3.0 Description of the Affected Environment

3.1 Introduction

This chapter describes the environment that would be affected by the development of the Proposed Action and the alternatives analyzed in this EIS. The baseline information summarized in this chapter was obtained from published and unpublished materials; interviews with local, state, and federal agencies; and from field and laboratory studies conducted in the project area. The affected environment for individual resources was delineated based on the area of potential direct and indirect environmental impacts for the proposed project.

In general, the descriptions of the affected environment focus on the land within the project area boundary shown in **Figure 1-1**. For resources such as soils and vegetation, the affected area was determined to be the physical location and immediate vicinity of the areas to be disturbed by the proposed project. For other resources such as water, air quality, and social and economic values, the description of the affected environment is more extensive (e.g., watersheds, regional geology, climate, local communities, etc.).

The specific aspects of each resource that are described in each section were selected because they have the potential to be affected by the proposed HB In-Situ Solution Mine Project or to affect the construction and operation of the proposed project.

3.2 Geology and Minerals

3.2.1 Regional and Project Area Geology

The following subsections provide an overview of the geology and topography of the region and describe the important geologic features in the project area that are relevant to the proposed project.

3.2.1.1 Physiography and Topography

The proposed project is located in the Pecos Valley Section of the Great Plains Physiographic Province (Fenneman 1928). The Pecos Valley Section is located between the High Plains on the east, the Raton Section to the north, the Edwards Plateau on the south, and the Mexican Sacramento Section of the Basin and Range Province on the west (**Figure 3.2-1**) (Trimble 1990). The Pecos Valley was formed by the Pecos River as it eroded into the mantle of Tertiary sedimentary rocks (capped by the Ogallala Formation) that used to gird the front range of the Rocky Mountains from Texas to Montana. The High Plains to the east of the Pecos Valley is a remnant of the Tertiary rocks that have been stripped away from the mountain front by the Missouri, Platte, Arkansas, and Pecos rivers. The boundary between the Pecos Valley and the High Plains is the Mescalero Ridge, a prominent escarpment that rises 100 to 200 feet above the valley. The Pecos Valley is characterized by rolling hills and mesas. Another prominent feature of the lower half of the valley is the presence of karst topography typified by sinkholes, caves, and enclosed depressions (Hill 1996). The karst topography resulted from the dissolution of evaporite deposits and limestone in the subsurface.

Elevations in the project area range from less than 3,200 to over 3,500 feet amsl. The topography in the project vicinity is dominated by features thought to be related to subsidence that resulted from natural dissolution of evaporite minerals in the subsurface. There are depressions with no surface drainage, escarpments along the boundaries of subsided areas, and many other smaller features such as sinkholes, caves, and sinking drainages (Vine 1963).

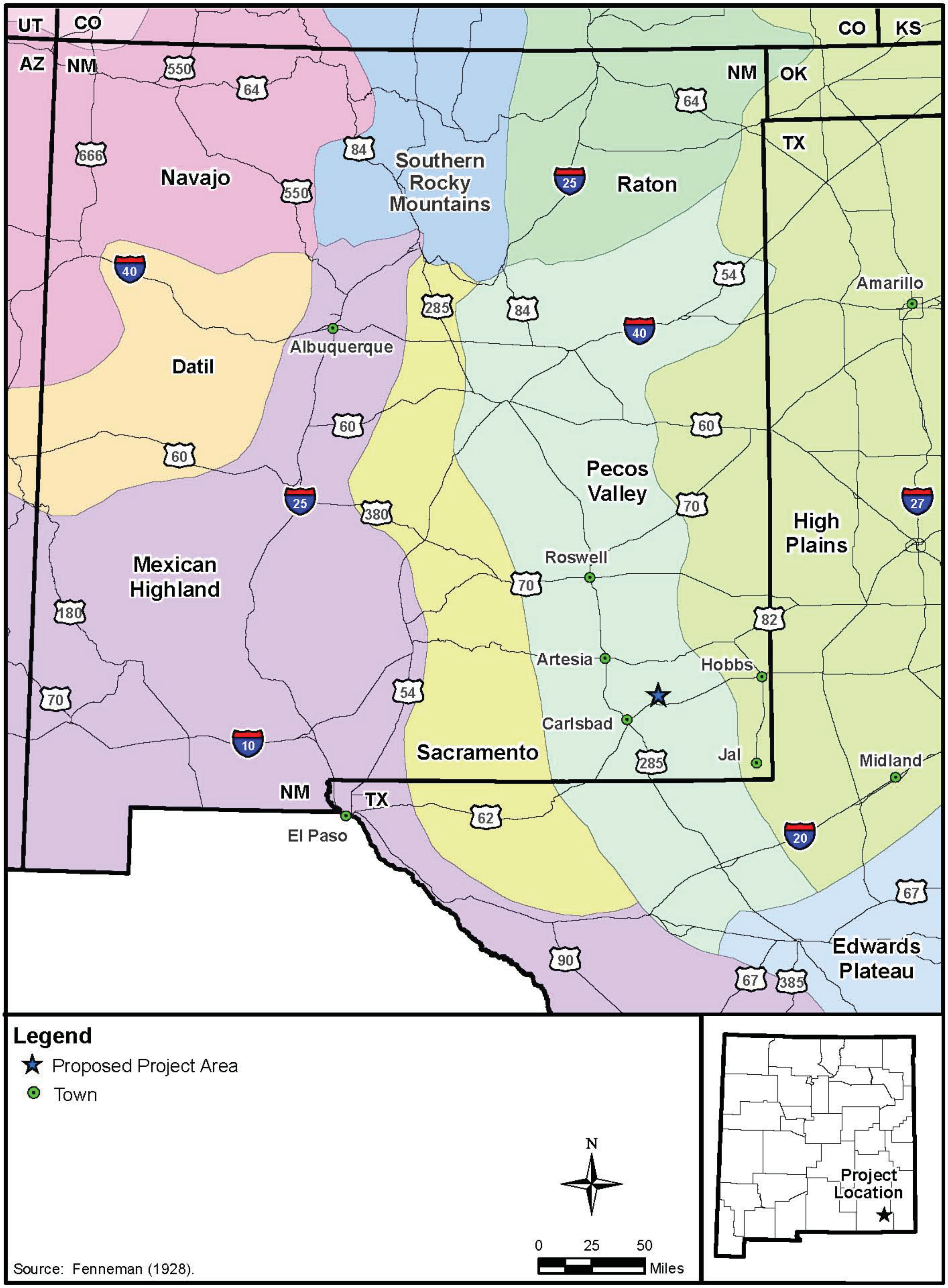


Figure 3.2-1. Physiographic Provinces of New Mexico

3.2.1.2 Regional Geology

The proposed project is located in the Delaware Basin, a sub-basin of the greater Permian Basin of west Texas and New Mexico (see **Figure 3.2-2**). The Delaware Basin is bounded on four sides by basement uplifts that include the Marathon Fold Belt to the south, the Diablo Platform on the west, the Northwest Shelf to the north, and the Central Platform to the east (Montgomery et al. 1999). The sedimentary rocks in the basin dip gently to the south and east and the deepest part of the basin is on the southeast side in Pecos County, Texas. There are complex bounding fault zones on the east, south, and west sides of the basin. Along the structural boundary along the Northwest Shelf to the north, there are no faults as rocks dip gently to the south from the shelf into the basin (Hill 1996). Internally in the basin, the structure becomes more complex at depth with relatively little faulting and folding of the thick Permian section. Fold structures are common in areas of bedded salt such as in the SPA, but large complex structures are present in the deeper parts of the basin.

