Gulch and Hunter Canyon supported flows in only short reaches of those drainages.

In 1984, the baseline hydrology report by Kaman Tempo for the Fruita Mine (proposed by Dorchester Coal Company) commented that many spring locations are statigraphically controlled, and associated with outcrops or subcrops of sandstone and coal. The Kaman Tempo report stated that the most apparent geologic control on groundwater movement is the unnamed syncline that intersects Hunter Canyon and Coal Gulch. (This syncline is shown on Map 2.04.7-1, which is reproduced in Appendix G, Water Data and Information.) The report suggested that the relatively intense fracturing along the synclinal axis may provide a preferential path for groundwater movement, and noted that several springs exist along the synclinal axis in Hunter Canyon and Coal Gulch.

Where sufficient flows allowed, samples collected for lab analyses showed the spring water to be of sodium-sulfate type with high concentrations of TDS, sodium, and sulfate. Water quality data for the springs are provided in Appendix G, Water Data and Information. Overall, the spring water is of poor quality and would not be suitable for domestic use because the sulfate and TDS concentrations exceed drinking water standards. Nonetheless, the water quality of the spring water is suitable for livestock and wildlife, and possibly some types of agriculture. Most springs are located at high elevations in narrow rocky canyons, which are difficult to access. None of the springs have been developed for human use.

A low-flow investigation along Big Salt Wash was conducted in the fall of 1983 for the purpose of identifying groundwater contributions to streamflow (Kaman Tempo 1984). That investigation found that the Big Salt Wash reach from Post Canyon to Ruby Lee Diversion is neither a gaining nor a losing stream. Therefore, groundwater recharge or discharge along that stream reach was found to be negligible.

In April 2008, URS hydrogeologists performed a site reconnaissance of the areas of the proposed Red Cliff Mine facilities, the existing coal lease area, and portions of the proposed coal lease area, to further evaluate the hydrogeologic conditions and assess the springs. URS observed:

- The 1982–1983 spring surveys provided a reasonable, comprehensive description of the spring characteristics in the existing and proposed lease areas, however several of the spring locations reported in the earlier surveys were found to be dry in April 2008. (The locations of springs mapped during the 1982-1983 surveys are shown in Appendix G, Water Data and Information, Map 2.04.7-1.)
- No springs or seeps were found within or near the planned waste rock disposal area, conveyor area or unit train loadout area;
- Near the proposed mine entrance, one small spring exists, which was not reported in the 1982–1983 survey report; it is located at the bottom of the drainage approximately 350 feet down slope from the proposed portal location; this spring was flowing at less than 2 gpm on April 22, 2008.

A comparison between the land surface elevations of the reported springs and the water table elevation provides an indication of the hydrogeologic relationship between the saturated groundwater flow system and the springs. Table 3-17, Estimated Depth of Groundwater Table at Spring Locations, shows the estimated depth to the water table below each spring described in the 1982-1983 survey reports. The water table elevation is estimated based on the empirical relationship shown on Figure 3-13, Groundwater Levels and Surface Topography. This information indicates all the springs emanate from substantially higher elevations than the water table elevation estimated at the same location. Thus, the source of the springs is likely to be shallow zones of interflow or perched water, that are not hydraulically connected with the water table of the saturated groundwater flow system.

Table 3-17
ESTIMATED DEPTH OF GROUNDWATER TABLE AT SPRING LOCATIONS

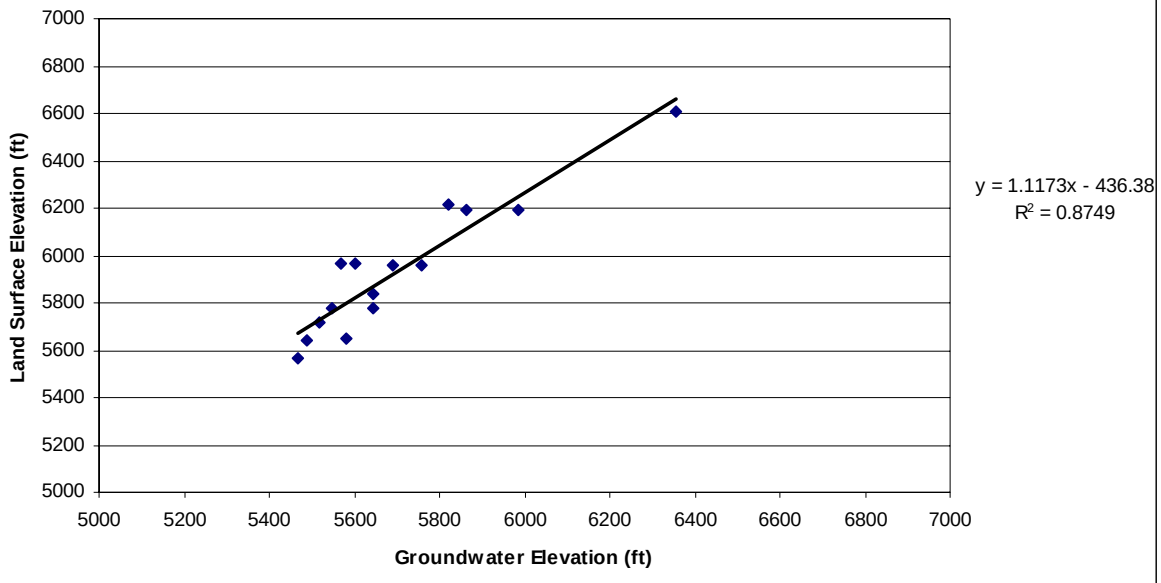
Spring Name	Spring Elevation (feet, msl)	Groundwater Table Elevation * (feet, msl)	Depth to Ground-water Table (feet)		Spring Name	Spring Elevation (feet, msl)	Groundwater Table Elevation * (feet, msl)	Depth to Ground-water Table (feet)
CGS1	5540	5349	191		LWS8	5630	5429	201
CGS2	5640	5438	202		LWS9	5625	5425	200
CGS2A	5780	5564	216		LWS10	5760	5546	214
CGS3	5820	5600	220		LWS10A	5550	5358	192
CGS4	6020	5779	241		LWS11	5560	5367	193
T1S1	5630	5429	201		LWS11A	5300	5134	166
T1S2	5680	5474	206		LWS12	5240	5080	160
T1S3	5740	5528	212		PCS1	6190	5931	259
T1S4	5790	5573	217		PCS2	6110	5859	251
T1S5	5960	5725	235		LW1S6	5480	5295	185
T1S6	6120	5868	252		HCS1	5710	5501	209
T2S1	6110	5859	251		HCS2	5690	5483	207
T2S2	6140	5886	254		HCS3	5680	5474	206
T2S3	6190	5931	259		HCS4	5605	5407	198
GCS5	5510	5322	188		HCS5	5600	5403	197
GCS4	5675	5470	205		HCS6	5560	5367	193
GCS1	6000	5761	239		HCS7	5530	5340	190

Table 3-17
ESTIMATED DEPTH OF GROUNDWATER TABLE AT SPRING LOCATIONS

Spring Name	Spring Elevation (feet, msl)	Groundwater Table Elevation * (feet, msl)	Depth to Ground-water Table (feet)		Spring Name	Spring Elevation (feet, msl)	Groundwater Table Elevation * (feet, msl)	Depth to Ground-water Table (feet)
GCS2	5580	5385	195		HCS8	5525	5336	189
GCS3	5680	5474	206		HCS9	5520	5331	189
LiWS1	6140	5886	254		HCS10	5515	5327	188
LiWS2	5980	5743	237		HCS11	5500	5313	187
LiWS3	5880	5653	227		HCS12	5485	5300	185
LiWS4	5710	5501	209		BSC1	5790	5573	217
LiWS5	5680	5474	206		BSC1A	5850	5626	224
LWS1	6120	5868	252		BSC2	5720	5510	210
LWS2	6100	5850	250		BSC3	5630	5429	201
LWS3	6140	5886	254		BSC4	5620	5421	199
LWS4	5920	5689	231		SCS1	5635	5434	201
LWS5	5780	5564	216		SCS2	5615	5416	199
LWS6	5670	5465	205		SCS3	5550	5358	192
LWS7	5640	5438	202		CGS4	5675	5470	205

* Notes:
Groundwater table elevation is estimated based on linear regression equation shown on Figure 3-13, Groundwater Level Data.
msl = mean sea level

Figure 3-13 Groundwater Levels and Land Surface Topography



Groundwater Rights

Water rights are administered by the Colorado Division of Water Resources, Office of the State Engineer (OSE). Table F-1 of Appendix G, Water Data and Information, which was compiled from the OSE water rights database, lists the water rights and well permits within one mile of the project area boundary. Table F-2 of Appendix G includes water rights at springs both within the project area, and within one mile outside of the project area boundary. CAM holds well permits on two monitoring wells in the project area (permit numbers 270165 and 270164 in Table F-1 of Appendix G). There are three permitted alluvial wells located within a 3-mile radius of the proposed ROW area boundary, which are described in the beginning of this groundwater section, and located on Figure 3-11, Water Wells within the Project Area. Further northeast, outside the existing coal lease area, there are three more wells included in the OSE water rights database. These three wells are located within the central portion of the proposed coal lease area, along Big Salt Wash upstream of Hatchett Canyon. Information on these wells is shown for permit numbers 15498, 223206, and 223205 in Table F-1 of Appendix G. Well permit 15498 is for irrigation use, while the other two wells are permitted for domestic uses.

3.2.6.1 Conceptual Hydrogeologic Model

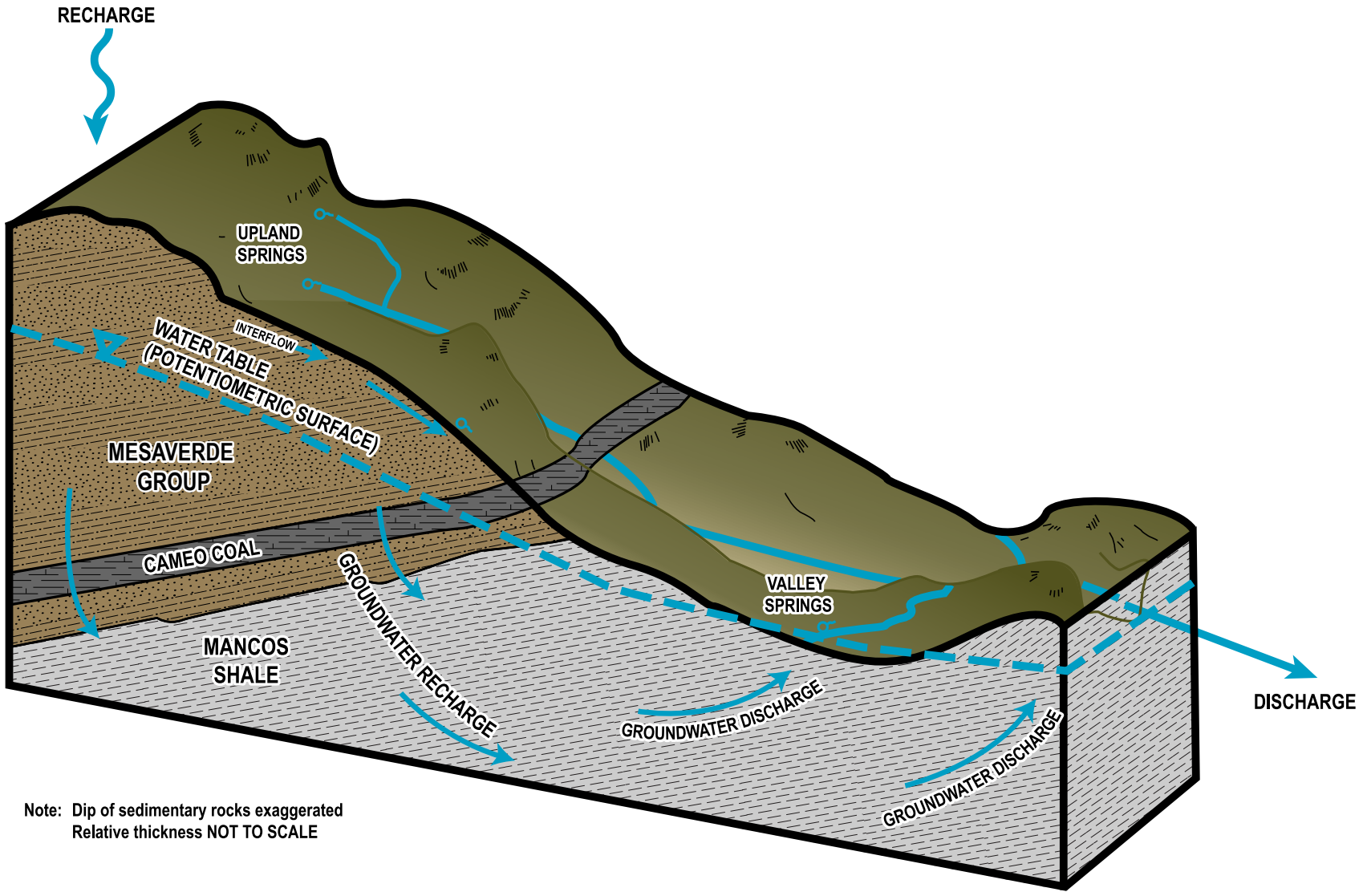
A conceptual hydrogeologic model for this DEIS study area has been developed based on an evaluation of the available hydrogeologic data and site information. The conceptual model aids in understanding groundwater flow system, including the inter-relationships between the groundwater regime and the surface water regime, and serves as the foundation for developing a mathematical groundwater flow model to estimate groundwater inflow rates to the proposed mine for the EIS impacts assessment (see Section 4.2.6, Groundwater).

Components of the Hydrologic System

The hydrologic system consists of physical processes at and below the land surface that dynamically interact in response to meteorologic conditions and anthropogenic factors. Below the land surface, water moving in the unsaturated zone also interacts with the processes controlling flow in and out of the deeper saturated groundwater zone. Accordingly, the conceptual model for this site is divided into three hydrologic components: (1) surface water flow, (2) interflow, and (3) groundwater flow. Figure 3-14, Conceptual Hydrogeologic Model, is a simple diagram to illustrate relationships between the major components of the conceptual hydrogeologic model for this study area.

Surface Water

A satellite image showing the land surface in the study area is included as Figure 3-15, Satellite Image of the Study Area. This figure is created from the remote sensing data obtained by the ASTER satellite on August 22, 2007. The near-infrared band is processed with the panchromatic band to reveal surface water features, vegetation, and to sharpen the image. The image provides a regional overview of the land surface topography, surface drainages, streams, lakes, and geomorphologic features.



Red Cliff Mine EIS

Figure 3-14
Conceptual Hydrogeologic Model

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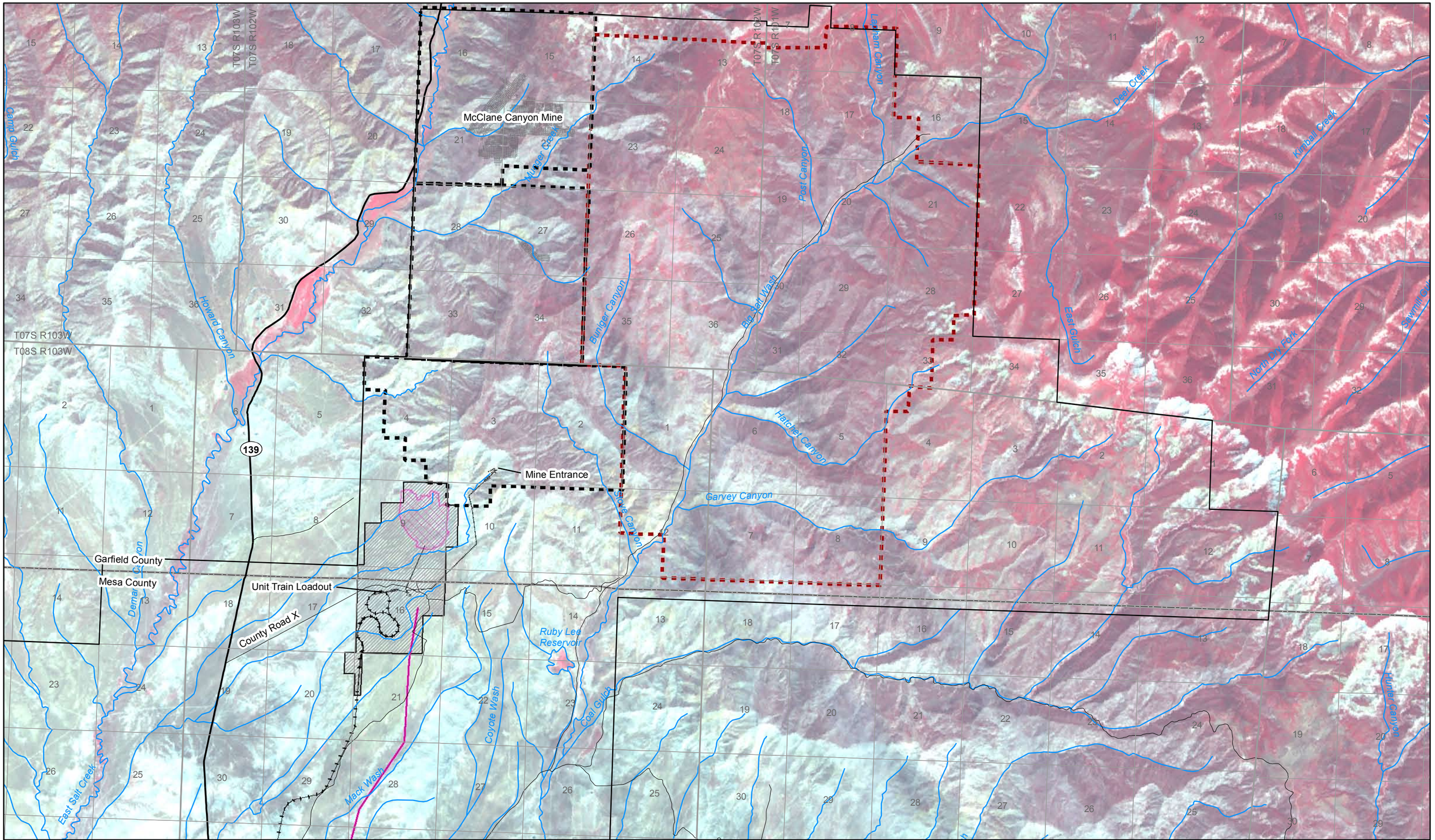


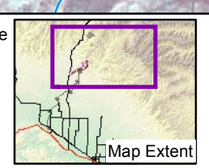
Legend

- 69kV Transmission Line Route
- Proposed Rail Spur
- Proposed Road
- Proposed Waste Rock Disposal Area
- Existing Lease
- Coal Lease Application
- Proposed Land Use Application Area
- Project Area

N

0 0.5 1 2 3 Miles

Satellite Imagery Source: Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER), NASA, August 2007.



Red Cliff Mine EIS

Figure 3-15
Satellite Image of the Study Area

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Information from this satellite image is used to supplement other hydrogeologic data to develop the conceptual model of the natural hydrologic system. On this image, the bluish gray areas are areas of bare soil and sparse vegetation while the reddish gray areas indicate areas of more dense, verdant vegetation. Larger, more densely spaced vegetation is reflected by the stronger reddish hues in the uplands on the northeastern side of the study area. There are also thin red zones, generally surrounded by blue areas, which indicate the large healthy vegetation along Big Salt Wash and East Salt Creek. The image also shows some relatively small red areas along other drainages such as Garvey Canyon and Coal Gulch.

These vegetation patterns help illuminate the near-surface hydrologic system. During the late spring or summer in a semi-arid area verdant vegetation is typically more widespread, consistent with higher residual soil moisture from the previous wet season and concentration of surface water runoff in drainages. Bright red spots on the satellite image, like those surrounding Ruby Lee Reservoir, would indicate phreatophyte vegetation sustained by shallow groundwater. Overall, the satellite image shows the very dry conditions present at this site. Throughout the proposed mine facilities and waste disposal pile areas, no areas of verdant vegetation are visible that could indicate areas of groundwater discharges to springs or seeps along surface water drainages.