The Delaware Basin contains up to 30,000 feet of sedimentary rock with deposits ranging in age from Cambrian to Quaternary (Hill 1996; Roche 1997). The Precambrian basement consists mainly of granitic and metamorphic sedimentary rocks, but volcanic rocks also may be present. The Paleozoic section from Cambrian to Pennsylvanian consists of clastic and carbonate rocks deposited in a variety of environments including continental, shallow marine, shelf, and basin. The pre-Permian rocks are largely known from the drilling of the deeper oil and gas wells, but there are limited surface outcrops.

3.2.1.3 Project Area Geology

The important units in the project area consist of Permian rocks of the Guadalupian and Ochoan Series, which are described below. The units are categorized by their locations relative to the Capitan Reef, which marks the transition from shelf (back reef) to reef (basin margin) to basin.

The stratigraphic relationships are shown in **Figure 3.2-3** and a correlation diagram is shown in **Table 3.2-1**. The project area lies along the basin margin-reef area, defined by the Capitan Limestone.

In addition to the upper Permian rocks, there are surficial exposures of Triassic, Tertiary, and Quaternary deposits in the project area that also are described below.

<u>Permian Rocks</u>

Guadalupian Series. Rock units in the Guadalupian Series of interest in the project area consist of the Capitan Limestone, Bell Canyon Formation, and the upper Artesia Group. These units are time-equivalent: the Capitan Limestone is the basin margin reef-derived unit, the Bell Canyon Formation was deposited in the basin, and the upper Artesia Group consists of back reef and shelf deposits.

Capitan Limestone. At the beginning of the Permian period, the configuration of the present Delaware Basin began to take shape (Hayes 1964). In late Guadalupian time, conditions were favorable for reef growth at the basin margin so the Capitan Limestone reef deposits built upward and toward the basin.

The Capitan Limestone is composed of massive reef material and associated reef talus zones (Hayes 1964). The reef material is thought to have been derived from organisms such as algae and sponges. Diagenetic changes and recrystallization have obscured most of the fossils. The massive reef-building rock built upward and toward the basin and developed on top of its own talus deposits. The talus resulted from erosion of the reef material at the water surface to wave base. Porosity in the massive Capitan reef facies is generally low because of cements, but there are occasional vugs and cavernous porosity (Hill 1996).

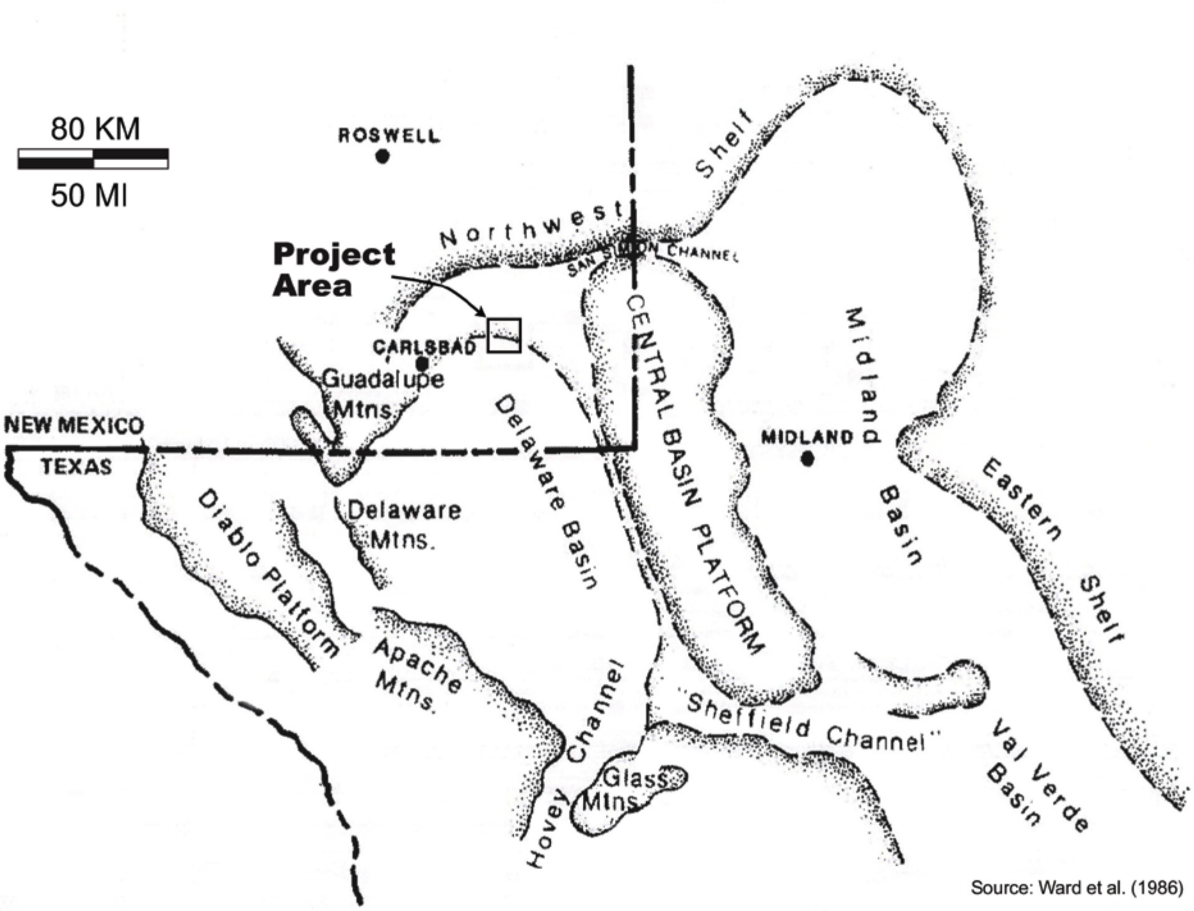
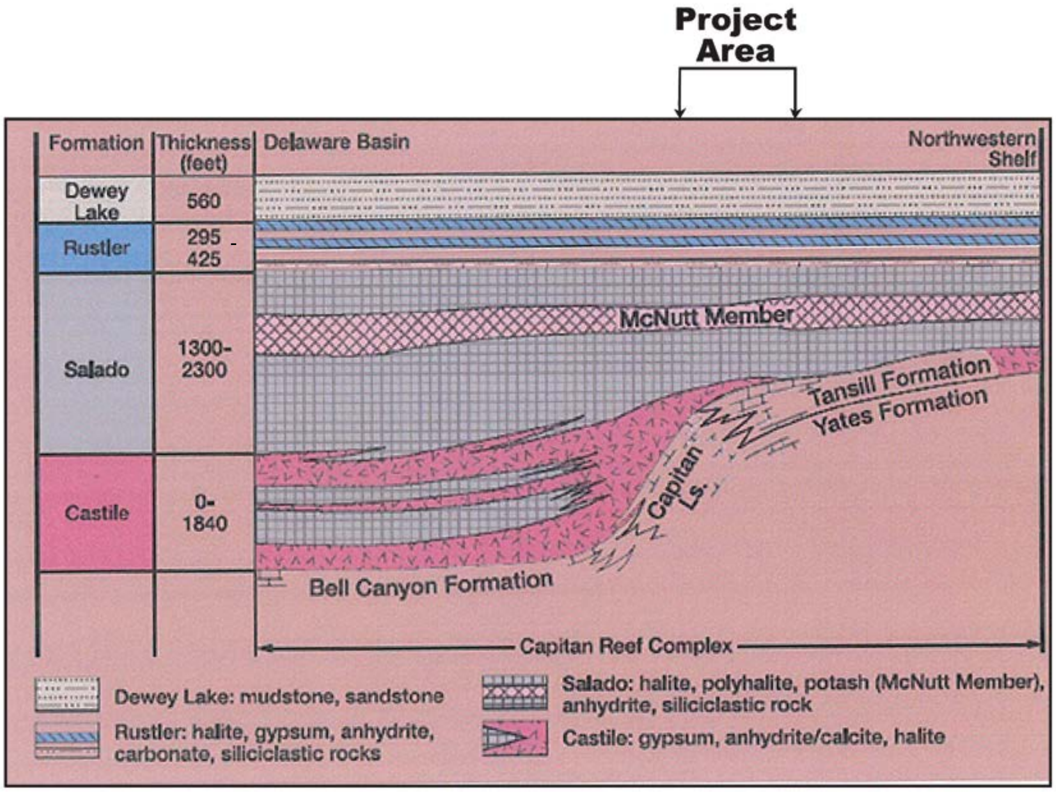


Figure 3.2-2 Major Structural Elements in the Region



Source: Barker et. at (2008)

Figure 3.2-3 Stratigraphic Relationship between Upper Guadalupian-Ochoan Series

Table 3.2-1 Upper Guadalupian-Ochoan Formations in Project Area

		South	Project Area	North	Approximate Thickness in Project Area (feet)
		Delaware Basin		Northwest Shelf	
System	**Series**	**Basin**	**Basin Margin - Reef**	**Shelf - Back Reef**	
Permian	Ochoan	Dewey Lake Red Beds	Dewey Lake Red Beds	Dewey Lake Red Beds	Up to 250
		Rustler Formation	Rustler Formation	Rustler Formation	Up to 350
		Salado Formation	Salado Formation	Salado Formation	150 to 1,000
		Castile Formation	Castile Formation	No equivalent	10 to 80
	Guadalupian	Bell Canyon Formation	Capitan Limestone	Tansill Formation	1,500
				Yates Formation	
				Seven Rivers	

Sources: Hayes 1964; Hill 1996; Lambert 1983; New Mexico Oil Conservation Division (OCD) 2009a; Wills 1942.

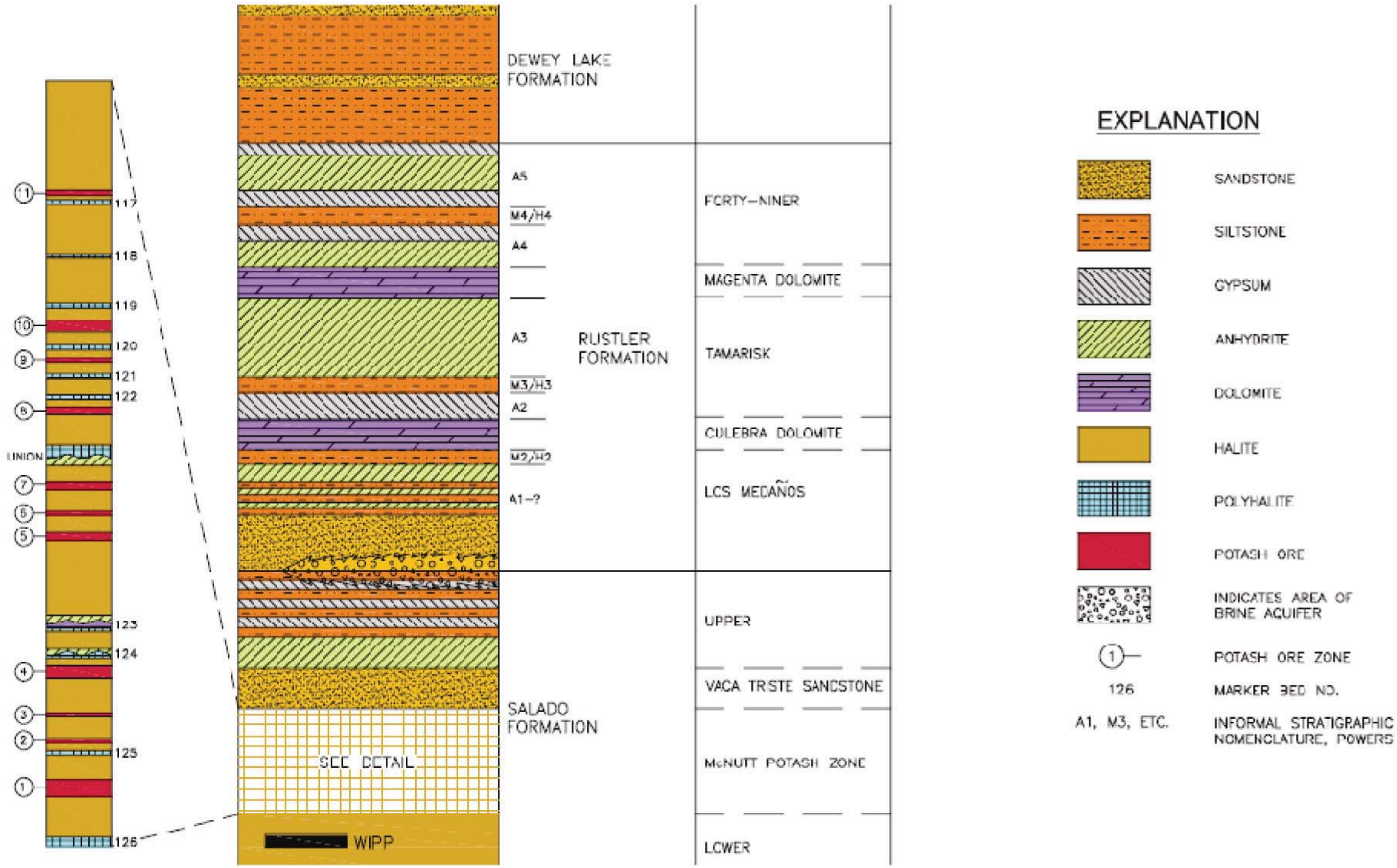
Bell Canyon Formation. The Bell Canyon Formation is the uppermost formation of the Delaware Mountain Group, a designation for the formations of the Guadalupian Series. It is equivalent to the Capitan Limestone and is generally composed of turbidite sandstones that were deposited in a deep water setting (Berg 1979). Carbonate rocks also are present in the Bell Canyon Formation in areas close to the reef. Bell Canyon sediments interfinger with the talus slope of the Capitan Reef. The Delaware Basin was a “sediment-starved” basin, but during times of sea level drop, clastic sediments were moved to the shelf margin and eventually deposited in the basin by turbidity flows. The turbidity flows deposited sand in elongated sinuous channels with sediment transport from north to south and southwest across the shelf and into the basin (Payne 1976).

Artesia Group. The formations in the upper part of the Artesia Group, Tansill, Yates, and Seven Rivers, are composed of rocks that are the time-equivalent units to the Capitan Limestone. The Seven Rivers Formation, time-equivalent to the lower Capitan Limestone, is largely composed of dolomite in areas close to the reef. Dolomite transitions into gypsum or anhydrite (carbonate) rock toward the shelf. The Yates is equivalent to the middle Capitan Limestone, consisting of up to two-thirds sandstone with intervening beds of dolomite (Lambert 1983). The Yates grades to evaporites in the direction of the shelf. The Tansill Formation is equivalent to the upper Capitan Limestone and is composed of dolomite in the basin margin-reef areas, transitioning into evaporites towards the shelf.

<u>Ochoan Series</u>

Salado Formation. The Salado Formation is the primary salt formation in the area and the formation mined for potash. The Salado is over 2,000 feet thick regionally, but is 1,000 feet thick in the project area. It contains four distinct members and is mainly composed of halite, but also contains anhydrite, siltstone, polyhalite, and soluble potash minerals (**Figure 3.2-4**). At the base of the Salado Formation is an unnamed lower member composed mainly of massive halite in the basin that also contains an anhydrite bed used to mark the base of the Salado in areas over the reef (Hill1996). This lower member is used as the repository host at the Waste Isolation Pilot Plant (WIPP) facility southeast of the project area. Overlying the lower member is the McNutt Potash Member, which contains the potash ore zones. The Vaca Triste Sandstone overlies the McNutt Potash Member and, while only ten feet thick, is a highly recognizable and widespread marker bed (Hill 1996). The upper member of the Salado, also unnamed, consists of halite, siltstone, and anhydrite. At the top of the upper member is a 30-foot-thick zone composed of unconsolidated clay that is thought to be the breccia zone caused by the dissolution of halite.