Under natural conditions in this region most of the precipitation evaporates, probably more than 90 percent. As stated in the Hydrologic Atlas of the United States (HA-730C) by U.S. Geological Survey (2008), potential annual evaporation generally exceeds average annual precipitation in this area. The high rate of evaporation removes most surface water and soil moisture before the water can percolate below the root zone of plants to recharge an underlying aquifer. Nonetheless, melting snow and ice, and major rainfall events, cause surface water to accumulate and run off into surface drainages and small ponds. Storm runoff moves downhill along the topographic surface, quickly concentrates in surface water drainages and flows downhill, generally toward the southwest. Within the mine area and proposed lease area, flow in most of the surface drainages only occurs following large precipitation or snowmelt events.

However, some perennial streams do exist in the project area, as further described in Section 3.2.7, Surface Water. Surface water that does not evaporate or run off, and is not consumed by plants, infiltrates below the root zone and contributes to groundwater recharge or interflow.

Groundwater

Fundamental concepts in physics, soil mechanics, and geology provide the foundation for the conceptual hydrogeologic model of the flow system at this site. Groundwater flow directions are controlled primarily by gravitational forces. In the unsaturated zone above the water table, moisture migrating downward in response to gravity is also strongly affected by capillary forces in the pore spaces of the soil and rock, and the spatial distribution of the pore spaces. Moisture migration is retarded by finer grained sediment or rock, which will cause water to accumulate along bedding plane partings along less permeable layers, or along intersecting fracture zones. Below the water table, the spatial distribution of hydraulic heads (groundwater level elevations) control the direction of groundwater flow. The rate of groundwater flow is controlled by the physical and hydraulic characteristics of the soil and rock units through which the subsurface water passes.

Hydrogeologic Units

Natural surface materials in this study area consist of weathered and fractured rock, residual soils, alluvium, and colluvium. Groundwater flows within two principal geologic materials: a surficial unconsolidated hydrogeologic unit consisting of alluvium, colluvium, and weathered bedrock, and a fractured sedimentary bedrock unit, which includes sandstone, shale, and coal seams.

The thickness and particle sizes of unconsolidated sediments vary significantly across the site. In upland areas of the watersheds surrounding the mine area, the unconsolidated sediments are thin or absent because of the steeper topographic relief. Alluvial deposits are thickest beneath the larger surface drainages, such as Big Salt Wash, and generally thicken in the lower parts of the watersheds. The lower portion of Big Salt Wash (near Ruby Lee Reservoir) is underlain by a substantial thickness of relatively coarse-grained alluvium, which comprises an alluvial aquifer.

Within the bedrock, groundwater flows primarily through secondary porosity features (e.g., fractures, joints, faults, and partings along bedding or lithologic contacts). Sandstone and shale units of the Cretaceous Mesaverde Group comprise the overburden, which overlies the Cameo Coal Seam. Outcrops of the overburden sandstone units show steeply dipping fractures with widely varying orientations, and fracture partings along bedding planes.

The porosity of the Cameo coal seam is relatively high. Dense networks of small fractures are well developed, which causes the cleat structure of the coal. In contrast, the matrix of the sandstone has relatively low porosity, because the fine sand grains are well cemented by calcium carbonate. Hence the unfractured sandstone matrix has relatively low porosity and low hydraulic conductivity. With its relatively higher porosity and permeability, the Cameo coal seam is the principal bedrock aquifer.

The thin sandstone section below the Cameo Coal Seam is underlain by the Mancos Shale, which is composed of fine-grained sediments deposited in the deeper waters of a large Cretaceous sea. Lower in the stratigraphic section, the Mancos shale also contains several relatively minor sandstone units. Overall, the Mancos Shale restricts the movement of groundwater and generally acts as an aquitard and confining unit in the regional groundwater flow system. Although it is sometimes possible to develop wells in this formation to supply small flows for stock watering purposes, the Mancos Shale is generally not considered an aquifer.

Recharge

Infiltrating precipitation is the source of groundwater recharge. As is typical in semiarid regions underlain by permeable rock and soil, a relatively small portion of the total annual precipitation typically infiltrates the land surface and becomes groundwater. Most of the moisture infiltrating the soil returns to the atmosphere, via evapotranspiration.

A major source of groundwater recharge in this area is melting snow. Extended periods of high rainfall are also significant but typically contribute less than snowmelt under these conditions. Recharge also occurs where the level of a surface water body or stream is at higher elevation than the underlying groundwater level.

Even though recharge occurs throughout the study area, relatively high recharge rates exist in higher elevations because of higher precipitation rates. Relatively high rates of recharge also exist along surface drainages, because drainages typically contain relatively permeable sediment

and concentrate storm runoff. Overall, the average, long-term recharge rate is likely in the range of 5 percent of the average annual precipitation, or less than 1 inch per year in the mine area.

Interflow

In the upland recharge areas, much of the groundwater migrates as interflow within the unsaturated zone, which may exist as water-filled fractures or as localized zones of perched water lying above the water table. The term "interflow" applies to groundwater that accumulates and flows within a localized saturated zone lying above a continuous, widespread phreatic surface or water table. Interflow often occurs in mountainous semi-arid areas underlain by fractured bedrock. The majority of the water that infiltrates the land surface moves rapidly as groundwater interflow within the highly permeable unconsolidated materials along the interface with the less permeable materials. Some interflow may also move within relatively permeable zones in the upper, weathered portion of the bedrock.

Most of the small springs in this study area are attributable to surface discharge of interflow, typically along localized fracture systems. Most springs discharge uphill of a surface drainage channel, at isolated points along the valley slopes. In these cases, the flow path between the snowmelt recharge area and the point of spring discharge is relatively short and does not extend as deep as the water table. Many of the interflow-fed springs appear to be supplied by melt water from the previous winter snow pack. Some interflow may be the result of even shorter, transient phenomenon generated in response to a single major precipitation or snowmelt event. The relatively small amount of water that percolates deeper into the bedrock to reach the water table becomes part of the regional, saturated-zone groundwater flow system.

Saturated Zone

Below the unsaturated zone, groundwater completely saturates the available pore spaces and creates a water table of regional proportions, which sometimes called the phreatic surface. The primary input of water to the saturated zone water table is deep infiltration of precipitation. Available data from wells indicate the bedrock fractures are of sufficient frequency, size, length and variable orientation to provide a regional continuous porous medium for groundwater flow. This saturated flow system extends into the lower portions of the regolith materials in some areas. For example, the water table beneath the Big Salt Wash valley extends outward from beneath the hill slopes into the alluvium.

Throughout the study area, bedrock groundwater flows through interconnected fractures, and to a lesser extent, within inter-granular pore spaces in the sedimentary rock. In some low-lying valley areas, groundwater also flows in the alluvium and saturated regolith material. Major factors controlling fracture flow are the size of the cross-sectional open area and continuity of the pore spaces within the rock units. The pore spaces in the rock fractures are largely controlled by the spacing, width, length, roughness, infill material and orientation of the fractures, which vary with location and depth.

Geologic and hydrologic data show that the groundwater flow system in the site vicinity exhibits the features of a topographically-driven flow system. The available groundwater elevation measurements show a strong correlation between ground surface elevation and the water table (i.e., phreatic surface) elevation. Groundwater level data provided by CAM and the Fruita Mine Baseline Data Report (Kaman Tempo 1984) show groundwater levels are related to land surface

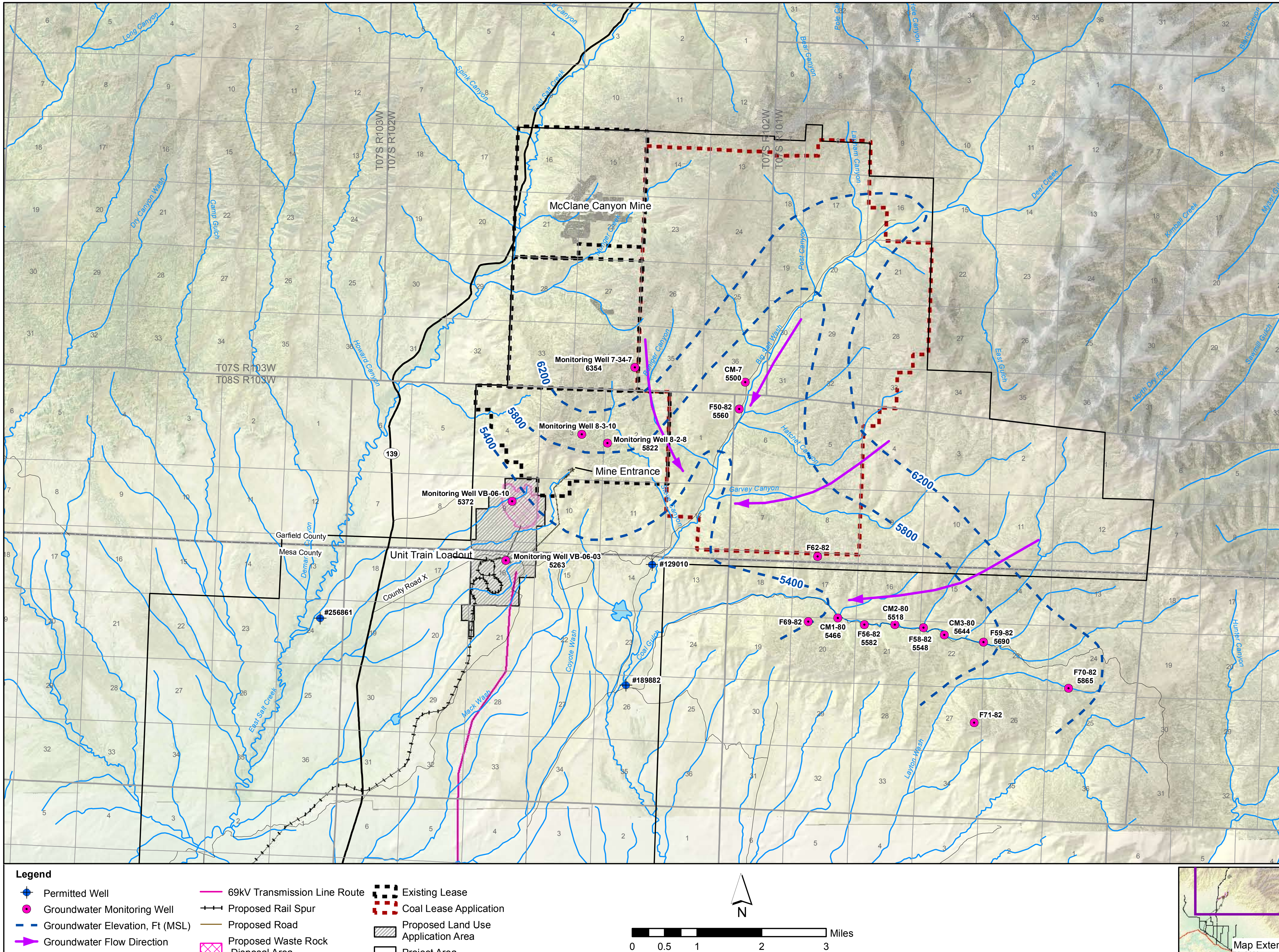
topography. Figure 3-13, Groundwater Levels and Land Surface Topography, is a linear regression plot of groundwater elevations versus topographic elevations using the available data for wells completed below the water table in the study area. The best-fit linear regression to these data has an R-square value of 0.87, which is a very good correlation. This empirical relationship indicates that hydraulic heads in the saturated zone are influenced primarily by the elevation of the ground surface topography. The best-fit regression line equation on Figure 3-13 also provides a basis for using topographic elevations to estimate water table elevations and hydraulic gradients in areas where no well measurements exist.

Using the empirical relationship shown on Figure 3-13, Groundwater Levels and Land Surface Topography, together with the hydraulic head measurements from available wells, provides the basis for estimating the spatial trends in hydraulic gradients and hence groundwater flow directions. Figure 3-16, Potentiometric Surface, is a potentiometric map showing contours of equal hydraulic head elevations throughout the study area, which are based on the available groundwater level data and values derived from Figure 3-13. The groundwater level elevation for Well F50-82 shown on Figure 3-16 was obtained from the DRMS permit application (Stover and Associates 2008). This potentiometric map shows groundwater flows away from the upland areas of higher hydraulic head and toward the areas of lower hydraulic heads. Hydraulic gradients in the groundwater flow system are oriented in the same general directions as the land surface slopes, which are generally toward the southwest. Flow paths emanate from the higher-elevation recharge areas and converge toward major stream valleys.

The topographic influence on groundwater flow is reflected in the potentiometric surface maps and cross-section provided in the Fruita Mine baseline hydrologic data report (Kaman Tempo 1984, Appendix G). That information shows groundwater flows generally away from the uplands surrounding Coal Gulch and Garvey Canyon toward lower elevations in those valleys, which is generally toward the southwest. In the higher elevation areas, hydraulic gradients are downward, but gradients are upward in the lower lying areas. The flow patterns reported previously (Kaman Tempo 1984) are consistent with those depicted on the potentiometric map prepared for this project, Figure 3-16, Potentiometric Surface.

Where the groundwater levels rise above ground surface or the level of a surface water body, groundwater will discharge (or seep) from the land surface. Table 3-17, Estimated Depth of Groundwater Table at Spring Locations, shows the estimated depth to the groundwater table below ground surface beneath the springs mapped during the 1982-1983 surveys (Figure 3-12, Spring Locations). This table indicates that the springs located on the upland valley walls emerge at much higher elevations than the water table. Therefore, those upland springs are not hydraulically connected with the water table of the saturated groundwater flow system. Rather, the upland springs are fed by relatively isolated zones of interflow (e.g., perched groundwater), and consequently the surface water seepage created by these small springs is limited to only a very small area because of rapid infiltration and evaporation.

Springs that emerge in the valley bottoms along surface drainages may contribute to streamflow. However, the amount of groundwater flow contributed by springs is insignificant relative to the surface water runoff. Discharge from the groundwater flow system is also indicated by the phreatophyte vegetation and wetlands lying along the lower portion of the Big Salt Wash valley.



Red Cliff Mine EIS

Figure 3-16
Potentiometric Surface

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In summary, the available groundwater data indicate it is possible to model the groundwater flow regime as a continuous saturated porous medium in the area potentially affected by the proposed mine.

Groundwater Flow Model

Based on the conceptual hydrogeologic model and available hydrogeologic data, the MODFLOW program has been used to estimate groundwater inflow rates to the proposed mine for the purposes of this EIS. MODFLOW is a well-tested and documented, numerical groundwater flow model developed by the USGS. The model area boundaries are shown on Figure 3-17, Numerical Model Boundaries. A regional scale model was developed for the area. The model domain extended from the Book Cliffs to the Colorado River. For the mine analysis, the model area was focused on the study area, but model boundaries were kept the same. This limited the impact of the boundaries on the model results.

Hydraulic Properties

This MODFLOW model has three layers, which allows the model to predict flow in the saturated zone. In upland areas, properties of the Cameo Coal Seam and the overburden bedrock units are assigned to the upper two layers, with flow in the alluvial aquifer valleys simulated by the upper layer. The bottom layer represents the Mancos Shale. Hydraulic properties of these hydrogeologic units are estimated based on borehole packer tests and aquifer pumping tests of wells. Table 3-18, Hydraulic Parameter Values Specified in MODFLOW Model, provides a summary of hydraulic conductivity (K) values used in the MODFLOW model.

Table 3-18
HYDRAULIC PARAMETER VALUES SPECIFIED IN MODFLOW MODEL

Model Layer	Unit	Hydraulic Conductivity		Thickness	Transmissivity
		ft/day	cm/sec	ft	ft^2/day
1	Mesaverde Formation	0.007	2.E-06	900	6.3
2	Cameo Coal	0.11	4.E-05	50	5.5
3	Mancos Shale	0.01	4.E-06	3000	30

Notes:
cm/sec = centimeters per second
ft = feet
ft/day = feet per day
ft^2/day = square feet per day

Boundary Conditions

The major watershed divides encompassing the study areas are incorporated into the model as no-flow boundary conditions. The Colorado River serves as a boundary along the southern portion of the model domain. Streams are simulated as drain boundaries, to represent areas of groundwater discharge. The Colorado River was simulated as a River Boundary. Area-wide recharge is specified in the model to be 0.4 inch/year.

Simulation of Current Groundwater Flow

Figure 3-18, MODFLOW Simulation A Groundwater Levels and Flow Into McClane Canyon Mine, shows the model-simulated distribution of hydraulic heads and flow into the MCM, prior to any operations at Red Cliff Mine. In addition to the hydraulic parameters specified in Table 3-18, Hydraulic Parameter Values Specified in MODFLOW Model, a drain boundary is

incorporated into the model throughout the extent of the existing underground mine openings. The drain elevation is set to the bottom elevation of the simulated coal layer in the model. The amount of water captured by the drain is calculated by mass balance of the drain area simulating the MCM in the model.

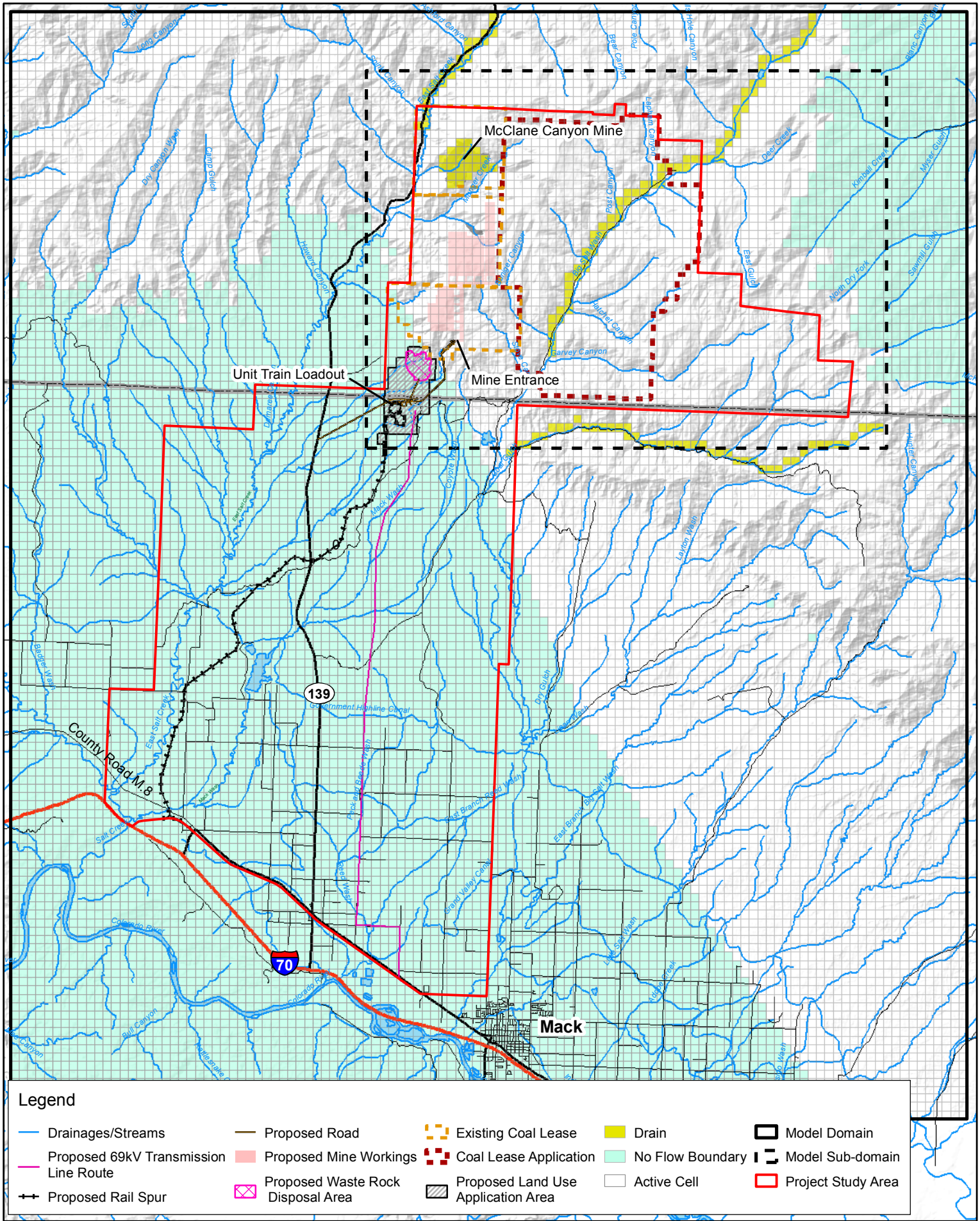
For the hydraulic parameters and hydrogeologic conditions specified, the model predicts the average inflow to the MCM area to be 48 gpm under long-term steady state conditions. This is similar to recent dewatering flows measured at the mine by CAM, which have ranged from about 10 to 30 gpm (Stover 2008). Reasonable agreement between the model-simulated and actual measurements, indicate the model is capable of reasonably predicting future groundwater inflow rates to Red Cliff Mine. The model predictions of mine dewatering rates and the potential impacts of the dewatering are described in Section 4.2.6, Groundwater.

3.2.7 Surface Water

The Red Cliff Mine project is located in the Colorado River Basin. This is the second-largest basin in Colorado, encompassing more than 18,160 square miles and 19,340 miles of streams. The volume of water that flows through the basin is greater than the combined flows of all the other basins in the state. The project area is located in a sub-basin within the Lower Colorado River watershed, north of the Colorado River near the Colorado-Utah border. The site encompasses the East Salt Creek, Mack Wash, and Big Salt Wash sub-basins.

Several ditches and reservoirs and 19 major streams are located in the Red Cliff Mine project area (see Table 3-19, Streams, Ditches, and Reservoirs Located Within the Red Cliff Mine Project Area). Ephemeral streams only flow in response to high surface runoff and when the water table is higher as a result of storms events. A perennial stream flows year round and typically supports aquatic life. An intermittent stream flow is seasonal, and flows are driven by storm events. The base flow of these streams is provided by groundwater seepage into the channel. Intermittent and perennial streams were identified from the most recent USGS maps for this region, dated 1972 and 1973 (Terraserver USA 2008). The specific USGS 7.5 minute series topographic maps reviewed to obtain this information included Fruita, Highline Lake, Howard Canyon, Mack, and Ruby Lee Reservoir. A solid, dark-blue line on the USGS map indicates a perennial stream, while either a thin, light-blue line or a three-dots-and-a-dash line represents intermittent streams. Although many ephemeral streams exist within the project area, none are mapped by USGS. According to the USGS map, Big Salt Wash is perennial along its entire length within the coal lease area and above the location of the planned mine workings. The USGS indicates that this stream changes from perennial to intermittent just south of the Ruby Lee Reservoir explained by the fact that much of the streamflow in Big Salt Wash is diverted to Ruby Lee Reservoir, thus reducing flow.

In addition to these streams, there are also four reservoirs and lakes, numerous springs, and irrigation ditches and laterals in the project area that may be affected. The reservoirs and lakes include Highline Lake, Ruby Lee Reservoir, Mack Mesa Lake, and Mack Mesa Reservoir. The main ditch/canal in the project area is the Highline Canal. A discussion of springs in this study area is located in Section 3.2.6, Groundwater.



Red Cliff Mine EIS

Figure 3-17
Numerical Model Boundaries

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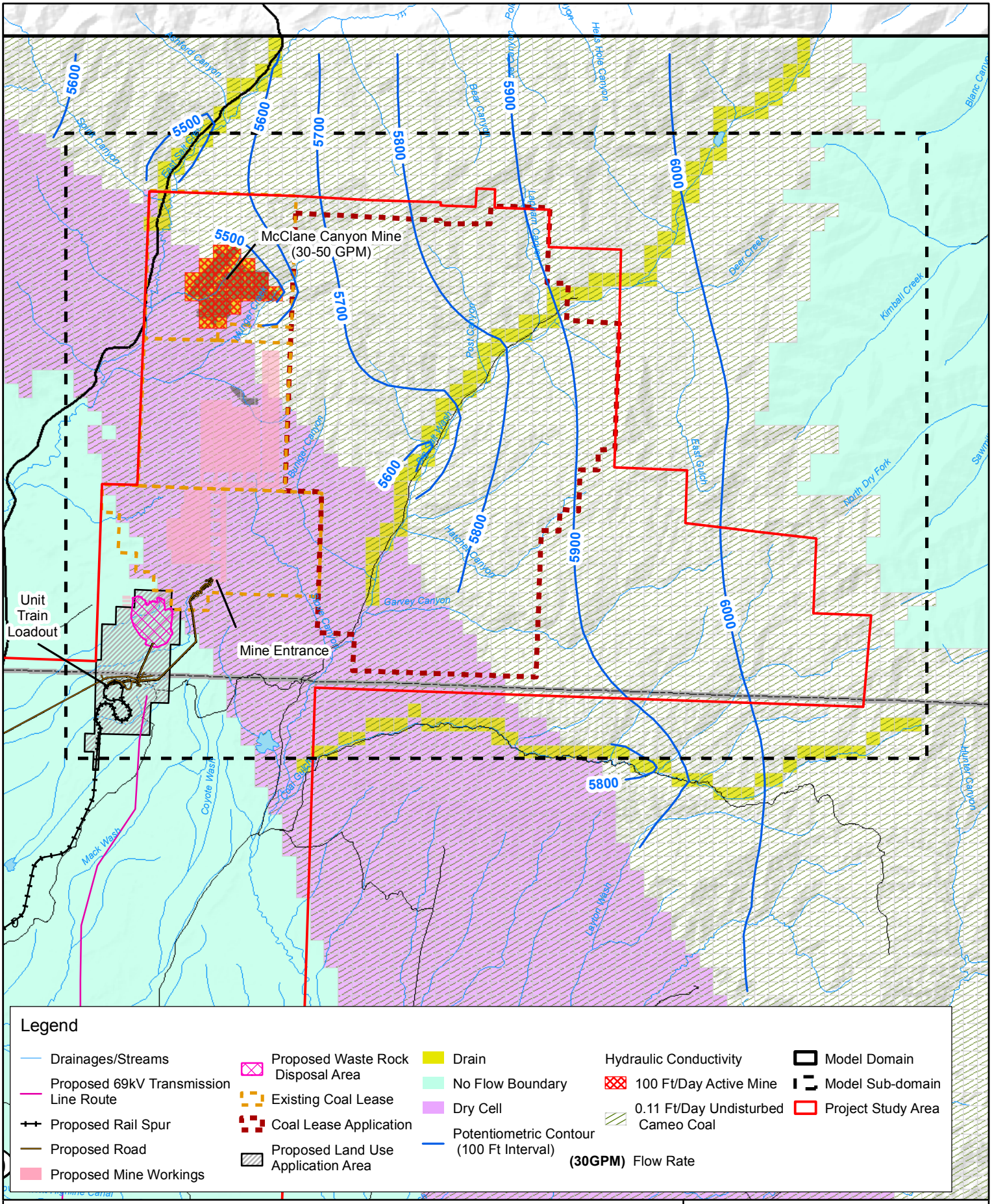

Red Cliff Mine EIS

Figure 3-18
MODFLOW Simulation A Groundwater Levels and Flow Into McClane Canyon Mine

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Table 3-19
STREAMS, DITCHES, AND RESERVOIRS LOCATED WITHIN THE RED CLIFF MINE PROJECT AREA

	Water Body	McClane Canyon Mine	Proposed Coal Lease Area	Proposed Mine Facilities and Rail Loop	Proposed 69kV Transmission Line Crossing	Alternative A Transmission Line Crossing	Alternative B Transmission Line Crossing	Alternative C Transmission Line Crossing	Proposed Railroad Spur Crossing
Perennial Streams	Salt Creek								
	East Salt Creek	X							
	West Salt Creek								
	Mack Wash				X	X	X	X	X
	Reed Wash				X	X	X	X	
	Big Salt Wash[1]		X						
Intermittent Streams	Big Salt Wash[1]		X			X	X		
	Demaree Canyon								
	Coyote Wash				X	X	X	X	
	Munger Creek	X	X						
	Lapham Canyon Creek		X						
	Post Canyon		X						
	Garvey Canyon		X						
	Buniger Canyon		X						
	Stove Canyon		X						
	Coal Gulch								
	Hatchet Canyon		X						
	East Branch Reed Wash				X	X	X	X	
	Peck and Beede Wash				X			X	
	Grand Valley Canal				X	X	X	X	
Ditches and Reservoirs	Mack Mesa Lake								
	Mack Mesa Reservoir								
	Highline Lake								
	Highline Canal				X	X	X	X	X
	Ruby Lee Reservoir								

Notes:
[1]Big Salt Wash is classified as perennial along its entire length within the coal lease area and above the location of the planned mine workings and changes from perennial to intermittent just south of the Ruby Lee Reservoir.
kV = kilovolt

Approximately 180 washes have been mapped within the project area as shown on Figure 3-19, Red Cliff Mine Jurisdictional Determination Drainage Crossings – South, and Figure 3-20, Red Cliff Mine Jurisdictional Determination Drainage Crossings – North (WestWater Engineering 2007). The proposed ROW area encompasses four different stream segments. The proposed coal lease area contains eight different stream segments. The existing coal lease area contains Stove Canyon, which has ephemeral flows although the USGS map indicates that Stove Canyon is an Intermittent Stream. Figure 3-9, Authorized Oil and Gas Leases within the Existing Coal Lease Application, depicts the streams located within the ROW and the proposed and existing coal lease areas.

Surface Water Rights

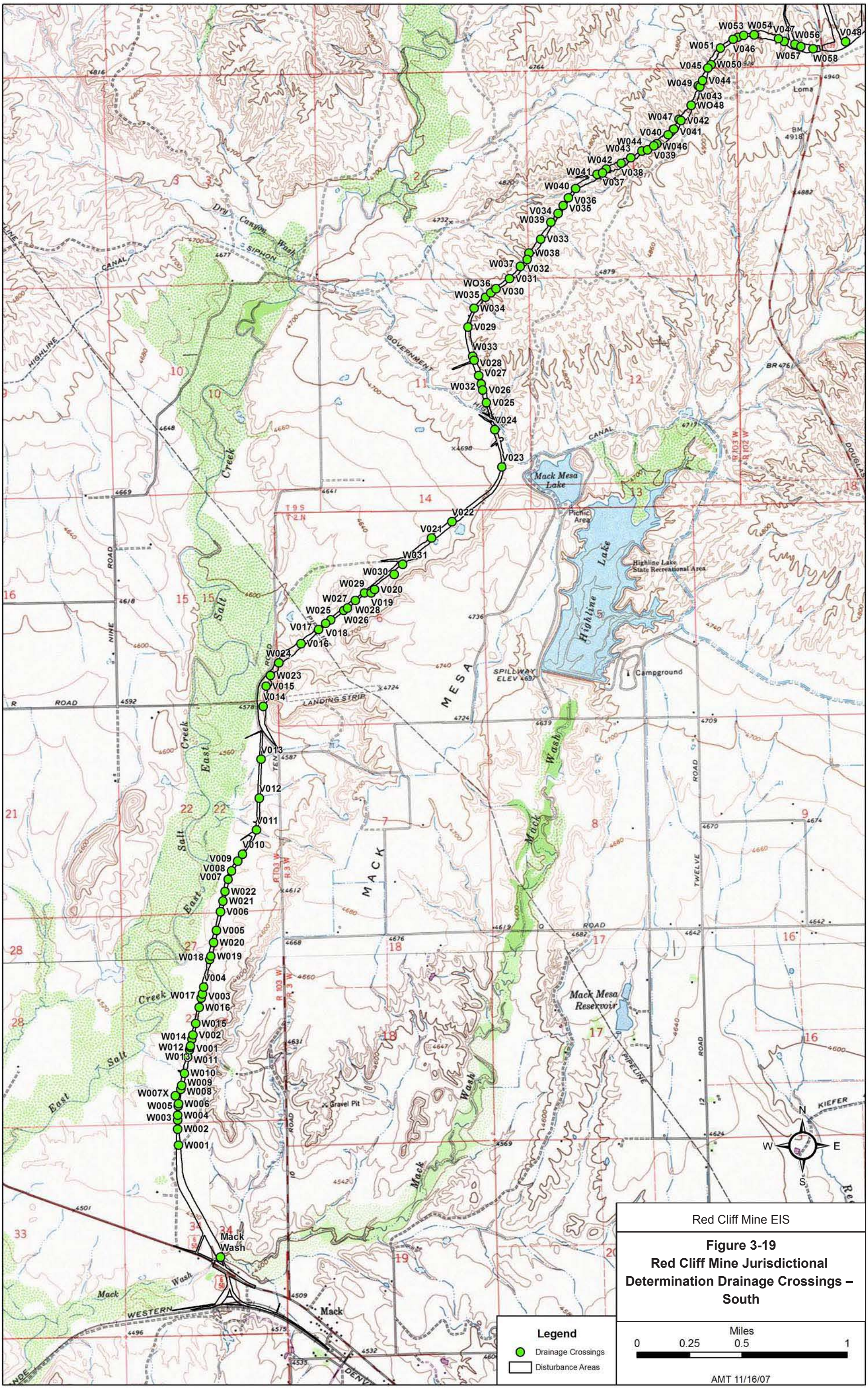
CAM has existing surface water rights of 3 cfs on Mack Wash (Structure ID 1385 in Table F-2 of Appendix G, Water Data and Information) that are administered by the Colorado Division of Water Resources (Office of the State Engineer).

3.2.8 Water Quality

This section identifies the regulations governing surface water quality within the project areas and describes the baseline water quality standards for determining the effects of proposed mining activities on surface water resources.

Available USGS and BLM water quality data within and near the project area was reviewed to assess the site-specific surface water quality of the area. In addition, a review of topographic and geologic maps was completed to assess the topography within the project area. This information is useful in understanding how and where the surface water flows. East Salt Creek, Big Salt Wash, and Mack Wash watersheds are the primary locations where potential impacts may occur as a result of the project; all of these watersheds flow to the south towards the Colorado River. The railroad spur and most of the surface facilities lie within the East Salt Creek watershed. The lease area generally lies on Mack Wash and Big Salt Wash watersheds. Additional surface water impacts on Mack Wash include surface water diversions and the construction of the rail line and bridge crossings. Mack Wash and Big Salt Wash watersheds are important stream segments to evaluate for this EIS; they are classified by the U.S. Army Corps of Engineers (USACE) as Relatively Permanent Waters (RPW).

The National Pollutant Discharge Elimination System (NPDES) was established as part of the Clean Water Act amendments of 1972. The purpose of these specific regulations is to control and regulate point sources of water pollution throughout the United States, with the overall objective of eliminating these discharges and ensuring all receiving waters were “fishable” and “swimmable”. These initial regulations targeted point source discharges such as municipal sewage treatment plants and industrial discharges. Stormwater was initially exempt from the point source category and not included. In 1987, the EPA established separate regulations for stormwater (implemented in 1990) for large municipalities greater than 250,000 (i.e., Phase I municipalities), and construction activities disturbing greater than or equal to 5 acres. The recently implemented Phase II regulations require municipalities greater than 10,000 (and identified counties and jurisdictions) to comply with the stormwater regulations in addition to construction activities disturbing greater than or equal to 1 acre (Pitt et al. 2007). In Colorado, stormwater discharge permits are issued by the CDPHE, Water Quality Control Division


Legend
Drainage Crossings
Disturbance Areas
Miles
0
0.25
0.5
1
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Red Cliff Mine EIS
Figure 3-19
Red Cliff Mine Jurisdictional Determination Drainage Crossings – South
N
S
E
W
Mack Wash
Mack Mesa Lake
Mack Mesa Reservoir
Highline Lake
Highline Lake State Recreational Area
Picnic Area
Campground
Gravel Pit
Dry Canyon Wash
East Salt Creek
MESA
CANAL
SIPHON
HIGHLINE
GOVERNMENT
LANDING STRIP
PIPELINE
ROAD
W053 W054 V047 W056 V048
W051 V046 W057 W058
V045 W050
W049 V044
V043
WO48
W047 V042
V040 V041
W044 W046
W043 V039
W042
W041 V038
V037
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V031
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W018 W019
V004
W017 V003
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W014 V002
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W007X W008
W005 W006
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W002
W001

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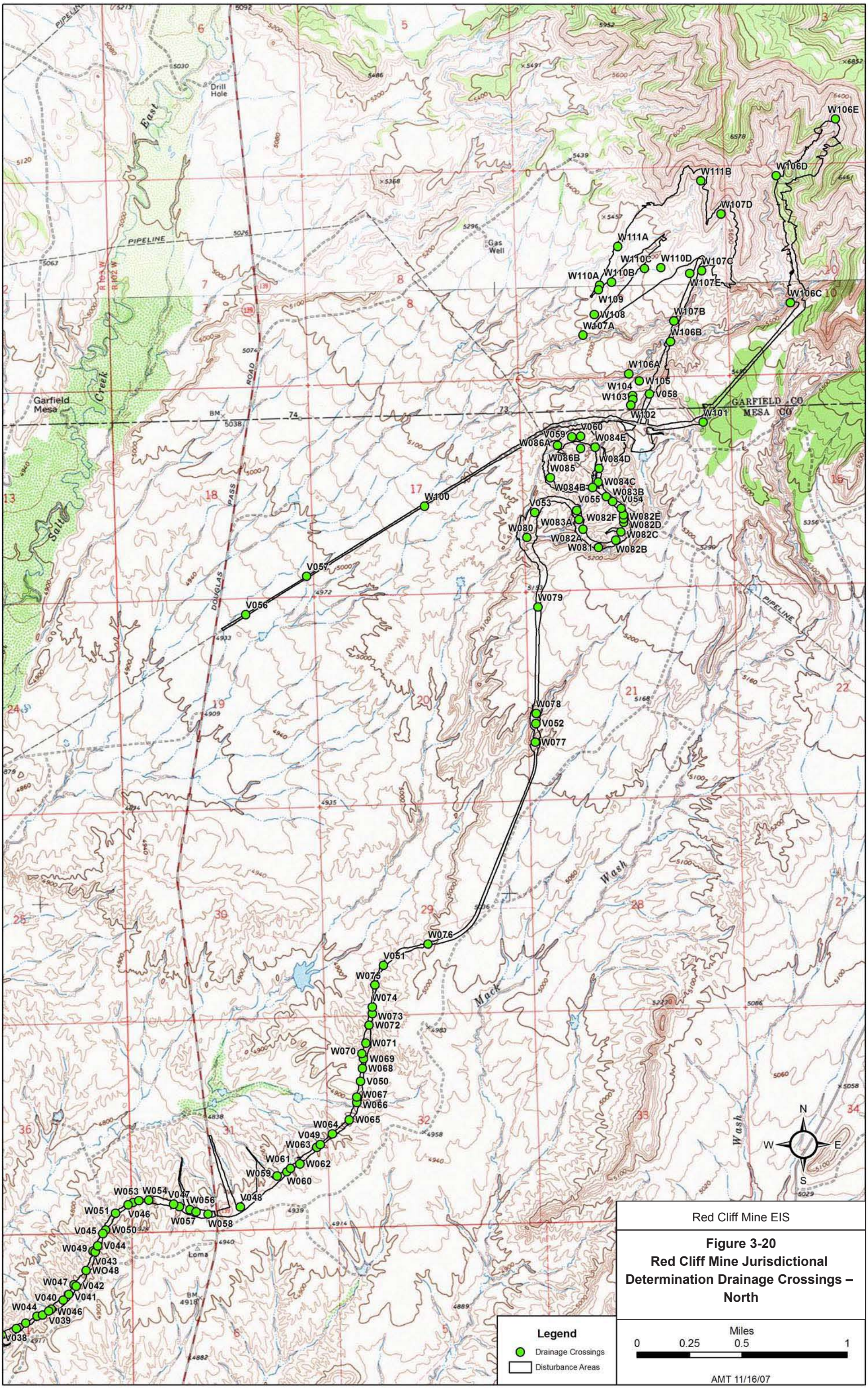
W106E
W106D
W111B
W107D
W111A
W110C
W110D
W107C
W110A
W110B
W107E
W109
W106C
W108
W107B
W107A
W106B
W106A
W105
W104
W058
W103
W102
W101
GARFIELD CO
MESA CO
V060
V059
W084E
W086A
W086B
W084D
W085
W084C
W084B
W083B
V055
V054
V053
W082E
W083A
W082F
W082D
W080
W082C
W082A
W081
W082B
W100
V057
V056
W079
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V045
W050
W049
V044
V043
WO48
W047
V042
V040
V041
W044
W046
V039
V038
Drill Hole
Gas Well
Garfield Mesa
Creek
PIPELINE
ROAD
PASS
DOUGLAS
Salt
Wash
Mack
Loma
BM 5038
BM 4918
N
W
E
S
Red Cliff Mine EIS
Figure 3-20
Red Cliff Mine Jurisdictional Determination Drainage Crossings – North
Legend
Drainage Crossings
Disturbance Areas
Miles
0
0.25
0.5
1
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(WQCD). Such permits are part of the Colorado Discharge Permit System, or CDPS, under Regulation 61. The Phase II municipal separate storm sewer systems (MS4s) are covered under a general permit for stormwater discharges from MS4s. In addition, the construction stormwater permits are covered under a separate permit addressing the temporary nature of these activities.