Rustler Formation. The Rustler Formation continues the succession of Ochoan units, and is present on the surface as well as in the subsurface in the project area. It is composed of anhydrite, dolomite, siltstone, sandstone, and gypsum. Members of the Rustler Formation from bottom to top are the Los Medaños, Culebra Dolomite, Tamarisk, Magenta Dolomite, and the Forty-niner (**Figure 3.2-4**). The Los Medaños member is composed of siltstone, gypsum, and fine-grained sandstone. The Culebra Dolomite is a thin-bedded crystalline dolomite that also has vugular porosity (Hill 1996). It is resistive to weathering and forms prominent outcrops where exposed. The Culebra Dolomite is exposed south of the project area at the southern end of Nash Draw. Above the Culebra, the Tamarisk member is largely composed of massive anhydrite that weathers to gypsum in outcrops. It also contains minor amounts of halite and siltstone. The next member is the Magenta Dolomite, which is 20 to 30 feet thick and identified by its color. When it weathers, it varies from pink to red to purple (Hill 1996). The uppermost member, the Forty-niner, is composed of gypsum, anhydrite, siltstone, shale, and clay.



Source: Intrepid Potash/Shaw (2008a)

Figure 3.2-4. Stratigraphic Column in the Project Area

Dewey Lake Red Beds. The Forty-niner member of the Rustler Formation represents the end of the marine incursions into the basin; the change to continental deposition is represented by the Dewey Lake Red Beds (Hill 1996). The Dewey Lake Red Beds are composed of reddish-orange siltstone with minor sandstone and clay. The Dewey Lake Red Beds are present as outliers in the project area, but more extensive outcrops occur to the east. The Dewey Lake Red Beds appear to have been deposited in a low-energy fluvial environment and represent the end of Permian (Hill 1996).

Triassic, Tertiary, and Quaternary Deposits

Triassic-aged rocks thought to be Santa Rosa Formation are present in the project area. Undivided Triassic rocks mapped by Dane and Bachman (1958) in the project area are composed of maroon, red, and gray sandstone interbedded with red, sandy shale and purplish limestone. The Santa Rosa outcrops on the east side of the project area (see **Figure 3.2-5**). The Dewey Lake Red Beds are distinguished from the Santa Rosa Formation because the top of the Dewey Lake is an erosion surface. The erosion surface is in contact with younger rocks, making it an “angular unconformity" (Lambert 1983).

Tertiary sedimentary deposits in the area consist of the Ogallala Formation that is composed of sandstone, silt, and cemented gravel capped by discontinuous caliche layers (New Mexico Bureau of Geology and Mineral Resources 2003). The Ogallala Formation was deposited during the Oligocene when uplift and erosion of the Rocky Mountains caused sediment to be deposited over a large area east of the mountains. In addition to fluvial deposits, the Ogallala contains considerable wind-blown deposits. Tertiary rocks include Oligocene-aged igneous dikes and sills are present in the project area (Calzia and Hiss 1978). The dikes reported in the potash mines occur as parallel and nearly vertical intrusions of trachyte (light-colored igneous rock) with widths up to 12 feet. The dikes appear to die out in the Ochoan rocks and do not appear on the surface.

The oldest Quaternary deposit is the Gatuña Formation, which is present in limited outcrops in the Nash Draw area south of the project area (Vine 1963). The extent and occurrence of the Gatuña in the project area has not been determined.

The Mescalero Caliche was described by Vine (1963) as limestone that ranges from dense to travertine-like with intermixed sand grains. It has been mapped in the southern part of the project area near the proposed evaporation ponds and near Intrepid’s West Mine; however, the full extent of the unit over the entire area has not been mapped.

Recent geologic materials at or near the surface in the project area consist of layers of alluvium, windblown sand, and gypsite that cover most of the Permian rocks (Wills 1942). Where deep channels have been cut into the Permian bedrock, recent materials may be as thick as 500 feet. Windblown deposits are fairly extensive over the project area. Playa deposits are mapped at the south end of Nash Draw at Salt Lake (Laguna Grande de la Sal), but not in the project area (Intrepid Potash Inc./Shaw 2008a; Vine 1963). The largest playa in this area is Salt Lake, south of Nash Draw.

Geologic Structure of the Project Area

The localized geologic structure of the project area was formed predominantly by salt dissolution and flowage not tectonic stress. The regional dip is 90 to 100 feet per mile (1 degree) to the southeast (Intrepid/Potash Inc./Shaw 2008a). However, in the vicinity of the project area, the dissolution of evaporite layers combined with the flowage of salt created a somewhat chaotic structure. Because of the plastic nature of salt, it responds to stress by flowing which results in deformation of adjacent strata. The dissolution of salt layers has had the effect of creating basins in which the strata bend downward into the depression against the regional dip. This is exhibited at Nash Draw where the structure on top of the Salado forms a closed depression and the rocks exposed on the surface have a chaotic, jumbled appearance. Other evidence of salt flowage and dissolution in the project vicinity includes localized steep dips and salt-cored anticlines.