According to the 1987 BLM Resource Management Plan for the Grand Junction Area (BLM 1987), the primary emphasis of water resources management includes the reduction of salinity and sediment yields from the Grand Valley. The CDPHE-WQCD has attested to these concerns of elevated selenium concentrations by including the Grand Valley washes on the 2008 303(d) List of Impaired Waters, necessitating a total maximum daily loading (TMDL) development. Currently, the Colorado Division of Wildlife (CDOW) is collaborating with the Grand Valley Selenium Task Force to address these concerns.

Baseline conditions are identified by drainage basins, as runoff from the proposed railroad spur, transmission line, and mining activities will collect by drainage basin. The physical, chemical, and biological quality of the water in the Lower Colorado River Basin is the product of the natural and human factors that make up the environmental setting of the basin. Natural conditions such as physiography, climate, geology, and soils affect the ambient water quality while anthropogenic factors such as water use, population, land use, and water-management practices can have a pronounced effect on water quality in the basin. The USACE Jurisdictional Determination Request (see Appendix E, Coordination and Consultations), identified potential Waters of the U.S. (WOUS), documenting specific information for Salt Creek and East Salt Creek. Spring runoff events for the Salt Creek watershed are associated primarily with snow melt from the higher elevations and snow accumulation below 5500 feet is minimal and seldom remains as ground cover for more than a few days. Chemical (water quality) function is most likely insignificant, however, during severe widespread precipitation events the washes could connect with East Salt Creek and transport sediment and pollutants downstream. The naturally occurring selenium in Mancos Shale could be transported during these events. The dry washes within the East Salt Creek Drainage would be impacted by spring runoff events in the upper reaches of drainage basins. Variations in precipitation intensity and spatial distribution further decrease the ability of the washes to transfer nutrients, sediment, or pollution to downstream waters. In general, it can be anticipated that tributaries within the proposed project impact area would have negligible impact on the physical, chemical, and biological conditions of the downstream Colorado River or its tributaries.

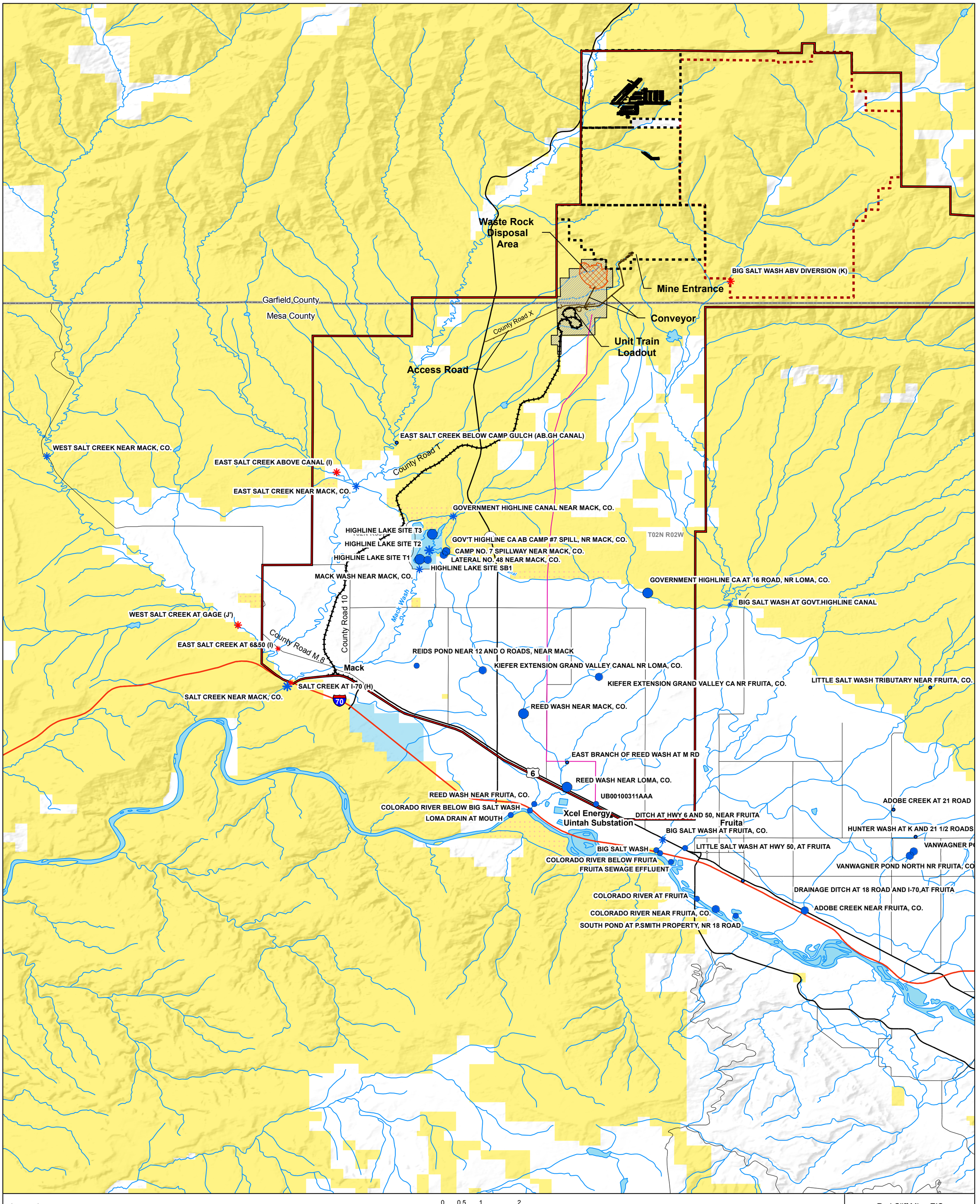
Existing water quality data collected from BLM and USGS gaging stations are summarized in Table 3-20, Summary BLM and USGS Water Quality Data from Gaging Stations, providing the most relevant data applicable to potential project impacts. The stations were selected to be representative of the project area, based on proximity to the project area and the amount of project-specific water quality data available. Figure 3-21, USGS Stations, illustrates all of the sampling events in the project area. The size of the circles represents the number of sampling events at each site (small is fewer than five samples, medium is five to nine samples, large is 10 to 99 samples, and extra large is greater than 100 samples). Table 3-20 provides water quality samples from BLM stations that represent approximately 20 sampling events from the early 1980s until the summer of 1995 and USGS stations that represent approximately ten sampling events from 1973 to 1999. A complete summary of available surface water analytical data in and near the project area is presented in Appendix G, Water Data and Information. The results of

this evaluation suggest that the conductivity, turbidity, and dissolved solids concentrations are high.

Table 3-20
SUMMARY BLM AND USGS WATER QUALITY DATA FROM GAGING STATIONS

Site	Location	Agency		Flow cfs	Conductivity µS/cm	Turbidity NTU	Selenium mg/L	Dissolved Solids * mg/L
Big Salt Wash Abv Diversion (K)	Latitude 39° 22' 28.8", Longitude 108° 43' 28.7"	BLM	Minimum	0.0	560	4.0	0.000	456
			Median	1.8	1205	75.0	0.000	1060
			Maximum	28.6	2270	1580.0	0.004	1670
East Salt Creek Above Canal (I)	Latitude 39° 18' 9.1", Longitude 108° 52' 24.8"	BLM	Minimum	0.3	1000	0.9	0.000	0
			Median	1.70	3750	125.0	0.000	2900
			Maximum	34.2	7200	600.0	0.010	8200
East Salt Creek at 6&50 (I)	Latitude 39° 14' 9.25", Longitude 108° 53' 44.83"	BLM	Minimum	12.0	1220	0.0	0.000	1282
			Median	15.5	2400	45.0	0.000	2204
			Maximum	63.9	2910	640.0	0.006	2948
Salt Creek at I-70 (H) Averages	Latitude 39° 13' 22.91", Longitude 108° 53' 27.16"	BLM	Minimum	98.9	1250	67.0	0.000	930
			Median	127.0	1330	168.5	0.000	1350
			Maximum	185.5	1770	700.0	0.002	1430
West Salt Creek at Gage (J')	Latitude 39° 14' 41.3", Longitude 108° 54' 38.8"	BLM	Minimum	0.0	2230	0.2	0.000	1620
			Median	0.2	8500	87.0	0.000	9920
			Maximum	6.6	16000	100000.0	0.004	15000
West Salt Creek Nr 8 Road (J)	Latitude 39° 14' 41.3", Longitude 108° 54' 38.8"	BLM	Minimum	0.8	1190	3.0	0.000	988
			Median	20.6	1673	95.0	0.000	1391
			Maximum	40.7	8100	35000.0	0.004	10400
Salt Creek Near Mack, CO Station Number 9163490	Latitude 39°13'18", Longitude 108°53'32"	USGS	Minimum	9.9	884	2.0	7.000	3790
			Median	21.0	1670	2.0	11.000	3790
			Maximum	148.0	5410	2.0	26.000	3790
East Salt Creek Near Mack, CO Station Number 9163310	Latitude 39°17'50", Longitude 108°51'58"	USGS	Minimum	0.2	3180	---	8.000	---
			Median	0.4	6955	---	14.500	---
			Maximum	2.6	9150	---	21.000	---
Big Salt Wash At Fruita, CO Station Number 9153270	Latitude 39°09'49", Longitude 108°45'01"	USGS	Minimum	9.5	931	2.0	7.000	1570
			Median	18.0	1830	2.0	12.000	1570
			Maximum	106.0	3390	2.0	20.000	1570
Mack Wash Near Mack, CO Station Number 9163340	Latitude 39°15'57", Longitude 108°50'32"	USGS	Minimum	2.2	1380	---	---	---
			Median	7.8	2570	---	---	---
			Maximum	33.0	3960	---	---	---
West Salt Creek Near Mack, CO Station Number 9153400	Latitude 39°18'31", Longitude 108°58'59"	USGS	Minimum	0.1	1820	---	3.000	6980
			Median	0.5	7070	---	3.000	130000
			Maximum	1.0	11700	---	3.000	318000

Notes:
*Suspended sediment concentration, milligrams per liter
--- = No data available
µS/cm = microSiemens per centimeter
BLM = U.S. Bureau of Land Management
Cfs = cubic feet per second
mg/L = milligrams per liter
NTU = nephelometric turbidity unit
USGS = U.S. Geological Survey



Red Cliff Mine EIS

Figure 3-21
USGS Stations

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The high values for these parameters are likely attributed to the chemistry of the Mancos Shale being the predominant geologic formation present at the project location as well as the dynamics of the flow. While the Mancos Shale geology creates naturally high selenium levels, the deep percolation and irrigation return flow from irrigation of the Mancos Shale through agriculture below the Highline Canal can be attributed to the very high concentrations near Mack and Fruita. Section 3.2.5, Soils, provides additional information regarding the Mancos Shale. Kaman Tempo (1984) provided a detailed survey of Coal Gulch, Garvey Canyon, Layton Wash, and Lipan Wash. In addition, Munger Creek, a tributary to East Salt Creek was surveyed. Section 3.2.6, Groundwater, provides a review and summary of the data provided in this report. A summary of this information is also provided in Appendix G, Water Data and Information.

The data summarized in Table 3-20, Summary BLM and USGS Water Quality Data from Gaging Stations, indicate a marked difference in water quality above and below the Highline Canal. Big Salt Wash above diversion and East Salt Creek above canal have substantially better quality, particularly of selenium. The data from these two sites indicate no exceedences of the Se standard, whereas Se values are orders of magnitude higher due to irrigated agriculture on Mancos Shale which mobilizes the Se. In general, one of the biggest water quality concerns within the Lower Colorado River basin is elevated selenium concentrations. In July 2001, the CDPHE-WQCD established a “temporary” dissolved selenium standard of 4.6 µg/L for Grand Valley tributaries, including those within the project area, which flow into critical habitat for four endangered fish species of the Colorado River west of Grand Junction, Colorado. This standard was set to increase protection for aquatic life and includes a chronic dissolved selenium standard of 4.6 µg/L. Section 3.2.8.1, Surface Water Classifications, describes the water classifications for the segments within the project area, addressing any increased protection levels to protect assigned designated uses.

Salinity or total dissolved solids (TDS) occurs at low concentrations in the headwaters of the Colorado River and its tributaries in Colorado; however, salinity concentrations increase downstream. The primary effects of salinity occur in the lower Colorado River basin. This is largely due to the higher levels of salinity and the type of crops grown there. Since total dissolved solids are conservative constituents which affect certain water uses in the lower Colorado River basin, and in order to utilize the most effective control methods, a basin-wide approach for controlling salinity is being followed. The seven states through which the Colorado River runs formed the Colorado River Basin Salinity Control Forum ("Forum") to coordinate the basin-wide approach. The Forum gathers and reviews information relevant to the complex problem of salinity standards and implementation of controls by the basin states. Colorado, as a member of the Forum, will work with the other basin states and the federal government to manage salinity and its effects through this basin-wide effort (CDPHE-WQCC 1997).

In order to provide for sound water quality objectives, numeric criteria are to be established at three key stations (i.e., below Hoover, below Parker and at Imperial Dams) as:

- Below Hoover Dam 723 mg/l
- Below Parker Dam 747 mg/l
- At Imperial Dam 879 mg/l

3.2.8.1 Surface Water Classifications

The Colorado Quality Control Commission (WQCC) has classified streams for various uses as described in Colorado Regulation 37, Classifications and Numeric Standards for the Lower Colorado River Basin, effective March 1, 2008. Segment 13a contains all drainages, wetlands, lakes, and reservoirs within the project area upgradient of the Highline Canal within the Lower Colorado River Basin. Segment 13b contains all drainages, wetlands, lakes, and reservoirs downgradient of the Highline Canal within the project area within the Lower Colorado River Basin. Segment 19 contains all lakes and reservoirs tributary to the Colorado River from the point immediately below the confluence of the Colorado River and Parachute Creek to the Colorado-Utah border. The numeric water quality standards that are suitable in maintaining the water quality to preserve the beneficial uses or improve the water quality of the stream are available in CDPHE-WQCC Regulation No. 37 (http://www.cdphe.state.co.us/regulations/wqccregs/wqccreg37lowercoloradoriverbasin.pdf) (CDPHE-WQCC 2007b). According to the water quality regulations established by the WQCC, classifications are established for any state surface water, except water in ditches and other man-made conveyance structures. Although ditches are considered waters of the state, they are not classified, and numeric water quality standards do not apply. Following is a summary of the stream description, classification, and temporary modifications for each segment. Appendix G, Water Data and Information, includes a table specifying the water quality standards for these stream segments (CDPHE-WQCC 2008).

Stream Segment 13a

- Segment Description – All tributaries to the Colorado River including wetlands, from a point immediately below the confluence of Parachute Creek to the Colorado/Utah border except for the specific listings in Segments 13b through 19.
- Stream Classifications – Aquatic Life Warm 2; Recreation 1b; Agriculture. The definitions for these classifications are found in Regulation No. 31 (CDPHE-WQCC 2007a).
  - Aquatic Life Warm 2 – Waters not capable of sustaining a wide variety of cold or warm water biota, including sensitive species, due to physical habitat, water flows or levels, or uncorrectable water quality conditions that result in substantial impairment of the abundance and diversity of species.
  - Recreation 1b – Potential Primary Contact Use: The WQCC intends that surface waters have the potential to be used for primary contact recreation. This classification shall be assigned to water segments for which no use attainability analysis has been performed demonstrating that a recreation class N classification is appropriate, if a reasonable level of inquiry has failed to identify any existing primary contact uses of the water segment, or where the conclusion of a use attainability analysis is that primary contact uses may potentially occur in the segment, but there are no existing primary contact uses.
  - Agriculture – Waters are suitable or intended to become suitable for irrigation of crops usually grown in Colorado and which are not hazardous as drinking water for livestock.
  - A portion of this stream segment, Salt Creek, is listed on the 2008 303(d) List as an Impaired Stream Segment for sediment (CDPHE-WQCC 2008).

Stream Segment 13b

- Segment Description – All tributaries to the Colorado River, including wetlands, from the Highline Canal Diversion to a point immediately below Salt Creek, downgradient from the Highline Canal, the Orchard Mesa Canal No. 2, Orchard Mesa Drain, Stub Ditch and the northeast Colorado National Monument boundary, except for specific listings in Segment 13c.
- Stream Classifications – Aquatic Life Warm 2; Recreation 1a; Agriculture. The definitions for these classifications are found in Regulation No. 31 (CDPHE-WQCC 2008).
  - Aquatic Life Warm 2 – Waters not capable of sustaining a wide variety of cold or warm water biota, including sensitive species, due to physical habitat, water flows or levels, or uncorrectable water quality conditions that result in substantial impairment of the abundance and diversity of species.
  - Recreation 1a – Existing Primary Contact Use: The WQCC intends that this classification receive the highest level of protection (with an anticipated risk level of eight swimmer illnesses per 1,000 swimmers). It is to be adopted where evidence has been presented that these waters are used for primary contact recreation or have been used for such activities since November 28, 1975 (per the federal regulatory definition of "existing uses"). This use category applies to a subset of waters previously classified recreation 1a.
  - Agriculture – Waters are suitable or intended to become suitable for irrigation of crops usually grown in Colorado and which are not hazardous as drinking water for livestock.
- Temporary modifications (as defined in Regulation No. 31): Se(ch)=existing ambient quality based on uncertainty. Persigo Wash from Grand Junction discharge to confluence with the Colorado River; and Little Salt Wash from Fruita discharge to confluence with the Colorado River for D.O., F. Coli., NH_3, Cd, Cu, Ag, Ni, B, Hg, NO_2 = existing quality. Expiration date of 2/28/09. NH_3(ac/ch)=TVS(old)(Type i). Expiration date of 12/31/2011.
- This entire stream segment is listed on the 2008 303(d) List as an Impaired Stream Segment for selenium. All tributaries on the north side of the river, within the project area, are included in this listing (CDPHE-WQCC 2008). Adobe Creek is listed for *Escherichia coli* (E. coli) and total recoverable iron.

Stream Segment 19

- **Segment Description –** All lakes and reservoirs tributary to the Colorado River from a point immediately below the confluence of the Colorado River and Parachute Creek to the Colorado-Utah border.
- Stream Classifications – Aquatic Life Warm 1; Recreation 1a; Agriculture.
  - Aquatic Life Warm 1 – Waters that (1) currently are capable of sustaining a wide variety of warm water biota, including sensitive species, or (2) could sustain such biota but for correctable water quality conditions. Waters shall be considered capable of sustaining such biota where physical habitat, water flows or levels, and water quality conditions result in no substantial impairment of the abundance and diversity of species.

3.2.8.2 Stormwater Quality Regulations Affecting the Project

There are three primary stormwater NPDES permits that would be required for the construction and long-term operations of the Red Cliff Mine. The regulations supporting these NPDES permits have been established by the Federal Clean Water Act and the CDPHE-WQCC, and enforced by the CDPHE-WQCD. The General Stormwater Permit applies for five Phase II municipalities adjacent to portions of the project area. As part of the Phase II requirements, these Phase II municipalities may have specific construction stormwater manuals and design criteria that need to be considered. The Construction Stormwater Permit is required for all activities disturbing greater than or equal to one acre of disturbance. As part of this permit, a Stormwater Management Plan (SWMP) would be developed, outlining specific BMPs and phasing activities that would be implemented throughout the project. The Industrial Stormwater Permit addresses the long-term operations and maintenance requirements of certain industrial activities, including mining, specifically addressing measures to avoid contaminating stormwater runoff as a function of the normal mining operations.

General Stormwater Permit

The following Phase II entities within the vicinity of the project are required to comply with the General Stormwater Permit requirements: Grand Junction Drainage District, Grand Valley Water Users Association, City of Grand Junction, and Mesa County. Each one of these entities has an established stormwater program that includes specific elements pertaining to construction and post-construction activities, in addition to four other elements, within their respective urbanized areas. These Phase II entities have established guidelines, and even in some cases more regionally specific permits for construction activities that occur within their urbanized areas. In addition, many of them have specific drainage criteria guidelines that need to be referenced prior to selecting BMPs for temporary construction activities. Coordination with these entities prior to construction is needed to ensure proper selection of BMPs and that any hydraulic conveyance structures are sized appropriately. The proposed project areas that will be affected by these municipal stormwater permits will include the railroad spur, 69kV transmission line route, land use application, and the coal lease area. Although the proposed project area is not located within any municipal limits, the drainage criteria and erosion and sediment control guidance will assist in meeting stormwater requirements downstream. Additional information regarding this program can be obtained at the following websites:

- CDPHE Information: http://www.cdphe.state.co.us/wq/PermitsUnit/stormwater/municipal.html
- Grand Valley Drainage District: http://www.gjdd.org/
- City of Grand Junction: http://www.gjcity.org/CityDeptWebPages/PublicWorksAndUtilities/StormWater/StormWater.htm
- Mesa County: http://www.mesacounty.us/publicworks/stormwater.aspx
- Grand Valley Water Users Association: http://www.irrigationprovidersgv.org/stormwater_discharge.htm

Note that the 5-2-1 Drainage Authority is assisting with the implementation of some of the permitting requirements for some of the above-listed municipalities. Additional information can be obtained at: http://521drainageauthority.org/.

Construction Stormwater Permit

Any projects involving greater than or equal to 1 acre of disturbance are required to apply for the CDPHE-WQCD-issued Construction Stormwater permit. The EPA has given CDPHE-WQCD jurisdiction over the issuance of this NPDES permit program in Colorado. A major component of this permit's requirements is the development of an SWMP, which outlines the construction phases and mitigation measures necessary to prevent erosion and sediment during and after construction.

Industrial Stormwater Permit

An industrial stormwater permit is required for mining operations on federal lands. Typically railroads do not have stormwater quality permit requirements for the track alignment; although, the fueling and maintenance facilities associated with the railroad do have stormwater quality requirements. These requirements are related to industrial activities, such as spill containment and prevention and material storage and handling.

3.2.9 Floodplains

A floodplain is a flat area adjoining a river or stream channel, constructed by the river or stream in the present climate and overflowed at times of high discharge. Changes in stream base level will affect flood stage. Floodplains are typically viewed as a region covered by the 100- and 500-year floods, but flooding can occur at 10- to 50-year recurrence intervals. A recurrence interval is based on the probability that the given event will be equaled or exceeded in any given year (e.g., a 100-year recurrence interval means that a flood of that magnitude has a 1 percent chance of happening in any year). Due to change in climate or changes in watershed condition from grazing, energy development, recreation, or other influences, the water level in a river may change its level by aggrading or degrading. Moreover, changes in the floodplain, such as adding fill material, constructing buildings or bridges, or in any way limiting the natural conveyance of floodwaters, can cause a rise in the 100-year water surface elevation, consequently impacting adjacent properties not previously affected by a 100-year storm event. Floodplains are associated with all of the major drainageways and streams in the project area.

The potential sources of flooding upstream and downstream of the project area are the major streams and minor ephemeral streams listed in Table 3-19. The perennial, intermittent, or ephemeral streams within the project area are not mapped by the Federal Emergency Management Agency (FEMA), and the assigned Flood Insurance Rate Maps (FIRM) (Panel ID Numbers 0802051575B, 0801150050B, 0801150075B, 0801150250B, 0801150250B, and 0801150245B) are designated as Zone D, or "areas in which flood hazards are undetermined." Thus, there are no FEMA-delineated floodplains in the project area

Flood-prone areas could be determined by using nearby gauging stations, channel morphology data, or software such as Hydrologic Engineering Centers River Analysis System (HEC-RAS), to determine flood flows for different recurrence intervals. Mesa and Garfield counties have

conducted some floodplain mapping, although it is not currently available for the portions of the county(ies) containing the project area.

Floodplain Regulations Affecting the Project

The following regulatory requirements apply to the floodplains located within the project area:

- *EO 11988, Floodplain Management* (1977), was authorized to direct federal agencies to "provide leadership and take action to reduce the risk of flood loss, to minimize the impacts of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains." This EO was authorized to assist in furthering NEPA, the National Flood Insurance Act of 1968 (amended), and the Flood Disaster Protection Act of 1973. Section 2 of the EO directs the BLM to "evaluate the potential effects of any actions it may take in a floodplain; to ensure that its planning programs and budget reflect consideration of flood hazards and floodplain management; and before taking any action, each agency will determine the floodplain, as well as consider alternatives to avoid adverse effects within a floodplain, including not taking the action."
- *CFR, Title 44 – Emergency Management and Assistance, Chapter I* – FEMA contains the basic policies and procedures of FEMA to regulate floodplain management and to analyze, identify, and map floodplains for flood insurance purposes.

Generally, these regulations are enforced at the local level by local governments and agencies, in this case Garfield County and Mesa County. Each of the local governments with jurisdiction in the project area has enacted floodplain regulations, which are consistent with the National Flood Insurance Program. Mesa County's floodplain management regulations include:

- Regulation of construction in the floodplain
- Ensure that structures currently within the floodplain are adequately protected
- Protect the natural state of the watercourse to maintain historic flow capacity
- Restrict hazardous uses
- Minimize discharge into watercourses from waste disposal
- Discourage citizens from purchasing land in the floodplain
- Control filling of dredged material in waterway
- Prevent construction that causes major erosion to the watercourse

(Mesa County 2003).

Although there are no FEMA-delineated floodplains in the project area, the local floodplain administrators recognize the beneficial values of the floodplain and thereby require a floodplain development permit.

As new development occurs in unmapped floodplains, the developer is responsible for mapping and providing floodplain data to Mesa County. Development on 5 acres or more requires that construction runoff protection measures be used. A permit is required from the Water Quality Division of the CDPHE, and BMPs must be used to mitigate erosion on the development site for up to 15 years (Mesa County 2004).

Alluvial Valley Floors

The following definition of alluvial valley floors (AVF) is taken from the Colorado Surface Coal Mining Reclamation Act, Section 34-33-103.

> *"Alluvial valley floors" means the unconsolidated stream-laid deposits holding streams where water availability is sufficient for subirrigation or flood irrigation agricultural activities, but does not include upland areas which are generally overlain by a thin veneer of colluvial deposits composed chiefly of debris from sheet erosion, deposits by unconcentrated runoff or slope wash, together with talus, other mass movement accumulation, and windblown deposits.*

An AVF determination has been prepared for CAM (Rare Earth Sciences, LLC and ERO Resources Corp. 2007). Using existing information, including reconnaissance mapping by OSM and a site reconnaissance, a map was prepared showing AVF's in the project area (Figure 3-10, Remnant Alluvial Fans at Red Cliff Mine Site). The mapped AVF's are along East Salt Creek and Big Salt Wash. The East Salt Creek AVF is located west of the project area, and the Big Salt Wash AVF is in the project area including the proposed lease area and areas of transmission line alternatives.

3.2.10 Vegetation

Identification of vegetation associations/plant communities within the study area was accomplished using a combination of field surveys, the recently completed Baseline Vegetation Survey (Cedar Creek Associates 2006), and the Colorado Vegetation Classification Project (CVCP) (CDOW et al. n.d.). The CVCP is a landscape-level vegetation dataset for the State of Colorado, developed cooperatively by CDOW, BLM, and USFS.

The study area (93,707 acres) consists of three directly impacted project areas: (1) a proposed mine facility site, (2) a proposed railroad spur corridor and included water pipeline, and (3) a proposed, and alternative, transmission line corridors, (together comprising 452 acres), as well as the existing lease area (7527 acres) and proposed lease area (14,525 acres) north of the facility site, and all the surrounding lands in the vicinity of the proposed project.

The vegetation within the study area can generally be categorized into ten CVCP vegetation associations/plant communities: saltbush, sagebrush, greasewood, mesic mountain shrub, piñon-juniper, riparian, Douglas fir, aspen, grass dominated, and disturbed rangeland communities.

Three additional CVCP classifications were also found within the study area: commercial/ residential, talus slopes and rock outcrops and bare soil, and water. For the purposes of this analysis (and in consultation with the BLM), two of the CVCP communities (saltbush and disturbed rangelands) were combined and are identified as salt desert shrub throughout this document. Each is described in more detail in Table 3-21, Vegetation Associations Found within the Study Area, and in the subsequent text.

Table 3-21
VEGETATION ASSOCIATIONS FOUND WITHIN THE STUDY AREA

Vegetation Association[1]	Area (acres)	Percent of Total
Shrublands	**45,598.33**	**48.66**
Salt Desert Shrub[1]	31,513.02	33.63
Sagebrush	6,520.83	6.96
Greasewood	5,244.21	5.60
Mesic Mountain Shrub Mix	2,320.27	2.48
Woodlands and Forest	**26,367.73**	**28.14**
Pinon-Juniper	24,850.06	26.52
Riparian/Wetland[1]	1,466.72	1.57
Douglas Fir and Aspen	Less than 46.85	Less than 0.05
Commercial/Residential	**17,733.41**	**18.92**
Grasslands – Grass Dominated	**90.66**	**0.10**
Other	**3,916.64**	**4.18**
Talus Slopes, Rock Outcrops, Bare Soil	3,741.61	3.99
Water	169.67	0.18
No Data	9.37	0.01
TOTAL	**93,706.78**	**100.00**

Note:
[1]Vegetation Association names as assigned by the Colorado Vegetation Classification Project, *except* Salt Desert Shrub (CVCP communities: Saltbush (22,923 ac) + Disturbed Rangeland (8,590 ac)) and Riparian/Wetland (CVCP community: Riparian).

Salt Desert Shrub: This is the most abundant natural vegetation association, covering over 33 percent of the study area (Table 3-21, Vegetation Associations Found within the Study Area). Saltbush-dominated associations are found primarily, but not exclusively, on the middle portion of the project areas, primarily north of the commercial/residential lands that comprise most of the southern portions of the railway and transmission line corridors (Figure 1-1, Proposed Action). Additionally, nearly half of the mine facility site is represented by this association. The dominant woody species are Gardner saltbush (*Atriplex gardneri*), shadscale (*A. confertifolia*), and mat saltbush (*A. corrugata*). Broom snakeweed (*Gutierrezia sarothrae*) and pretty buckwheat (*Eriogonum bicolor*) are also frequently encountered. Common native herbaceous species include Salina wildrye (*Leymus salinus*), Indian rice grass (*Achnatherum hymenoides*), galleta (*Hilaria jamesii*), and yellow milkvetch (*Astragalus flavus*). Weedy species include cheatgrass (*Bromus tectorum*), halogeton (*Halogeton glomeratus*), annual wheatgrass (*Eremopyron triticeum*) and tumble mustard (*Sisymbrium altissimum*). This association also includes a large population of Grand buckwheat (*Eriogonum contortum*), a dwarf perennial shrub that the Colorado BLM has identified as a Sensitive Species.

Sagebrush: This association is found primarily along the northern portion of the project areas, including the mine facility site and the northern portions of the railway and transmission line corridors. The dominant woody species is Wyoming big sagebrush (*Artemisia tridentata* var. *wyomingensis*). The herbaceous vegetation is dominated by cheatgrass but also includes Salina

wildrye and galleta. The intermediate fishhook cactus (*Sclerocactus parviflorus* var. *intermedius*), although not common, is notable for the robust individuals in this area.

Greasewood: This association is not common within the study area (Table 3-21, Vegetation Associations Found within the Study Area). It is found primarily along drainage bottoms within the salt desert shrub and sagebrush associations. The dominant woody species include greasewood (*Sarcobatus vermiculatus*) and Wyoming big sagebrush. Cheatgrass and annual wheatgrass are the most abundant herbaceous species.

Mesic Mountain Shrub Mix: This is the least common shrub-dominated association within the study area and is found primarily at elevations higher than the other shrub communities. The typical dominant species include gambel oak (*Quercus gambelii*), serviceberry (*Amelanchier utahensis*), and/or mountain mahogany (*Cercocarpus montanus*). Additional common woody species include snowberry (*Symphoricarpos* spp.), big sagebrush, or chokecherry (*Prunus virginiana*).

Pinon-Juniper Woodland: This association is restricted primarily to the slopes and mesas within and to the east of the mine facility site, the northern-most portions of the railway and transmission line corridors, and large portions of the proposed and existing coal leases. Dominant woody vegetation includes Utah juniper (*Juniperus osteosperma*), pinon (*Pinus edulis*) and Wyoming big sagebrush. Common herbaceous species include cheatgrass, broom snakeweed, and Salina wildrye.

Riparian/Wetland: Riparian vegetation within the study area is located along drainages and is dominated by a combination of cottonwoods, tamarisk and native wetland plants. Riparian/wetland is discussed further in Section 3.2.11, Wetlands and Riparian.

Douglas Fir and Aspen Forests: These forest communities together comprise just 0.05 percent of the study area and are found exclusively at higher elevations, north of the Book Cliffs, within the proposed and existing coal lease areas.

Grasslands - Grass Dominated: This association is not common within the study area (Table 3-21, Vegetation Associations Found within the Study Area) and all of it is found outside the directly impacted project areas of the proposed railway and transmission line corridors. It is most abundant on some flat mesa and bench tops found just to the east of much of the proposed railway alignments. The dominant species within the study area are the exotic invasives such as cheatgrass, annual wheatgrass, and jointed goatgrass.

Commercial/Residential: This category includes buildings and other developments, managed pastures, and both irrigated and non-irrigated croplands and is found exclusively on the southern portions of the proposed railroad spur and transmission line corridors.

Talus Slopes, Rock Outcrops and Bare Soil: Most of this category is located in the vicinity of the mine facility site and consists of the steep slopes of the Book Cliffs.

Threatened, Endangered and Sensitive Species (TESS): As described previously, one BLM Sensitive Species, the Grand buckwheat (*Eriogonum contortum*), was found in the study area in proximity to proposed project areas, as a component of the salt desert shrub association. These findings are discussed within Section 3.2.13, Threatened and Endangered Species.

Biological soil crusts (a.k.a. cryptobiotic crusts) occur within the study area, primarily on some of the gentle slopes within the salt desert shrub vegetation association. Along the proposed

railroad spur alignment, the southern extent of the distribution is the Highline Canal and the northern extent is the transition from salt desert shrub into the sagebrush vegetation association The distribution of these organisms was documented during the surveys for Grand buckwheat (a BLM-sensitive species discussed within Section 3.2.13, Threatened and Endangered Species and within the report by WestWater 2007). At that time, biological soil crusts were reported to occupy at least 3 percent of the surface area within 92 percent of the sampling plots used for the Grand buckwheat survey. In general, these crusts were not well developed. Mosses were the most frequently observed component of the crusts, lichens were not very extensive, and there was very little evidence of classic soil pinnacles or pedicles typical of well-developed crusts.

Exotic Invasive Plants

Mesa and Garfield counties have identified 22 species of exotic invasive plants as noxious weeds. Of these, three species are on the Colorado State 'A' List (Table 3-22, Mesa and Garfield Counties Noxious Weeds List), 16 species are on the State 'B' List, and three are on the 'C' list.

Table 3-22
MESA AND GARFIELD COUNTIES NOXIOUS WEEDS LIST

Species[1]	Common Name	County M=Mesa, G=Garfield	'A' List[2]	'B' List[3]	'C' List[4]
Acroptilon repens	Russian knapweed	M & G		X	
Aegilops cylindrical	Jointed Goatgrass	G			X
Arctium minus	Common Burdock	G			X
Cardaria draba	Whitetop, Hoary cress	M & G		X	
Carduus acanthoides	Plumeless thistle	M & G		X	
Carduus nutans	Musk thistle	M & G		X	
Centaurea diffusa	Diffuse knapweed	M & G		X	
Centaurea solstitialis	Yellow starthistle	M & G	X		
Centaurea maculosa	Spotted knapweed	M & G		X	
Cichorium intybus	Chicory	G			X
Cirsium arvense	Canada thistle	M & G		X	
Cirsium vulgare	Bull thistle	M & G		X	
Cynoglossum officinale	Houndstongue	M & G		X	
Elaeagnus angustifolia	Russian Olive	G		X	
Euphorbia esula	Leafy spurge	M & G		X	
Isatis tinctoria	Dyer's woad	M	X		
Leucanthemum vulgare	Oxeye daisy	M & G		X	
Linaria dalmatica	Dalmatian toadflax	M & G		X	
Linaria vulgaris	Yellow toadflax	M		X	
Lythrum salicaria	Purple loosestrife	M & G	X		

Table 3-22
MESA AND GARFIELD COUNTIES NOXIOUS WEEDS LIST

Species[1]	Common Name	County M=Mesa, G=Garfield	'A' List[2]	'B' List[3]	'C' List[4]
Onopordum acanthium	Scotch thistle	M & G		X	
Tamarix ramosissima	Salt cedar, Tamarisk	M & G		X	

Notes:
[1] List and nomenclature from the Colorado Noxious Weed Management Program 2007.
[2] All populations of 'A' list species are designated for eradication. It is a rules violation to let any plant of any population produce seeds or other reproductive propagules.
[3] Species on the 'B' list require an implemented weed management plan designed to stop the spread of these species.
[4] 'C' list species for which a management plan is to be developed.

Four species of exotic plants found on both county lists, and the State B List, were identified within the project areas. Three of these species, whitetop (*Cardaria draba*), Canada thistle (*Cirsium avense*), and Russian knapweed (*Acroptilon repens*), are found in several locations within the agricultural lands that comprise much of the southern portion of the proposed railway alignment.

Additionally, salt cedar or tamarisk (*Tamarix* spp.) was observed in several locations within proposed project areas. Tamarisk is the dominant species around the small stock reservoir and is also a small component of the pinon-juniper woodland; both areas are within the mine site facility. Tamarisk is also a small component of the vegetation along Mack Wash. It is found along the banks in the vicinity of where the wash crosses U.S. Highway 6. It is also an invader of the greasewood association around water impoundments on the wash west of SH 139 and north of the proposed railroad spur corridor.

Redstem filaree (*Erodium cicutarium*) is another State B list weed that is widespread within the Salt Desert Shrub association and other disturbed sites on BLM lands.

Several additional weeds from the State C List are also found within the proposed project areas. The most common non-native plant species found is cheatgrass (*Anisantha tectorum*, also known as *Bromus tectorum*). Cheatgrass is the dominant species on the mesa and bench tops above saltbush dominated areas, and represents a significant portion of the herbaceous understory throughout the study area. Jointed goatgrass (*Aegilops cylindrical*) is found in several locations within the mine facility site within the salt desert shrub, greasewood, and grass-dominated associations, as well as in the heavily disturbed stocktank/reservoir area. Halogeton (*Halogeton glomeratus*) is found infrequently as a component of the herbaceous understory in the salt desert shrub outside of areas that are likely to be directly disturbed by the proposed project.

There are a number of nuisance weeds (exotic plant species not currently listed as a noxious weed species by the State of Colorado) found within the project area. Annual wheatgrass (*Eremopyron triticeum*) has been increasing in abundance and extent over the last few years within Mesa County. Within the project area, this species appeared to be the second most abundant non-native species, second only to cheatgrass. It co-occurs with cheatgrass on the mesa and bench tops and is a significant component of the herbaceous understory of all the shrub associations. Bur buttercup (*Ranunculus testiculatus*), is abundant within salt desert shrub. Other notable nuisance weeds within the study area include Russian thistle (*Salsola tragus*), kochia (*Kochia* spp.), and tumble mustard (*Sisymbrium altissimum*).

3.2.11 Wetlands and Riparian

Wetlands and riparian areas exist in the project area. Wetlands are areas considered to be within the jurisdiction of the USACE under Section 404 of the Clean Water Act, whereas riparian areas are given special consideration by BLM due to importance to fish and wildlife, and hydrologic resources on public lands. The study area for wetlands and riparian included the mine facility area and the railroad corridor, but did not include the proposed lease area.

Wetlands

Areas of potential USACE jurisdiction consist of WOUS. In general, WOUS includes wetlands (areas with wetland plants, hydric soils and hydrology); Traditionally Navigable Waters (TNW), such as the Colorado River; RPW (drainages with water flow 3 or more months per year) such as Mack Wash, Big Salt Wash, and East Salt Wash; and Non-RPWs that provide a surface or subsurface hydrologic connection to wetlands along RPWs (USACE 2007a).