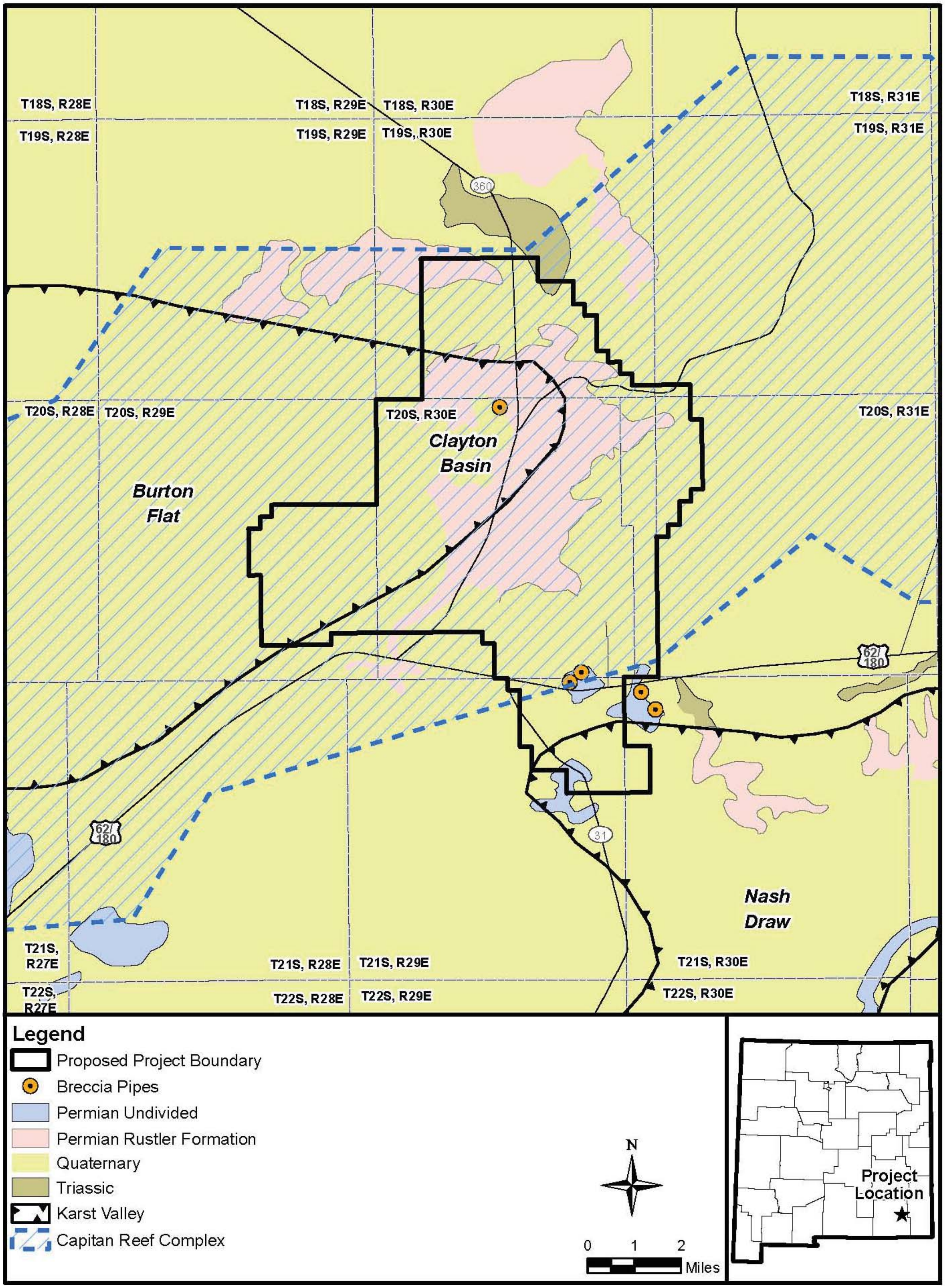


Figure 3.2-5. Surficial Geology of the Project Area and Vicinity

3.2.2 Mineral Resources

3.2.2.1 Potash

Potash was discovered in Eddy County in 1925 in a well that was being drilled for oil and gas by the Snowden McSweeney Company (Davis 2009). The discovery of high-grade potash resulted in the establishment of the American Potash Company in 1926. The company was organized by the Snowden McSweeney Company and was jointly owned by the Snowden McSweeney Company and the Pacific Coast Borax Company (Kern 1984). The company name, American Potash Company, was changed to United States Potash Company in 1929. The company began a potash exploration program in 1926, which located a sylvite bed of sufficient quantity to justify sinking a shaft and building a refinery. Shaft sinking began in December 1929 and the first shaft was completed in 1931. Potash production and commercial shipments began in 1931. By the mid-1930s, there were eleven companies exploring for potash in southeastern New Mexico (Barker et al. 2008).

The Potash Corporation of America (PCA) began mining operations in 1934 with peak production in 1966 of over 1 million tons of potash (Intrepid Potash/Shaw 2008a). The potash in southeastern New Mexico has been a major potash resource and the remaining reserves are estimated at 500 million tons (Cheeseman 1978, U.S. Geological Survey [USGS] 2009a). Potash production continues in the project vicinity with active mining at Intrepid's West and East Mines and the Mosaic Mine, about 10 miles south of the project area. Although much of the high-grade zones have been mined, exploration for commercially viable deposits continues (Muller and Galyen 2009).

The McNutt potash zone in the Salado Formation contains the potash minerals of interest to this project. It is named after V. H. McNutt who held the oil and gas lease where the potash was discovered (Davis 2009). The potash zones present a complicated mineralogy of potash. There are 12 ore zones present in the Salado Formation, 11 of which are located in the McNutt potash zone with varying mineralogy and commercial viability (Cheeseman 1978). The ore zones were numbered from the deepest to the shallowest by the USGS. The First Ore Zone is the deepest and the Twelfth Ore Zone is the shallowest. Mining has occurred in commercial quantities from the First, Third, Fourth, Fifth, Seventh, and Tenth ore zones. The First Ore Zone was the richest in terms of potassium content and has been extensively mined. The First Ore Zone, which is the target for the proposed in-situ mining, lies between 675 and 1,450 feet beneath the ground surface (Intrepid Potash Inc./Shaw 2008a). The major commercial minerals in the ore are sylvite and langbeinite. Non-ore, non-commercial minerals in the project area include leonite, kainite, carnalite, polyhalite, kieserite, halite, and anhydrite. Potash has a variety of uses with the most common being a component of fertilizer.

The mines are accessed through shafts sunk from the surface to the ore level. Entries for access and ore haulage are extended from the shafts out to the mining areas. Potash mining was originally conducted by room-and-pillar methods using mining techniques of drilling and blasting to extract the ore. Room-and-pillar mining is a method by which tabular-shaped or layered ore bodies are mined, leaving substantial reserves in the form of pillars for roof support (**Figure 3.2-6**) (American Geological Institute 1997). The room-and-pillar method of mining is particularly suited for flat or slightly dipping deposits like the New Mexico potash deposits. It is a mining method that offers a high degree of operational flexibility and derives its name from the basic approach—driving openings to divide the mineralized zone into rectangular or square blocks with pillars left to provide support for the overlying strata. This support may be temporary or permanent depending on whether pillars are removed or left intact.

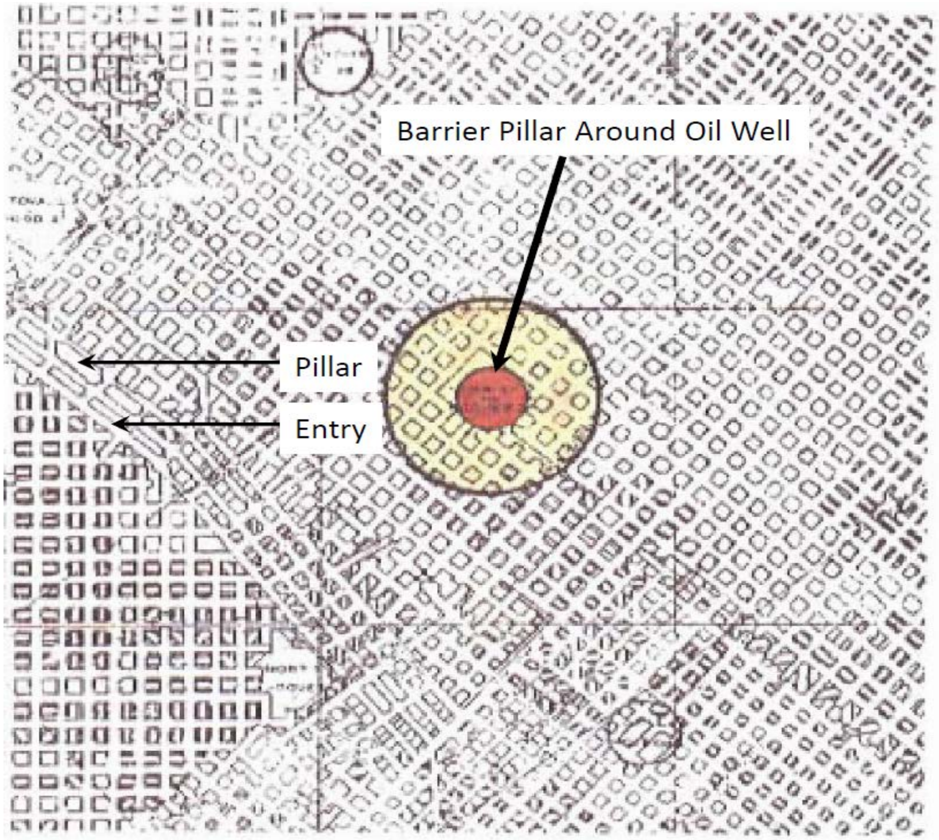


Figure 3.2-6 Plan View Example of Room-and-Pillar Mining

Continuous mining technology was introduced into the mines, increasing extraction efficiency (Sisselman 1978). Support pillars are necessary features of this mining method. When mining around existing oil and gas wells in the past, 100-foot-diameter pillars were established around the well bore (Intrepid Potash Inc./Shaw 2008a) to minimize the potential for subsidence. The pillar sizes were increased when conditions warranted more support. Current standards dictate that a zone equal to the depth of the ore zone plus 10 percent be left around the well bore to minimize subsidence. The size of the pillar left depends on specific mine conditions.