The project area was examined to determine areas of potential USACE jurisdiction during the 2006 and 2007 field seasons. Two Jurisdictional Determinations (JD) were filed with USACE in December 2007 and January 2008 requesting a non-jurisdictional determination for ephemeral drainages and a request for confirmation of wetland delineation and jurisdictional determination for potential wetlands in the project area. The USACE jurisdictional determinations are included in Appendix E, Coordination and Consultations.

The USACE Jurisdictional Determination concluded that no potentially jurisdictional WOUS were present in the project area north of the Highline Canal. South of the Highline Canal, several wetlands and one RPW were identified. Identified wetlands are related directly to application of irrigation water on agricultural lands, and on the basis of March 2007 USACE Regulatory Branch Memorandum 2007-1 (USACE 2007b) were considered to be non-jurisdictional. These include wetland fringes along irrigation ditches in upland areas and sections of irrigation ditches that are impounded by blockages from vegetation or at culverts. All of the ditches are constructed in upland areas, and historic aerial photographs indicate that all of the area where these wetlands now occur was salt shrub desert prior to initiation of irrigation. Several wetlands were found to be related to groundwater seeps that are also likely related to irrigation water application, and therefore, non-jurisdictional. Unlined ditches can have losses of up to 2 cubic feet of water per foot of ditch area per day (BOR 1986), and the irrigated areas of the Grand Valley are underlain by a shallow perched water table derived from deep percolation of irrigation water and seepage from irrigation systems. Wetlands are present in some areas where the perched water table occurs near the surface. Wetlands have not been delineated in the proposed coal lease area along Big Salt Wash.

On the basis of the USACE Jurisdictional Determination, the only jurisdictional wetland in the project area is 0.71 acre along the RPW, Mack Wash. The jurisdictional WOUS includes 0.6 acre of non-wetland (Mack Wash flow path) and 0.1 acre of adjacent fringe wetland. Approximately 16.1 acres of delineated wetland were considered to be non-jurisdictional because they are related to irrigation water application and return flows. Of this, approximately 11.5 acres are emergent wetland marshes, 3.1 acres are fringe wetland along irrigation ditches, and 1.5 acres are emergent marsh that no longer has wetland hydrology. Emergent wetland marshes are dominated by cattail (*Typha latifolia),* spikerush (*Eleocharis palustris),* threesquare (*Scirpus pungens),* alkali muhly (*Muhlenbergia asperifolia),* and mannagrass (*Puccinellia*

pauciflora). Fringe wetlands are also dominated by the same wetland plants as the marshes and coyote willow (*Salix exigua).* All of these wetlands exist on private lands located south of the Highline Canal along the railroad spur alignment. No wetlands were identified on BLM lands. The location of identified WOUS in the project area are shown on Figure 3-22, USACE Wetlands.

Riparian Areas

Riparian areas in the project area are limited to the narrow floodplains along Mack Wash and other small washes south of the Highline Canal on private lands. Riparian habitat north of the Highline Canal (BLM) within the project area includes areas along Big Salt Wash in the proposed coal lease area. The riparian areas present south of the Highline Canal are dominated by scattered cottonwoods, coyote willow and greasewood. Portions of the riparian areas include wetlands likely to be under USACE jurisdiction. Other than along Big Salt Wash in the proposed coal lease area, the proposed project and all alternatives do not include any riparian areas on BLM lands. For the purposes of this analysis, all riparian areas south of the Highline Canal (private lands) will be considered to be wetlands.

3.2.12 Fish and Wildlife

The project area (mine facilities area and railroad corridor, see Figure 1-1, Proposed Action) is comprised of four dominant and reasonably distinct habitat community types: agricultural, salt desert shrub, sagebrush, and juniper scrub. These community types support a diversity of wildlife species as well as key habitats important to their survival.

Information contained in this section is derived from the Baseline Wildlife and Vegetation Surveys conducted by WestWater Engineering, Inc. (WestWater) in 2006, and the Baseline Wildlife Report compiled by Cedar Creek Associates, Inc. in 2006. Surveys done by WestWater focused on BLM sensitive plant and animal species, raptor nest sites, areas of concentrated big game use, prairie dog town distribution, and birds of conservation concern (BOCC) along with a listing of all migratory bird species encountered, noxious weed concentrations, and naturally occurring perennial waterways. These observations are shown on Figure 3-23, Wildlife Observations.

Wildlife Species

Big Game

Mule deer, pronghorn, elk, and mountain lion are the four big game species that occupy habitats in or near the project area. Black bear may also be present at higher elevations, more heavily wooded habitats above the project area, but this species presence in the area is unlikely. Observations of animals or animal sign (pellets) confirmed use of the study area by mule deer, pronghorn, and elk. The entire project area is contained within the CDOW Game Management Unit (GMU) 30.

The project area is located within year-long range for mountain lion and pronghorn, while elk and mule deer use the project area primarily during the winter months. The project area is located within or near CDOW mapped mule deer, elk, and pronghorn winter range, winter concentration areas, and/or severe winter range. Winter range is shown on Figure 3-24, Winter & Severe Winter Range. Map classification information for mule deer, elk, and pronghorn was

obtained from Natural Diversity Information Source (NDIS) (CDOW n.d.). CDOW's definitions for these big game winter activity areas are as follows.

- **Winter Range** – That part of the overall range of a species where 90 percent of the individuals are located during the average five winters out of ten from the first heavy snowfall to spring green-up or during a site-specific period of winter as defined for each Data Analysis Unit (DAU).
- **Winter Concentration Area** – That part of the winter range of a species where densities are at least 200 percent greater than the surrounding winter range density during the same period used to define winter range in the average five winters out of ten.
- **Severe Winter Range** – That part of the range of a species where 90 percent of the individuals are located when the annual snow pack is at its maximum and/or temperatures are at a minimum in the two worst winters out of ten.

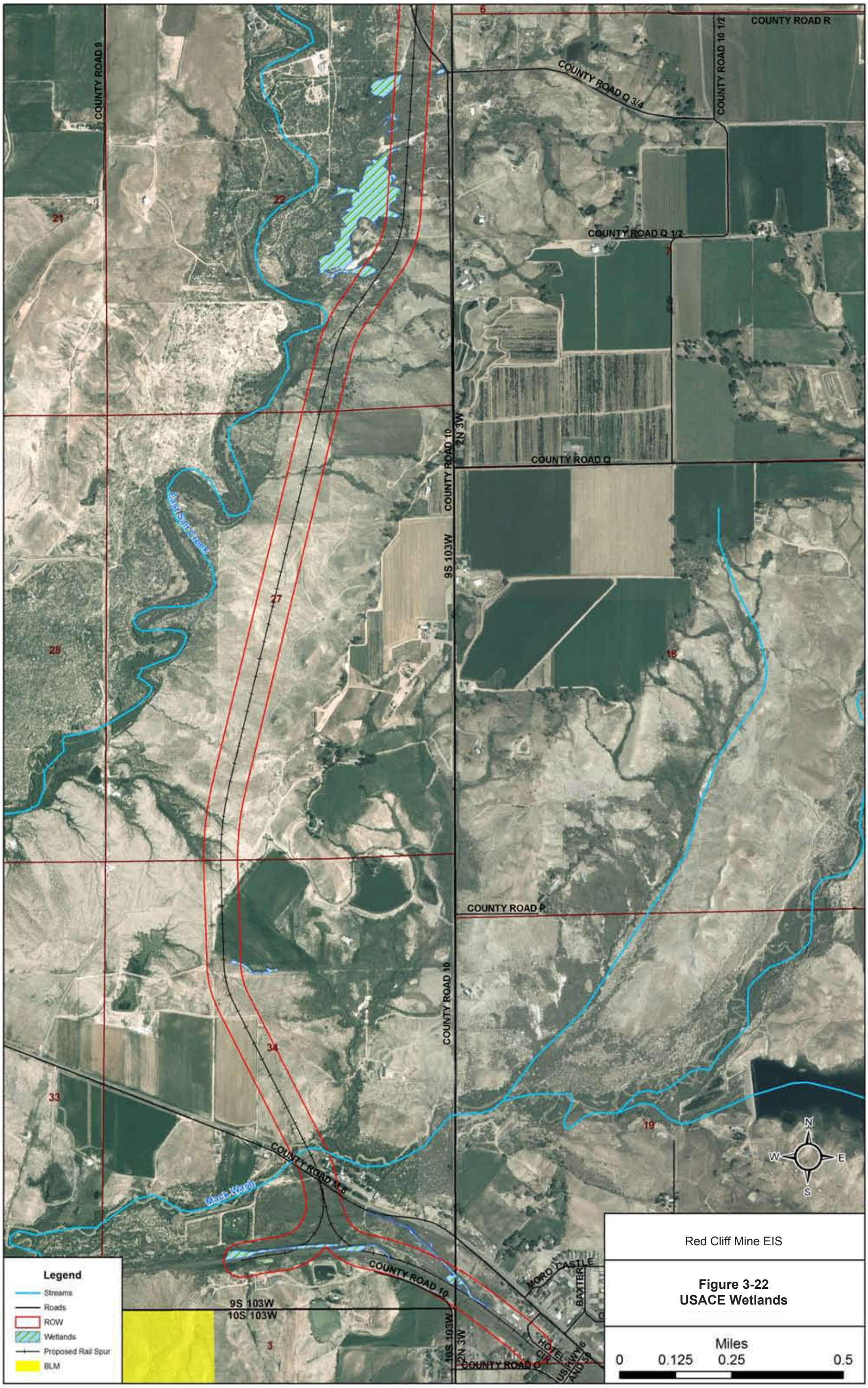
Mule Deer

Mule deer populations in the project area region are managed by CDOW as part of the Book Cliffs Herd. This herd population is contained within GMUs 30 and 21. GMU 21 is located adjacent to and north of GMU 30. Most of the entire northern portion of the project area is located within mule deer winter range in GMU 30. The project area at the base of the Book Cliffs escarpment is entirely within mule deer severe winter range, while a mule deer winter concentration area extends into the northwest portion of the project area (Figure 3-24, Winter & Severe Winter Range). The August 2006 field survey observations of mule deer pellet group concentrations confirmed extensive mule deer use of portions of the project area. Accumulations of mule deer pellet groups and evidence of shrub hedging was most pronounced on the outwash benches supporting sagebrush habitat at the base of the Book Cliffs. Based on trails and fecal droppings in the canyons leading to the mine bench, the juniper mesa below the mine site, the northeastern portion of the disposal area and the open juniper woodland north of the disposal area are important foraging areas for elk and deer. These areas contain annual vegetation and are the first to green-up early in the year. CDOW considers these sagebrush benches to be the most important mule deer winter habitat areas within the study area (Riggs 2006). The areas near the base of the Book Cliffs are also considered important daily or weekly movement corridors as the steep slopes of the Book Cliffs funnel animals through the area. Access across all areas for foraging and watering appears very important for the well being of mule deer herds in this area

CDOW population estimates for the Book Cliffs mule deer herd (*Colorado Outdoors* n.d.) indicate recent deer herd numbers to be relatively stable to slightly increasing: 2003 – 9,670 animals; 2004 – 8,770 animals; and 2005 – 9,800 animals.

Elk

Elk populations in the project area region are managed by the CDOW as part of the Yellow Creek Herd. This herd population is contained within GMUs 21, 22, 30, 31, and 32. GMUs 21, 22, 31, and 32 are located to the north and east of GMU 30 and include the entire area between the state line, I-70, SH 13, and SH 64. As indicated on Figure 3-24, Winter & Severe Winter Range, the northern portion of the project area is located within elk winter range, and most of this area is also within elk severe winter range. The August 2006 field survey observations of elk pellet group concentrations confirmed relative high elk use of potions of the project area,


COUNTY ROAD 9
COUNTY ROAD R
COUNTY ROAD 10 1/2
COUNTY ROAD Q 3/4
COUNTY ROAD Q 1/2
COUNTY ROAD Q
COUNTY ROAD P
COUNTY ROAD 10
COUNTY ROAD M.8
COUNTY ROAD 10
COUNTY ROAD O
9S 103W
10S 103W
2N 3W
East Salt Creek
Rock Wash
6
21
22
27
28
34
33
7
18
19
3
N
W
E
S
Legend
Streams
Roads
ROW
Wetlands
Proposed Rail Spur
BLM
Red Cliff Mine EIS
Figure 3-22
USACE Wetlands
Miles
0
0.125
0.25
0.5

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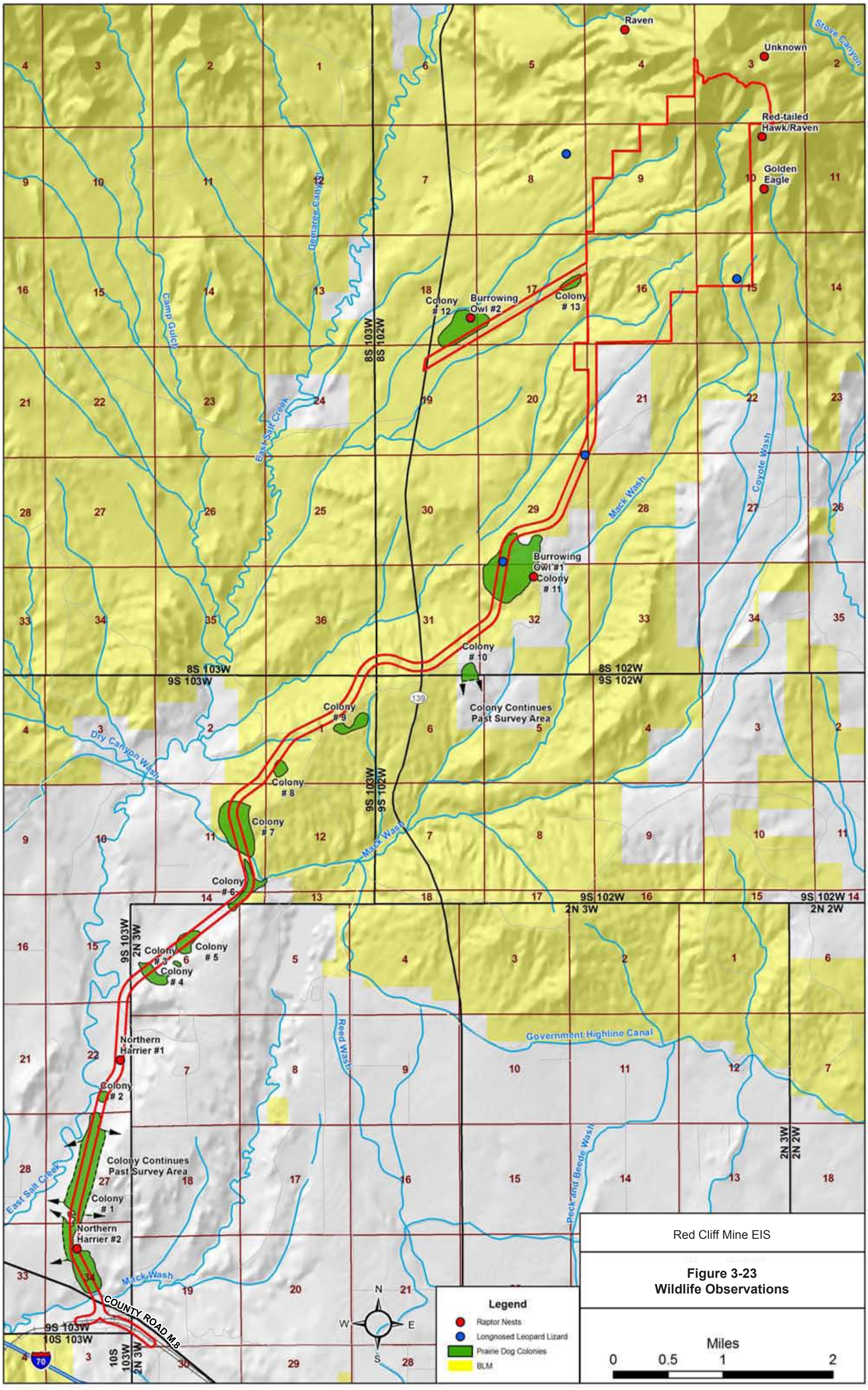

Red Cliff Mine EIS

Figure 3-23
Wildlife Observations

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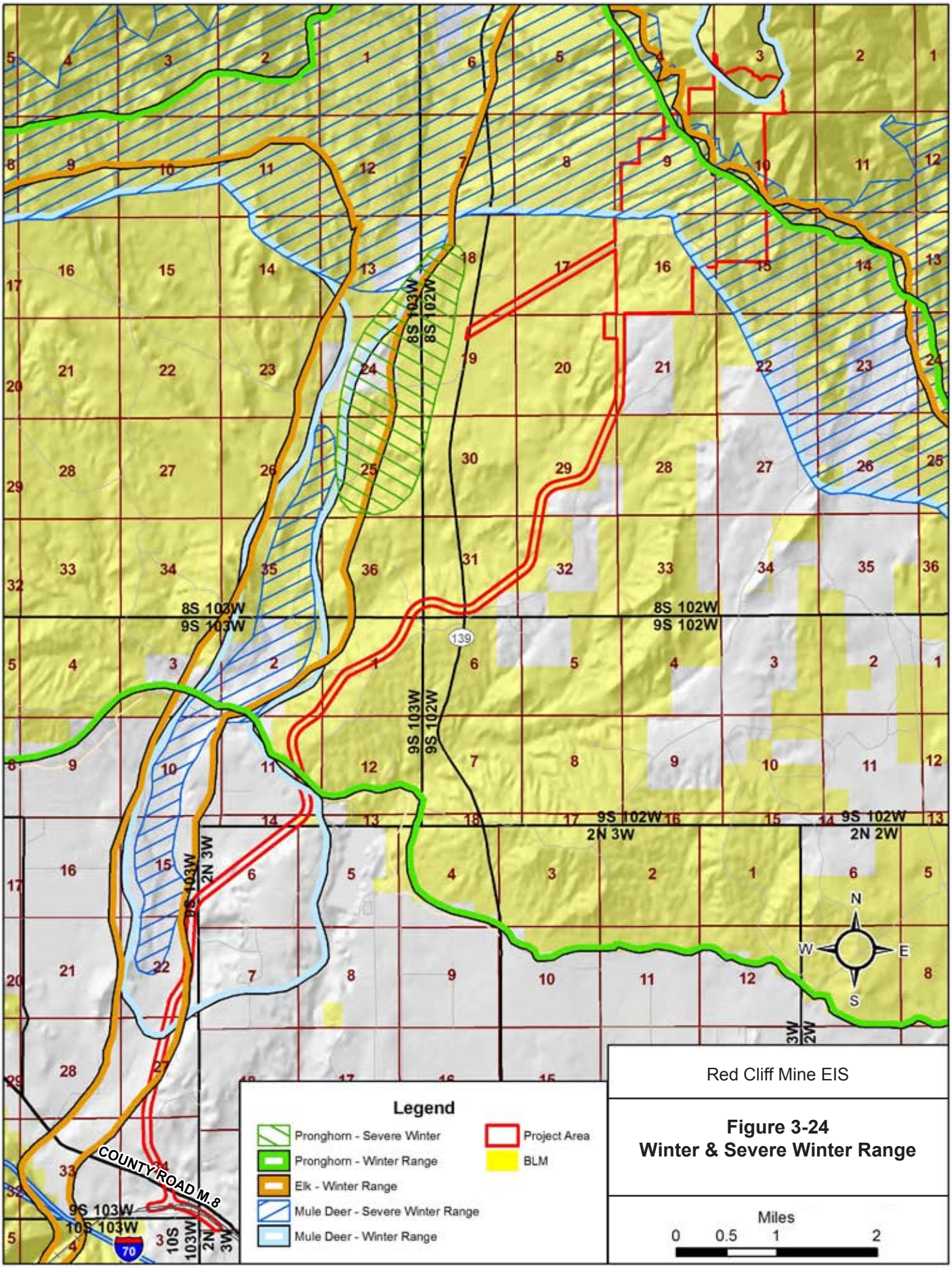
Legend
Pronghorn - Severe Winter
Pronghorn - Winter Range
Elk - Winter Range
Mule Deer - Severe Winter Range
Mule Deer - Winter Range
Project Area
BLM
Red Cliff Mine EIS
Figure 3-24
Winter & Severe Winter Range
Miles
0 0.5 1 2
N
W
E
S
COUNTY ROAD M.8
8S 103W
9S 103W
8S 102W
9S 102W
10S 103W
2N 3W
2N 2W
139
70

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although elk pellet group numbers were not as abundant as those observed for mule deer. Accumulations of elk pellet groups and evidence of shrub hedging was similar to mule deer and was most pronounced on the outwash benches supporting sagebrush habitat at the base of the Book Cliffs. The CDOW considers these sagebrush benches to be the most important elk winter habitat areas within the project area (Riggs 2006). Early spring use by elk was also very evident on the point of the ridge to the south of the proposed mine bench. Past disturbance and an old jeep road leading to this area have resulted in the abundance of annual grasses and forbs on disturbed areas.