Potash ore is typically moved from the working face and transported by a system of conveyor belts to the hoisting shaft. The ore is then hoisted from the mine level to the surface where it is sent to a refinery to remove the potash minerals from the ore. The major waste products from ore processing are sediment, salt, and other minerals that cannot be easily extracted (Barker et al. 2008). The salt and sediment are transported in a slurry to tailing piles, and waste brine solutions from the process are placed into ponds where additional recovery of waste water and salt minerals may occur.

At the height of the mining activities in the Carlsbad Mining District, seven companies were operating mines. Currently there are two companies, Intrepid and Mosaic, operating four of the original mines. The proposed action is to extract potash from four of the inactive workings located in the project area, HB Eddy, HB South, HB North, and Duval Crescent (**Figure 3.2-7**). Mining has been suspended in all of these areas, but potentially extractable resources remain in the support pillars, walls, and floors.

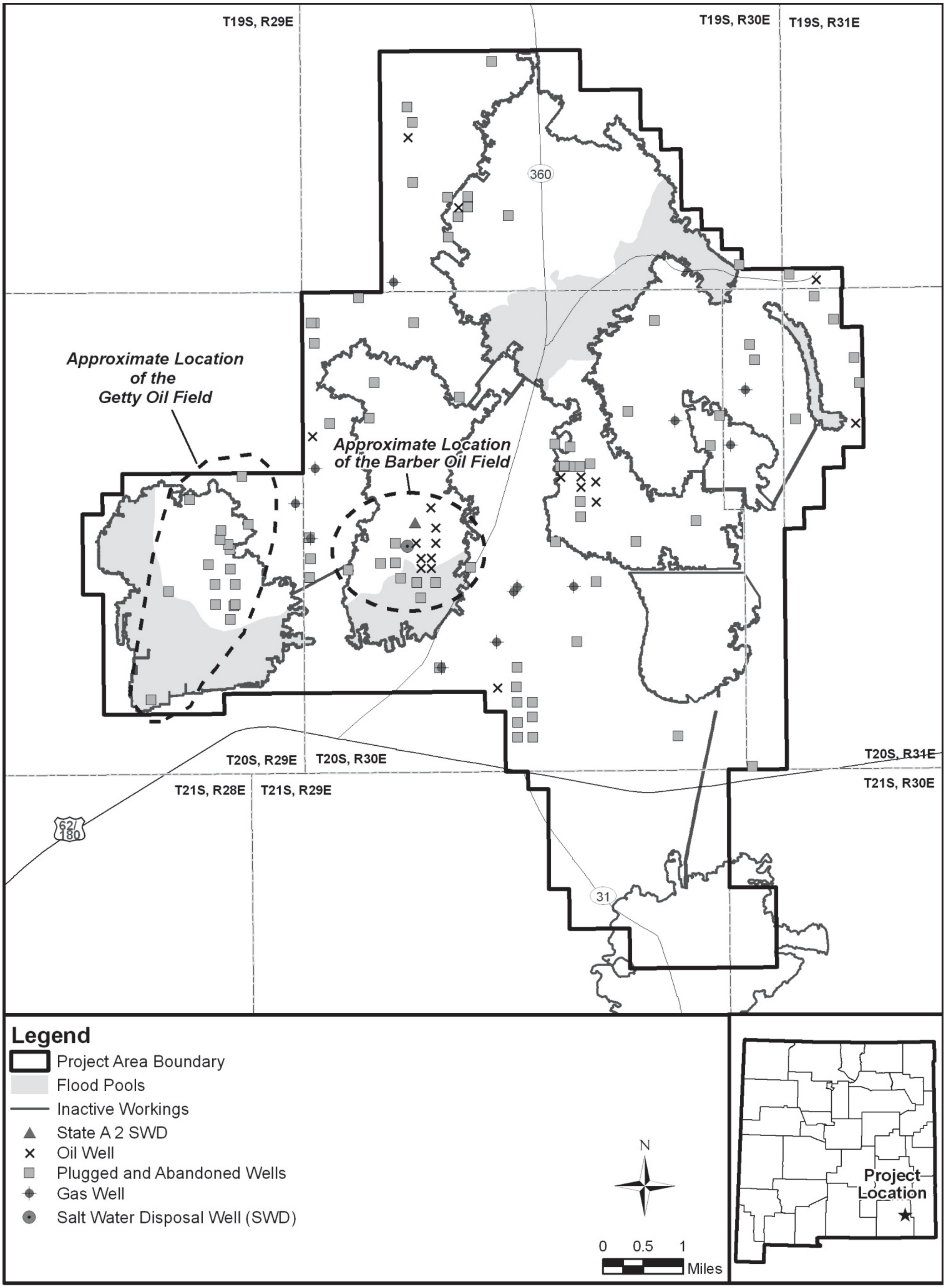


Figure 3.2-7. Oil and Gas Wells in Project Area

3.2.2.2 Oil and Gas Production

Oil in southeastern New Mexico was discovered in 1909, 8 miles south of Artesia. The well was never completed due to mechanical problems (Montgomery 1965). Oil and gas production began in the New Mexico portion of the Delaware Basin in 1924 with the discovery of the Dayton-Artesia Field (Independent Petroleum Association of New Mexico Undated). From 1924 to 2000, 300 reservoirs have produced 4.5 billion barrels of oil mainly from plays on the Northwest Shelf and Central Platform (Broadhead et al. 2004). More than 3.5 billion barrels of the total production came from Permian rocks. The USGS estimates that the greater Permian Basin area, including areas in southeastern New Mexico and west Texas, contains substantial undiscovered oil and gas resources. Evidence suggests that there is potentially 1.3 billion barrels of oil and 41 trillion cubic feet of natural gas (Schenk et al. 2008).

Oil was discovered in the project area in 1927 by the Getty Oil Company in Section 14, T20S, R29E (Wills 1942) (**Figure 3.2-7**). On the basis of the discovery of the Getty Field, several small oilfields were established along a west to east trend line. These new fields included Barber (starting 1937), PCA (1939), Hale (1940), and Wills (1942). Hale is the only gas field. These fields produced out of the limestones in the Yates Formation. The pay zones range in depth from 1,300 to 1,800 feet deep and are 300 to 400 feet deeper than the potash ore zones. Another oil field in the vicinity, the Dos Hermanos Field, was discovered in 1955 and produces from the Yates Formation (Broadhead et al. 2004). The Getty and Dos Hermanos fields have been abandoned and the Barber and PCA fields continue to produce, but many of the wells have been plugged and abandoned.

Oil and gas exploration and production continues in the project area, but the targets are much deeper and natural gas is the primary objective (Walsh 2006). There are scattered wells within the project area that produce from zones below the upper Guadalupian rocks.

3.2.2.3 Conflicts between Potash Mining and Oil and Gas

Although potash was originally discovered by wells drilled for oil and gas, conflicts between the oil and gas industry and potash mining emerged early on. The federal government withdrew 2,560 acres from oil and gas leasing for the purpose of protecting and conserving the potash deposits belonging to the United States (1939 Order). The 1939 withdrawal remained in effect until 1951, at which time the Secretary of the Interior issued a new Order that allowed for concurrent operations in the exploration, development, and production of oil and gas and potash owned by the U.S.A. A succession of orders followed (1951, 1965, 1975, and 1986), which expanded the SPA each time.

In 1986, the Secretary of the Interior issued the most recent Potash Order (Department of the Interior 1986), which expanded the area to 497,002 acres. The SPA boundaries are shown in **Figure 1-1**.

In addition to the 1986 Order, the State of New Mexico issued rules for oil and gas drilling in the Known Potash Leasing Area, which is a subset of the SPA. Since 1955, the New Mexico Oil Conservation Commission (OCC) issued a series of orders that have been amended over the years to specifically address how oil and gas operations are to be conducted in the potash enclave. The original OCC order was R-111-A and the current order is R-111-P. The most recent order issued in 1988, contains revisions meant to resolve disputes between the potash and oil and gas industries and clarify uncertainties regarding boundary changes (OCC 1988).

In 2004, the oil and gas production from the SPA was 27.3 billion cubic feet of gas and 4.7 million barrels of oil (Walsh 2006). The remaining oil and gas resource in the Potash Area is estimated to be 468 million barrels of oil and 5.5 trillion cubic feet of gas. A total of 1,291 wells have been drilled in the R-111-P area (Balch et al. 2009). Copies of the 1986 Order and the OCC Order R-111-P are provided in **Appendix A**.

3.2.2.4 Other Minerals

Other minerals produced in Eddy County include sand and gravel, caliche, salt, and sulfur (USGS 2009a). Salt is extracted in the area by the following two methods.

- Solution mining where a well is drilled into the salt formation and unsaturated water is pumped into the well to dissolve the salt. The saturated solution is extracted and used as make-up water for saturated drilling fluids for oil and gas well drilling. There are no brine extraction wells in the project area.
- Mining salt that has precipitated in playas is typically accomplished with the use of scrapers.

3.2.3 Geologic Hazards

3.2.3.1 Subsidence

Subsidence is defined as “a gradual settling or sudden sinking of the Earth’s surface owing to subsurface movement of earth materials” (Galloway et al. 2008). Subsidence can occur from several conditions including dissolution of subsurface strata, underground mining, withdrawal of subsurface fluids, drainage of organic soils, hydrocompaction, thawing permafrost, and natural consolidation.

Subsidence in the Delaware Basin has been caused primarily by the dissolution of subsurface strata or potash mining. Dissolution of subsurface strata is the result of natural conditions as well as the deliberate or inadvertent actions by humans. The mining of potash has caused some ground subsidence in the region.

<u>Caves and Karst</u>

Karst topography is widespread in the Delaware Basin. Karst is a terrain with distinctive, often rolling, landforms created from the dissolution of soluble rocks, principally limestone, gypsum, and dolomite. It is characterized by springs, caves, and sinkholes that are often directly connected to aquifers, causing them to be vulnerable to contamination by activities at or near the ground surface. The karst topography in this region is linked with sulfuric acid cave genesis, which causes rapid “bottom-up” cave formation, resulting in large karst features that may not be recognized from the surface (Hill 2000). Other karst features can result from anhydrite that expands in size when it becomes hydrated and turns to gypsum. The expansion can result in buckling and deformation of adjacent rock layers and cracking in the gypsum bed (Bachman 1983). The cracking and deformation of adjacent beds can allow fluids to infiltrate into lower rock layers.

It has been proposed that dissolution in the Ochoan Series rocks has been occurring since Permian times and that episodes of dissolution are similar because each episode involves uplift causing dissolution and erosion of surface and near-surface rocks (Bachman 1983). The period of strongest dissolution is thought to have taken place during Tertiary times when many units west of the Pecos River may have been completely dissolved and eroded, and large amounts of surficial material filled in the troughs and depressions. The project area is in a transitional area between the western and eastern portions of the Delaware Basin. Portions of the Rustler and Salado formations have been removed by dissolution, while to the east and south, where the deeper areas have not been exposed, the evaporite layers are still present. Mapped thicknesses of the evaporites appear to thin from east to west. Evidence of removal is derived from tracing the recognizable blanket-dissolution breccias into the basin and correlating them with existing salt layers. Of particular concern is the presence of evaporite karst because evaporite minerals are much more soluble than calcium carbonate. As a result, dissolution of evaporites can occur rapidly when exposed to water, compared to the dissolution of limestone. Most of the karst in the Delaware Basin is evaporite karst.

Sinkholes are common in the Nash Draw and Burton Flat areas and are primarily developed in the gypsum that outcrops or is near the surface (Hill 1996). Sinkholes are small depressions in the earth’s surface that are manifestations of rock dissolution that has taken place in the subsurface. Sinkholes are commonly small elliptical or circular features. However, sometimes sinkholes can attain dimensions in the hundreds of meters (Galloway et al. 2008).

Karst features occur when sinkhole development is widespread and multiple sinkholes coalesce to form a sizable depression. Two major karst valleys occur in or near the project area: Nash Draw and Burton Flat (see **Figure 3.2-5**). The north end of Nash Draw begins south of the project area. Nash Draw extends for 15 miles north to south and is 5 to 6 miles wide (Vine 1963). Burton Flat is west of the project area, and is described as a “karst plain” by Hill (1996). Burton Flat is about 13 miles north to south and east to west (Dane and Bachman 1958). In both areas, the bedrock is primarily in the Rustler Formation and the valleys are characterized by sinkholes, caves, and interior drainage.

Within the project area, karst is manifested in a number of features, some of which can be identified on the surface and others are hidden in the subsurface (Hill 1996). The Capitan Reef contains cavernous areas in the subsurface and anomalously high porosity, indicating the presence of large vugs, or “honeycomb” structure, and evidence of rock dissolution (Hill 1996). The Capitan Limestone does not outcrop in the project area, but is present in the subsurface. The formation of cavernous porosity may be relevant to the formation of karst features such as breccia pipes.

Caves, another karst feature present in the project area, developed in gypsum bedrock. Numerous caves and pits have been identified and cataloged by the BLM and the Southwest Region National Speleological Society (1991). Hill (1996) reported 20 to 40 caves in Nash Draw. Some of the caves in or near the project area are as deep as 50 to 60 feet with entrances located at the bottom of sinkholes up to 30 feet deep. Some caves in the project area that have been surveyed are in excess of 800 feet long and 75 feet deep. Cave entrances vary from 16 to 30 feet high and from 40 to 90 feet long. In one case, an underground void was observed to be within 15 feet of the edge of the running surface of a major paved road. At another cave, a nearby gravel road collapsed due to the void breaching the surface. It has been observed that cave development in some cases has been enhanced by erosion during heavy precipitation events.

The cave/karst potential ratings in and near the project area (total area of 277,778 acres) are summarized in **Table 3.2-2** and displayed on **Figure 3.2-8**. There are 106 known caves and numerous karst features in the vicinity of the project area. The primary area of karst concern, which contains an exceptionally high density of karst features such as depressions and sinkholes, is located in and near the western portion of the project area. Within this dense karst area, it is estimated that there are as many as 120 karst features per square mile in the southern portion of Burton Flats. To delineate this area and identify karst features, the BLM used satellite imagery to locate features that are visible at the ground surface, ranging from closed depressions to sinkholes with small openings in the bottom to sinkholes with large cave entrances in the bottom.

Karst features and caves are point sources for groundwater recharge because they allow for the rapid transmission of surface water to the subsurface environment. This groundwater recharge can affect karst formation by supplying fresh water that dissolves soluble rock, causing the creation of underground voids and eventual collapse. Water from precipitation and near-surface karst aquifers is critical to troglobitic species (small cave-dwelling animals adapted to their dark surroundings) that inhabit the numerous cave systems in the primary area of karst concern. Several of the caves in the Burton Flats karst plain extend down to permanent water sources. On average, the water levels found in the caves are 80 to 90 feet below the ground surface. Within the vicinity of the project area, identified as the Groundwater Modeling Domain on **Figure 3.2-8**, it is estimated that 47 of the 106 known caves (44 percent) are located where the existing groundwater table is within 90 feet of the ground surface. The other caves may derive water from precipitation or a perched water table.