CDOW population estimates for the Yellow Creek elk herd (*Colorado Outdoors* n.d.) indicate recent elk herd numbers to be slightly decreasing: 2003 – 9,780 animals; 2004 – 8,840 animals; 2005 – 8,270 animals.

Pronghorn

Pronghorn populations in the project area, GMU 30, and surrounding GMUs are relatively low, and the CDOW has not established any hunting seasons for pronghorn in the region. The majority of the project area (lower elevations below the Book Cliffs escarpment and north of the Highline Canal) is within pronghorn yearlong range and winter range (see Figure 3-24, Winter & Severe Winter Range). Pronghorn winter concentration areas are located immediately southwest and south of the mine facilities area, while severe winter range is located just west of SH 139 and the project area (see Figure 3-24). Pronghorn use was most notable along the railroad route in the area between the Highline Canal and SH 139. Several well-used trails crossed the rail route, one of which likely leads to a watering site adjacent to irrigated cropland. The trails are also used by cattle. Not all crossings of the rail corridor use the trails, but the trails are areas of concentrated use. The southernmost trails occur about 0.4 mile north of the Highline Canal. The other two trails occur in close proximity to each other, about 0.25 mile further north, with one in a draw and the other on an adjacent ridge. The second area of obvious use was adjacent to the utility road corridor between SH 139 and the mine facilities. Because of low pronghorn numbers in the region, field surveys did not document any heavily used areas by pronghorn, but sagebrush and salt desert shrub habitats are the most important for pronghorn in the study area. During field surveys in June and August 2006, pronghorn were observed along the proposed railroad spur alignment north and east of the Highline Canal, along the main access road (CR X) to the facilities area, and on the facilities site. Recent herd population numbers for pronghorn in the study area region are not available from the CDOW. Informal estimates place the herd size in the neighborhood of 75 animals (Van Graham 2008).

Mountain Lion

Mountain lion occur throughout the study area region with their range being closely tied to that of mule deer. Mountain lion prey primarily on mule deer and, like their prey, are typically wide-ranging. Mountain lions will follow their prey's seasonal movement and inhabit summer range or winter range in conjunction with mule deer. As a result of their wide-ranging habits, population densities are usually low. Documented home ranges for mountain lion in the Western U.S. range from 32.5 to 479.0 square kilometers (Anderson 1983). Preferred mountain lion habitat consists of rough or steep terrain in remote areas with suitable rock or vegetation cover. Based on this information and the wide-ranging habits of mountain lion, it is likely that the project area occurs within a territory occupied by this species. Mountain lions are most likely to

utilize the project area during the winter months when mule deer numbers increase on the northern portion of the project area.

Predators, Furbearers, and Small Mammals

Due to the secretive nature and nocturnal habits of many furbearers and other small mammals, the specific distribution and population densities within the project area are unknown. Furbearers and predators known or likely to occur in the area include coyote, badger, gray fox, ringtail, kit fox, long-tailed weasel, western spotted skunk, striped skunk, and bobcat. All of these species, except ringtail, are adapted to a wide range of grassland and shrubland habitats and are likely residents of the project area. Field surveys documented the presence of coyote and badger.

Coyote sign (scat) was encountered irregularly, but throughout the less rugged portions of the study area and coyotes are likely to occur in all habitats wherever suitable small mammal or rabbit prey can be found. Badgers prefer open grassland and sagebrush habitats supporting populations of white-tailed prairie dogs and ground squirrels, its preferred prey. Badger diggings were encountered occasionally in the desert salt shrub and sagebrush habitats in white-tailed prairie dogs towns within the project area.

Bobcats, like coyote, occur in wide variety of habitats. This species prefers rugged areas with caves, rock outcrops, and ledges. Favored prey includes large rodents, rabbits, and hares. Juniper scrub habitat, along the Book Cliffs escarpment, provides the most suitable habitat for bobcat within the study area. Striped skunk and long-tailed weasel inhabit a wide variety of habitats but often prefer areas near water and may not be common in the project except in the agricultural area in the southern portion of the rail line. The western spotted skunk prefers canyon and foothill country below 8,000 feet in elevation in Colorado. It appears to favor broken country or rocky terrain supporting montane shrublands, semi desert shrublands, and piñon-juniper woodlands (Fitzgerald et al. 1994).

Kit fox inhabit desert and semi-desert shrubland and margins of piñon-juniper woodlands throughout much of the Southwest. Additional information on the kit fox is included in Section 3.2.13, Threatened and Endangered Species.

The range of the ringtail extends from southern Mexico and Baja, California, through the Southwest and into the northwestern one-third of the U.S. They inhabit open, semi-arid country where rocky outcroppings, canyons, or talus slopes are present. Although omnivorous, ringtails show a preference for animal matter. Principal food items include arthropods, small mammals, and fruits (Poglayen-Neuwal and Toweill 1988). Ringtails most often den in rock crevices, boulder piles, and talus but also use brush piles, other animal burrows, rural cabins, and caves (Poglayen-Neuwal and Toweill 1988).

Habitats within the project area support a wide variety of other small and medium-sized mammals including the gray fox, long-tailed weasel, western spotted skunk, and striped skunk, associated with Colorado Plateau semi-desert and agricultural habitats. Many of the rodents and other small mammal species present represent an important food source for raptors and mammalian predators. Although specific information regarding population numbers and the distribution of most of these species is not available, some general conclusions related to species occurrence in the project area can be made based on habitats present and field surveys. Field surveys documented the presence of black-tailed jackrabbit, desert cottontail, white-tailed prairie

dog, and least chipmunk. Prairie dogs were encountered at various points on public and private lands from the Highway 6&50 crossing to the mine facilities area. Figure 3-23, Wildlife Observations, indicates areas on and adjacent to proposed facilities currently supporting prairie dog populations. Burrow densities and area occupied by various populations varied considerable. The largest concentrations occurred on private land north of CR M.8 and on private and public land east of agricultural lands along East Salt Wash and north of the Highline Canal. White-tailed prairie dogs are a cornerstone species in desert habitat, and additionally provide habitat for black-footed ferret, an endangered species. More information about the locations of white-tailed prairie dog towns is presented in Section 3.2.13, Threatened and Endangered Species.

Other small mammals likely to be study area residents include deer mouse, long-tailed vole, and plains pocket mouse at the lower elevations and mountain cottontail, rock squirrel, canyon mouse, piñon mouse, bushy-tailed woodrat, and yellow-bellied marmot at the higher elevations, associated with the upper portions of the Book Cliffs escarpment.

Raptors

Raptors that are not considered TESS and likely to occur in the project area are listed in Table 3-23, Raptor Species that May be Present in the Project Area. Several of these raptors are identified as BOCC by the USFWS (USFWS 2002).

Table 3-23
RAPTOR SPECIES THAT MAY BE PRESENT IN THE PROJECT AREA

Common Name	Scientific Name	BOCC	Habitat & Breeding Records
Bald eagle	*Haliaeelus leucocephalus*	Y	Open Water – Lakes, Forested Wetlands, Shrub Dominated Wetlands; common winter migrant along river corridors. Elevation: 300-8,000 feet
Northern harrier	*Circus cyaneus*	Y	Grassland, shrubland, agricultural areas, and marshes. Nests in areas with abundant cover (e.g., tall reeds, cattails, grasses) in grasslands and marshes. Also known to nest in high-elevation sagebrush.
Cooper's hawk	*Accipiter cooperii*	N	Cottonwood riparian to spruce/fir forests, including piñon/juniper woodlands. Nests most frequently in pines and aspen.
Sharp-shinned hawk	*Accipiter striatus*	N	High density young, or even-aged, stands of coniferous forest and deciduous forests of aspen or oak brush with small stands of conifers. Piñon-juniper woodland.
Red-tailed hawk	*Buteo jamaicensis*	N	Diverse habitats including grasslands, piñon-juniper woodlands and deciduous, coniferous and riparian forests. Nests in mature trees (especially cottonwood, aspen, and pines) and on cliffs and utility poles.
Swainson's hawk	*Buteo swainsoni*	Y	Typically, arid grassland, desert, agricultural areas, shrublands and riparian forests. Nests in trees in or near open areas.
Golden eagle	*Aquila chrysaetos*	Y	Grasslands, shrublands, agricultural areas, piñon-juniper woodlands, and ponderosa forests. Prefers nest sites on cliffs and sometimes in trees in rugged areas.

Table 3-23
RAPTOR SPECIES THAT MAY BE PRESENT IN THE PROJECT AREA

Common Name	Scientific Name	BOCC	Habitat & Breeding Records
American kestrel	*Falco sparverius*	N	Coniferous and deciduous forests and open terrain with suitable perches. Nests in cavities in trees, cliffs and buildings.
Prairie falcon	*Falco mexicanus*	Y	Grasslands, shrublands, and alpine tundra. Nests on cliffs or bluffs in open areas.
Great-horned owl	*Bubo virginianus*	N	Occupies diverse habitats including riparian, deciduous and coniferous forests with adjacent open terrain for hunting.
Northern saw-whet owl	*Aegolius acadicus*	N	Mountain and foothills forest and canyon country. Significant use of piñon-juniper woodland and Douglas-fir.
Long-eared owl	*Asio otus*	N	Occupies mixed shrublands. Nests and roost in sites in dense cottonwoods, willows, scrub oak, junipers and dense forest of mixed conifers and aspens.

Note:
BOCC = birds of conservation concern

Bald eagles are common winter residents on the Colorado River and utilize cottonwood trees for night roosts, hunting perches, and nesting. There are several nesting pairs of bald eagles on the Colorado River, with the closest nest sites found in Horsethief Canyon, approximately three miles southwest of the south end of the railroad spur. Golden eagles and red-tailed hawks will nest in large trees and cliffs or rock outcrops. The only trees of suitable size for nesting by these species occurred on private land within the railroad corridor. Suitable nesting habitat for red-tailed hawk, golden eagle, prairie falcon, and great-horned owls is provided by ledges on cliffs and areas of rock outcrop on the Book Cliffs. Great-horned owls do not build their own nests and often occupy old nests of eagles, hawks, and ravens on cliff faces and rock outcrop.

Northern harriers usually nest on the ground or in low shrubs in pockets of dense shrub and grass cover, along drainages or near wetlands. Two nests were located in cattail patches adjacent to Big Salt Wash. The American kestrel is a cavity-nester that uses abandoned woodpecker holes, magpie nests, and rock outcrop crevices. Stands of juniper and large cottonwoods also provide potential nest sites for red-tailed hawk, long-eared owl, saw-whet owl, Cooper's hawk, and sharp-shinned hawk.

Biologists surveyed and inventoried the project area for raptors during June and August of 2006 by searching cliffs and walking all areas of suitable nesting habitat. All potentially suitable sites within 0.25 mile of the proposed railway route were inspected for the presence of nests. Survey results are depicted in Table 3-24, Raptor Nest-Site Locations. All locations of survey observations were recorded using handheld global positioning system (GPS) units, and locations were recorded as Universal Transverse Mercator (UTM) coordinates North American Datum of 1983, Zone 12 South.

Table 3-24
RAPTOR NEST-SITE LOCATIONS

Species	UTM Easting	UTM Northing	Habitat Type	Status	Ownership	Comments
Northern harrier	683479	4346830	Cattails	Active	Private	Approximately nest location based on adult behavior
Northern harrier	6832223	4345191	Cattails	Active	Private	One chick in nest
Burrowing owl	688695	4354251	Annuals	Active	Private	Adult Pair with owl pellets on several mounds
Burrowing owl	688678	4358750	Annuals	Active	BLM	Three young observed in burrow
RT hawk/ raven	692902	4361476	Cliff	Active	BLM	Young fledged but active this year based on white-wash
Golden eagle	692945	4360716	Cliff	Active	BLM	Large stick nest. Young fledged but active based on white-wash
Raven	690866	4363011	Cliff	Active	BLM	Stick nest. Raven nest based on white-wash
Unknown	692916	4362653	Cliff	Inactive	BLM	Old stick nest not active this year
Great-horned owl	692003	4359843	Unknown	Active	BLM	Fledglings; nest site not observed; likely tree

Notes:
BLM = U.S. Bureau of Land Management
UTM = Universal Transverse Mercator

Raptor observations (Cedar Creek 2006) other than nest sites included red-tailed hawk, raven, and northern harrier along the road access corridor, golden eagles perched on the Book Cliffs above the disposal area and soaring over the desert area, a peregrine falcon stooping on prey at a small stock pond, kestrels, and a falcon (undetermined species) perched on the transmission pole along access corridor. Very heavy white-wash beneath a cottonwood located on private land strongly indicates a hunting perch for bald or golden eagles during the winter months. Three great-horned owlets were observed on the juniper woodland bench indicating nesting in the woodland or adjacent cliff habitat.

In this portion of Colorado, the raptor nesting season is generally considered to occur between mid-February and mid-August. Typically, owls and eagles are the first raptors to begin the annual nesting cycle followed by members of the Genus *Accipiter, Buteo, Circus*, and *Falco*. By mid-August all young birds have usually fledged and left the nest.

Several TESS raptor species including the bald eagle, ferruginous hawk, peregrine falcon, and burrowing owl are known to utilize the project area. The burrowing owl is the most frequent user of the project area, breeding and nesting in the project area. The bald eagle, peregrine falcon, and ferruginous hawk utilize the area for hunting during the months they are present in Colorado. Additional information on these Threatened and Endangered birds of prey can be found in Section 3.2.13, Threatened and Endangered Species.

Migratory Songbirds

The Migratory Bird Treaty Act (MBTA) provides federal protection of migratory bird species, and the BLM is required to evaluate the potential effects of a project on such species. A draft USFWS MOU defines BLM responsibilities under the MBTA. The MOU directs the BLM to avoid or minimize the unintentional take of migratory birds to the extent practicable. The MOU also places high management priority on BOCC identified by the USFWS (USFWS 2002).

The BOCC listing for the Southern Rockies/Colorado Plateau (USFWS 2002) was reviewed, and migratory songbirds on this list that are potential breeders in the study area are presented in Table 3-25, Birds of Conservation Concern Likely to Occur in the Project Area. BOCC raptors are listed in Table 3-23, Raptor Species that May be Present in the Project Area.

Table 3-25
BIRDS OF CONSERVATION CONCERN
LIKELY TO OCCUR IN THE PROJECT AREA

Common Name	Scientific Name	Habitat & Breeding Records
Pinyon jay	*Gymnorhinus cyanocephalus*	• Piñon-juniper woodlands. Nests in piñons or junipers. • Confirmed breeder in Mesa County and observed on the project area.
Gray vireo	*Vireo vicinior*	• Sparse Woodland, dry shrubby areas.
Black-throated gray warbler	*Dendroica nigrescens*	• Mature piñon-juniper woodlands. Nests on horizontal branches in piñon or juniper. • Nesting has been confirmed in Mesa County.
Sage sparrow	*Amphispiza belli*	• Large contiguous areas of low-elevation big sagebrush or sagebrush/greasewood shrublands. Nests in sagebrush. • Presence has been confirmed on the area during the nesting season.
Brewer's sparrow	*Spizella breweri*	• Sagebrush, desert shrub. • Confirmed breeder in Mesa County

Songbird diversity within the study area is limited by the lack of vegetation species and structural diversity. Few songbird species were recorded by qualitative surveys within the study area. Juniper scrub slopes represent potentially suitable habitat for gray vireo, but their distribution in Colorado is irregular and quite localized (Andrews and Righter 1992). Piñon jay and black-throated gray warbler typically prefer denser and taller piñon-juniper woodlands than the juniper scrub habitat areas supported within the study area with the exception of the woodland located on the east edge of the project area. Sage sparrows prefer extensive stands of sagebrush. Sagebrush benches in the study area appear to contain suitable sagebrush stands for sage sparrow. Like the gray vireo, the sage sparrow's distribution in Colorado is irregular and localized (Andrews and Righter 1992). The Colorado Natural Heritage Program (CNHP) database indicated that sage sparrow presence was recorded in and near the study area in April 1988 in Sections 2 through 11 (T8S, R102W). Brewer's sparrow is well distributed throughout western Colorado but was not observed in the project area. It is found primarily in larger sagebrush stands of medium to tall height and is a confirmed breeder in Mesa County.

Other songbirds noted on the project area during surveys in 2006 included horned lark, mourning dove, loggerhead shrike, sage thrasher, magpie, Clark's nutcracker, mocking bird, ash-throated

flycatcher, chipping sparrow, black-chinned sparrow, night hawk, meadow lark, lark sparrow, Scott's oriole, Say's phoebe, blue-gray gnatcatcher, western kingbird, violet green swallow, rock wren, and canyon wren.

Upland Game Birds

Chukar and mourning dove are the only upland game birds likely to be found in the project area. Mourning doves inhabit shrubland and grassland habitats in the region. However, they prefer agricultural areas and open woodlands with scattered trees and shrubs near water and are common throughout the project area. Doves were common during June, particularly around a small watering hole, although none were observed during the August 2006 field survey of the facilities area. Mourning doves are present in the region primarily during the summer months, migrating to warmer climates in the southern U.S. and Mexico for the winter.

Chukars have been introduced as a game bird throughout many arid areas of the western U.S. This species prefers arid sagebrush/grasslands in areas of rocky or rugged terrain. Chukar nest on the ground typically in rock or shrub cover. They require water and will make daily trips to watering sites during the hottest parts of the summer (Terres 1980). Preferred food includes the seeds of understory grasses (especially cheatgrass and bunchgrasses) and weedy species and the leaves of succulent forbs (Terres 1980). The lack of springs and other water sources throughout the summer near or in areas of suitable chukar habitat may limit chukar presence within the project area during this period. Chukars were observed at the base of the Book Cliffs in June 2006, but were not seen or heard during the August 2006 field survey.

Waterbirds

Waterbirds include waterfowl, shorebirds, and other wading birds typically associated with wetlands and bodies of surface water. Within the study area, aquatic habitat for waterbirds is restricted to two small seasonal stock ponds in the desert area and irrigation water found in the agricultural areas. In the desert area perimeters of stock ponds have been degraded by livestock use, and they offer little vegetation cover suitable for use as waterbird resting or nesting cover. Ducks, geese, great blue heron, and killdeer are quite common in agricultural areas and adjacent wetlands, canals, and ponds that occur within the project area.

Reptiles and Amphibians

A total of 20 reptiles and amphibians could potentially occur within the project area based on habitat preferences and known distributions. Within the desert area the presence of amphibians is limited by the general lack of surface water in the project area. Only one amphibian, Great Basin spadefoot, is a likely resident in this portion of the project area. This species is listed as BLM sensitive and is discussed in Section 3.2.13, Threatened and Endangered Species.

Within the agricultural area south of the Highline Canal, bull frogs were noted at two locations associated with small ponds and wetland habitat.

Five species of reptiles (longnose leopard lizard, short-horned lizard, plateau striped whiptail, collared lizard, and gopher snake) were recorded during the 2006 field surveys. The longnose leopard lizard is listed as a BLM sensitive species and is discussed in Section 3.2.13, Threatened and Endangered Species. Five observations of longnose leopard lizard were recorded during the 2006 field surveys (Figure 3-23, Wildlife Observations). All observations occurred north of the

Highline Canal and below the base of the Book Cliffs. Although WestWater biologists did not observe sagebrush lizards, western whiptail lizards, milk snakes, and midget-faded rattlesnakes, these species are likely residents in the project area.

Fish

Fish species known to inhabit Mack Wash include flannel-mouth suckers, roundtail chubs, bluehead suckers, and speckled dace. Natural spawning of flannel-mouth suckers occurs in Salt Creek (Martin 2007). Salt Creek and East Salt Creek are not crossed by the railroad, and no flowing washes were encountered between the Highline Canal and Book Cliffs during the field surveys that were conducted during all seasons in 2006 and 2007. Except for East Salt Creek and scattered stock ponds on the desert (mostly dry) all water in the project area is a result of irrigation development.

3.2.13 Threatened and Endangered Species

This section describes threatened and endangered species (TESS) of plants and animals present within the project area or within habitat that could be affected by project actions.

Threatened and endangered species are protected under the Endangered Species Act (ESA). Projects that may affect species listed under the ESA, habitat for such species and candidate for listing species are subject to consultation between the federal permitting agency (BLM) and the USFWS. Sensitive species are rare species managed by BLM to ensure that proposed projects do not contribute to the need for the species to become ESA listed.

USFWS has identified the following species for consideration (USFWS 2006, 2008) (Table 3-26, Threatened and Endangered Species with the Potential to Occur within the Project Area).

Table 3-26
THREATENED AND ENDANGERED SPECIES WITH THE POTENTIAL TO OCCUR WITHIN THE PROJECT AREA

Common Name	Scientific Name	ESA Status
Boneytail*	*Gila elegans*	E
Colorado pikeminnow*	*Ptychocheilus lucius*	E
Humpback chub*	*Gila cypha*	E
Razorback sucker*	*Xyrauchen texanus*	E
Uinta Basin hookless cactus	*Sclerocactus glaucus*	T
DeBeque phacelia	*Phacelia submtica*	E

Notes:
(T = federally-listed threatened; E = federally-listed endangered; C = a federal candidate species)
*Water depletions in the Upper Colorado River Basin may affect the species and/or critical habitat in downstream reaches in other states.

In addition, USFWS has requested that estimates of the size of white-tailed prairie dog colonies present in the project area be provided to determine if surveys for black-footed ferrets (*Mustela nigripes*) is warranted. Therefore, a section describing black-footed ferret habitat and occurrence in the Grand Valley is included here.

The four endangered fish listed in Table 3-26, Threatened and Endangered Species with the Potential to Occur within the Project Area, are collectively referred to as the Colorado River fishes for the purposes of this analysis.

Colorado River Fishes

The Colorado River fishes are native species of the Colorado River system which have decreased in numbers due to decreased flow in the rivers, loss of suitable habitat, and diminished water quality likely resulting from human uses. The portion of the Colorado River downstream from the proposed project is designated critical habitat for these fish. In addition, Mack Wash and Salt Creek may at times be used by these species. Projects that may result in the depletion of water or diminish water quality must undergo USFWS consultation.

Uinta Basin Hookless Cactus

This threatened species is found between 4,500 and 6,000 feet in elevation, primarily on rocky hills, mesa slopes, and alluvial benches of desert shrub communities and similar habitats. Uinta Basin hookless cactus has been found at a few locations in the Grand Valley (Spackman et al. 1997), but not within the proposed project area.

Surveys of the project area by WestWater Engineering and Cedar Creek Associates did not locate any individuals or populations of this species.

DeBeque Phacelia

This plant is a candidate for listing under the ESA and is also considered to be a BLM sensitive species. DeBeque phacelia is a small, summer annual plant that grows only in Garfield and Mesa counties within the Piceance Basin in western Colorado (Spackman et al. 1997). The species' total range is less than 300 square miles. The plant is restricted to elevations between 4,700 and 6,200 feet on the sparsely vegetated, dark gray and brown, clayey soils with high shrink-swell potential of the Atwell Gulch and Shire members of the Eocene and Paleocene Wasatch geological formation. To date, no individuals or populations of this plant have been reported in the Grand Valley or the proposed project area.

Surveys of the project area by WestWater Engineering and Cedar Creek Associates did not locate any individual or population of this species.

Black-footed Ferret and White-tailed Prairie Dog Colonies

Numerous black-footed ferret surveys have been performed in the Grand Valley since the species was included on the ESA list. To date, no ferrets have been observed in the Grand Valley or within the project area. All known populations of black-footed ferrets in North America were introduced from captive-reared stock. The nearest such experimental population (managed by the BLM White River Field Office) is located between Massadona and Elk Springs, over 60 miles north of the project area.

Active prairie dog colonies are an essential element of black-footed ferret habitat. White-tailed prairie dog colonies at least 200 acres in area, with a burrow density of at least 8 burrows per acre, and located within 4.34 miles of a similar colony may be considered potential black-footed ferret habitat.

WestWater surveys of the project area identified 13 white-tailed prairie dog colonies (see Figure 3-23, Wildlife Observations). Of these, 11 are located along the proposed railroad spur alignment, seven of which may be crossed by the railroad spur. Two colonies were found along the access road to the facility site. The estimated acreage of each town and the estimated burrow density per acre are shown in the Table 3-27, White-tailed Prairie Dog Colonies.

Table 3-27
WHITE-TAILED PRAIRIE DOG COLONIES

Colony Number	Area of Colony Acres	Estimated Burrow Density/Acre
1	> 173.78 *	16
2	4.70	10
3	18.57	3
4	1.59	8
5	17.85	3
6	23.01	6
7	74.10	12
8	9.00	3
9	16.89	2
10	>12.33 *	2
11	137.73	11
12	56.77	4
13	9.43	2

Notes:
*Surveys in these areas were limited by land ownership issues.
> = greater than

The location of these colonies relative other colonies beyond the survey limits of the WestWater work is not known.

Sensitive Species

Several species of birds, mammals, reptiles, amphibians, fish and plants are identified by the State of Colorado and/or the BLM as sensitive species. Table 3-28, Federal and State Sensitive Species, lists the species that may occur in the project area.

Table 3-28
FEDERAL AND STATE SENSITIVE SPECIES

Common Name	Scientific Name	State Status	Federal Status
Bald eagle	*Haliaeetus leucocephalus*	Threatened	De-listed in 2007, protected under Bald and Golden Eagle Protection Act
Burrowing owl	*Athene cunicularia*	Threatened	BLM Sensitive
Peregrine falcon	*Falco peregrinus*	Special Concern	De-listed in 1999.
Kit fox	*Vulpes macrotis*	Endangered	BLM Sensitive
Townsend's big-eared bat	*Plecotus townsendii*	Special Concern	BLM Sensitive
Spotted bat	*Euderma maculatum*	N/A	BLM Sensitive
Fringed myotis	*Myotis thysanodes*	N/A	BLM Sensitive
Yuma myotis	*Myotis yumanensis*	N/A	BLM Sensitive
Big free-tailed bat	*Nyctinomops macrotis*	N/A	BLM Sensitive
Botta's pocket gopher	*Thomomys bottae*	Special Concern	N/A
Midget faded rattlesnake	*Crotalus viridis concolor*	Special concern	BLM Sensitive
Milk snake	*Lampropeltis triangulum*	N/A	BLM Sensitive
Long-nosed leopard lizard	*Gambelia wislizenii*	Special concern	BLM Sensitive
Great basin spadefoot	*Scaphiopus intermontanus*	N/A	BLM Sensitive
Northern leopard frog	*Rana pipiens*	Special Concern	BLM Sensitive
Colorado round-tailed chub	*Gila robusta*	Special Concern	BLM Sensitive
Grand buckwheat	*Eriogonum contortum*	N/A	BLM Sensitive
DeBeque milkvetch	*Astragulus deqequaeus*	N/A	BLM Sensitive
Grand Junction camissonia	*Camissonia eastwoodiae*	N/A	BLM Sensitive
Cliffdwellers cryptanth	*Cryptantha elata*	N/A	BLM Sensitive

Notes:
BLM = U.S. Bureau of Land Management
N/A = not applicable

Searches for these species were carried out concurrent with other biological surveys performed by WestWater in 2006. No evidence of kit fox, Botta's pocket gopher, midget faded rattlesnake, milk snake, Great basin spadefoot, Northern leopard frog, DeBeque milkvetch, Grand Junction camissonia, or cliff dwellers cryptanth was observed. However, considerable numbers of Grand buckwheat were observed, as were five long-nosed leopard lizards.

Bald Eagle, Peregrine Falcon and Burrowing Owl

Bald eagles are common winter residents on the Colorado River and utilize cottonwood trees for night roosts, hunting perches and nesting. There are several nesting pairs of bald eagles on the Colorado River, with the closest nest sites found in Horsethief Canyon, approximately three miles southwest of the south end of the railroad spur. Peregrine falcons nest on cliffs and forage over wide areas of adjacent habitat. There are known nesting pairs in Colorado National Monument, approximately 8 miles southeast of the project area. Burrowing owls were found at

two locations during the biological survey (see Figure 3-23, Wildlife Observations). An adult pair was observed about 0.25 mile east of the proposed rail alignment in prairie dog colony 11. Owls had apparently being using several burrows because regurgitated pellets were found on several burrow openings. The second group of owls (3 young birds) was observed in prairie dog colony 12 near the access road from SH 139 to the mine site. Specific locations of the burrowing owl observations are included in Table 3-24, Raptor Nest-Site Locations.

Kit Fox

In addition to being a BLM Sensitive Species, the kit fox is state listed as a Colorado Endangered Species. Kit fox occupy semi-desert shrubland dominated by saltbush, shadscale, sagebrush and/or greasewood, as well as the margins of piñon-juniper woodlands. Rabbits are a critical component of their diets. According to NDIS, kit fox are known to occupy Mesa, Delta, and Montrose counties. The project area includes the appropriate vegetation and abundant rabbits, both of which are important components of kit fox habitat.

Western Colorado represents the northeastern edge of the kit fox's range that extends from the northern Great Basin south through the desert Southwest and into Mexico. In Colorado this species' historic range included the lower Gunnison River and Colorado River drainages below about 6,000 feet (Fitzgerald et al. 1996). After four years of study, Fitzgerald concluded that kit fox range and numbers in western Colorado had declined considerably. Fitzgerald captured ten kit fox in 1,930 trap nights at 922 trap sites over the four-year period in the lower Colorado River valley. One fox was trapped in Prairie Canyon (extreme west Garfield County), three were captured in Rabbit Valley (extreme west Mesa County) and six were trapped in the Cocoran Point area northeast of the Grand Junction airport. Radio-collared kit fox captured in western Mesa and Garfield counties moved 20 to 25 miles during the Fitzgerald study. Follow-up studies by Beck (1999, 2000) supported Fitzgerald's conclusions and postulated that the species was close to extinction in the state. Other incidental sightings of kit fox were made by CDOW personnel in the early and late 1980s (Graham 2007).

Fitzgerald estimated that over 200 square miles of sagebrush and saltbush rangelands, clay barren areas, and shrub-grasslands appeared to be suitable habitat in the lower Grand Valley. Almost the entire project area represents potential habitat for kit fox and is within their historical range. Although no den sites or kit fox sign were found during the 2006 surveys, it must be noted that kit fox are nocturnal and the field surveys were conducted during daylight hours, therefore it cannot be ruled out that kit fox are residents in the project area. Given the habits and mobility of this species, use of several inventory methods would be required, including spot-light routes, track detection stations, and searches for dens, to more accurately determine the status of kit fox in the project area.

Sensitive Bats

Five bat species (Townsend's big-eared bat, spotted bat, fringed myotis, Yuma myotis, and big free-tailed bat) listed as BLM sensitive could reside in the Red Cliff Mine project area. Townsend's big-eared bat is also listed as a state special concern species. Based on existing data it is unlikely that the fringed myotis and big freetail bat occur within the project area. The remaining bat species, Townsend's big-eared bat, spotted bat, and Yuma myotis could occur within the project area but the probability is not high. Adequate foraging habitat exists for all

three species but suitable habitat for roosting, maternity roosts, and hibernacula is lacking in the project area.

Botta's Pocket Gopher

Although no specific sites were surveyed in 2006 to determine the status of Botta's pocket gophers in the project area, they are known to inhabit the project area. Botta's pocket gophers can be found in a variety of habitats, including agricultural land, piñon juniper woodland, and semidesert shrublands (Fitzgerald et al. 1994). They are expected to occupy areas with deep soils along the rail alignment.

Midget Faded Rattlesnake and Milk Snake

These snake species inhabit varied habitats, including rocky to sandy soils in semi-desert shrublands, canyons, piñon-juniper woodlands, and arid river valleys between 7,500 and 9,500 feet (rattlesnake) or below 8,000 feet (milk snake). Both are secretive and may be difficult to detect without a concerted effort.

Long-nosed Leopard Lizard

Within the project area, habitat for this species includes fairly dense stands of saltbush, greasewood, rabbitbrush, juniper woodlands, and cheatgrass on clay soils. This habitat is found along much of the railroad alignment north from the Highline Canal continuing east of SH 139 to the proposed facility site, including the base of the Book Cliffs within and north of the mine and facility site. According to Hammerson (1999), these lizards are most common where the ground surface between shrubs is bare or lightly vegetated and where the soil is mounded at the base of the shrubs and pocked with rodent burrows used by the lizards during the nighttime and winter. A minimum of five individuals were observed by WestWater biologists within the study area during the biological surveys, including two in salt desert shrub (saltbush/shadscale), one in sagebrush, one in juniper woodland, and one in a burn reseeded with four-wing saltbush and perennial grasses.

Great Basin Spadefoot and Northern Leopard Frog

Great Basin spadefoot toads occur north of the Uncompahgre Plateau (including parts of Mesa and Garfield counties) at elevations up to 7,000 feet in piñon-juniper woodlands, sagebrush flats, and semi-desert shrublands. Habitats include the bottoms of rocky canyons, broad dry basins, and stream floodplains. There are known records of occurrence in the Grand Valley, west of the project area, between Salt Creek and the Utah state border (Hammerson 1999).

Northern leopard frogs are widely distributed in Colorado including the project area below the Highline Canal, in habitats including wet meadows, ponds, marshes and irrigated areas. Formerly abundant, the frogs have become scarce in many areas of Colorado, due in part to loss of habitat and predation from non-native bullfrogs (Hammerson 1999).

Colorado Round-tailed Chub

Colorado round-tailed chub are listed as a Colorado species of special concern and a BLM sensitive species. These fish occupy slow-moving waters adjacent to areas of faster current in large rivers (NDIS), including the portions of Mack Wash and Salt Creek adjacent to the

Colorado River (Martin 2007). Formerly abundant in the lower Colorado River drainage, they have become increasingly scarce in recent years, causing them to be added to the sensitive species lists.

Grand Buckwheat

Grand buckwheat is a dwarf perennial shrub with small yellow flowers, typically in bloom from May to August (Freeman & Reveal 2005). This species is found in Mancos shale badlands on gently rolling hills with sparse salt desert shrub vegetation between elevations of 4,250 to 5,600 feet (Spackman et al. 1997). Grand buckwheat has a limited distribution largely restricted to the Grand Valley of Mesa County, Colorado and Grand County, Utah.

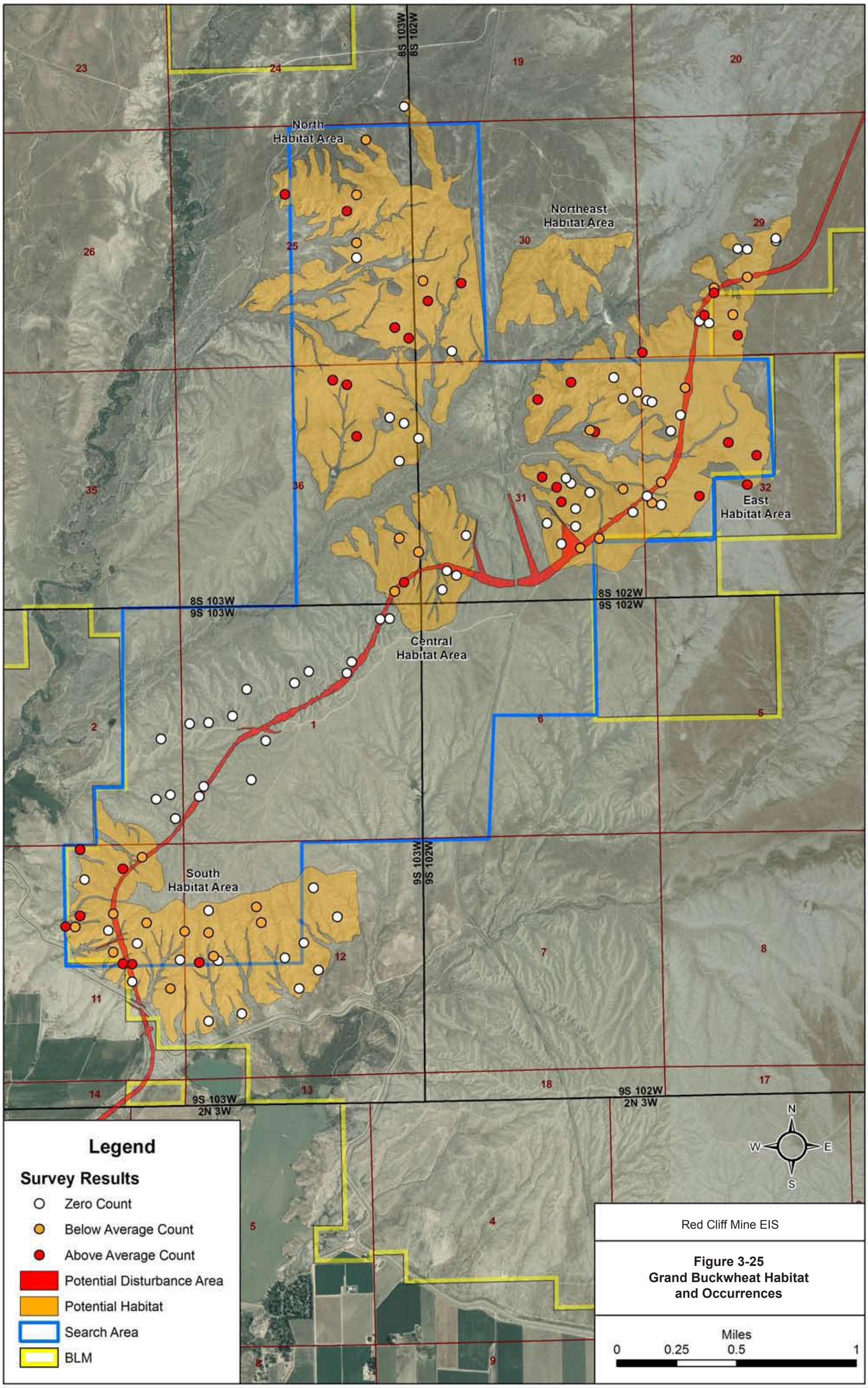
A Grand buckwheat sampling plan was prepared in consultation with BLM biologists on the basis of the WestWater observations. The results were reported in a document prepared by WestWater Engineering (WestWater 2007). A summary of the findings is presented.

The approved sampling plan, including the shape and area of the sampling quadrats, as well as the number of samples to collect, was based on the methods described by Elzinga et al. (2001).

The study found an estimated total Grand buckwheat population within the study area of approximately 1,144,614 individuals. These plants are found on side slopes of the numerous ridges in the study area, but not within lowlands dominated by greasewood (*Sarcobatus vermiculatus*), or in areas with dense cheatgrass (*Bromus tectorum*) (see Figure 3-25, Grand Buckwheat Habitat and Occurrences).

Debeque Milkvetch, Cliffdweller's Cryptanth and Grand Junction Camissonia

DeBeque milkvetch is found between the elevations of 5,100 and 6,400 feet inhabiting the varicolored, fine textured, seleniferous saline soils of the Wasatch Formation-Atwell Gulch Member. The cliffdweller's cryptanth is found between the elevations of 4,600 and 5,000 feet in salt desert shrub communities found on the clayey Mancos shale derived soils. The Grand Junction camissonia is found between 3,900 and 5,900 feet in sparse desert shrub communities (mat saltbush, shadscale, and blackbrush) and sparse juniper woodlands on adobe hills in the lower valleys of western Colorado. There is suitable potential habitat for each of these species within Mesa County and both the cliffdweller's cryptanth and Grand Junction camissonia have been recorded within the Grand Valley between the study area and the Utah state border. The nearest recorded observation of DeBeque milkvetch is over 20 miles east of the project area.



Red Cliff Mine EIS

Figure 3-25
Grand Buckwheat Habitat and Occurrences

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