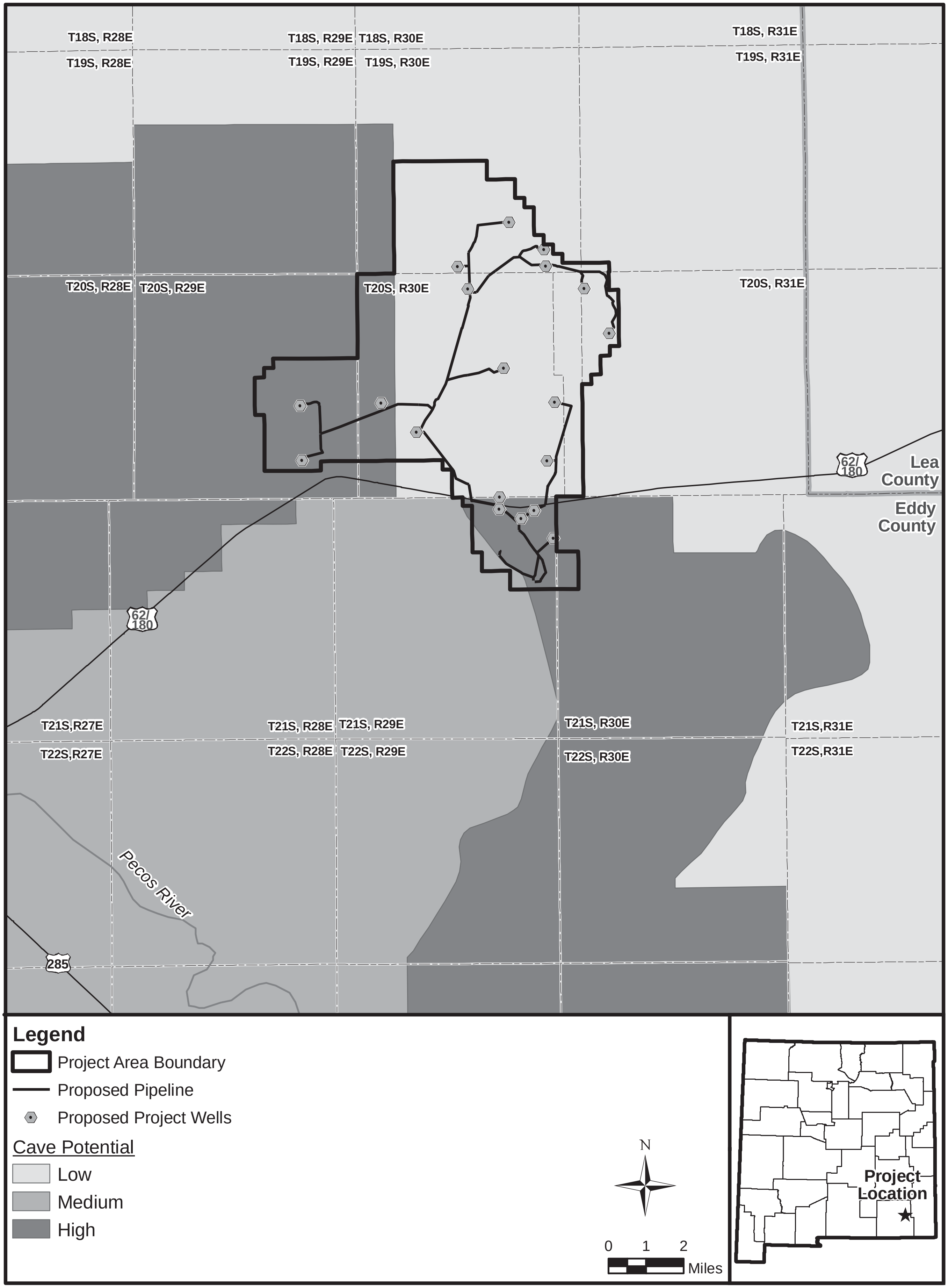


Figure 3.2-8 Cave/Karst Potential in the Vicinity of the Project Area

Table 3.2-2 Cave/Karst Potential Ratings in the Project Area

Cave/Karst Potential Rating	Acres	Rating Definition
High	103,202	Areas of known karst geology that contain high density of significant caves and karst features
Medium	72,867	Areas of known karst geology that contain dispersed caves and karst features
Low	101,709	Areas of questionable karst geology and few if any known caves or karst features
Total	**277,778**	

The caves provide habitat for various fauna including bats, rodents, and rattlesnakes. A few caves have been nominated as Significant Caves under the Federal Cave Resources Protection Act of 1988 based on biological, recreational, geological, and hydrological values. However, many of the caves in or near the project area have not been explored and documented in detail by biological inventories.

Breccia pipes are an unusual feature in the project area, and have been described in detail by Vine (1960) and Bachman (1983). The pipes occur on the surface as circular domes, approximately 1,200 to 1,500 feet in diameter and about 50 to 100 feet high (Vine 1960). Drilling and exposures in the Intrepid West underground mine has shown that the matrix of the breccia pipes consists of tilted and erratic blocks of rock material derived from the Salado and Rustler formations (Snyder and Gard 1982). The breccia pipes are thought to have originated from solution and collapse of voids in the Capitan Limestone, but also could have resulted from the dissolution of salts or anhydrites higher in the section. One theory surmises that when dissolution caused breaching of the Capitan Limestone, the loss of support caused the layer above to collapse. Artesian conditions in the Capitan Limestone then forced unsaturated water upward, causing continual collapse that resulted in unsaturated water coming in contact with soluble salts (Davies 1983; Hill 1996). The dissolution of the evaporites caused additional collapsing, creating the dome effect. The caliche layer on the domes dates the pipes to around 600,000 years before present.

Of the four documented breccia pipes in the vicinity (see **Figure 3.2-5**), two are located in the project area, in the SW¼ of Section 35, T20N, R30E (Dome A) and in the NW¼ of Section 1 and the NE¼ of Section 2 in T21S, R29E (Dome B). Two other breccia pipes or domes are located on the east side of Intrepid's West Mine in the SW¼ of Section 5, T21S, R30E. Dissolution breccias or blanket-dissolution breccias occur where subsurface solutions have dissolved the evaporite layer, leaving the insoluble residue (Hill 1996). Such breccias can be widespread in the subsurface, and their presence is evidence of the dissolution of salt. A blanket breccia zone at the top of the Salado Formation is present in Nash Draw (see **Figure 3.2-5**).

Oil has been observed where mine workings have intercepted one of the breccia pipes. Geochemical fingerprinting reveals the oil to be similar to oil from the Yates Formation produced in the Getty, Barber, PCA, and Dos Hermanos oil fields (Palacas et al. 1982). The presence of oil similar to Yates reservoirs supports the pipe formation theory described above because artesian water from the Capitan Limestone may have carried oil from breached traps in the Yates Formation to higher levels. Other evidence supporting the possible migration of fluids from deeper zones comes from an exploratory oil well drilled in 1938. The Neil Wills State 2-A well in the SE¼ NE¼ Section 19, T20S, R30E, located on the west flank of the Barber Field, had a recorded rise in water level from the oil zone between 1,647 and 1,650 feet deep to about 1,200 feet in 9 hours (OCD 2009a,b). Information is not provided in the description of well testing to determine whether the fluid was allowed to rise to the maximum height possible. The information provides evidence of a hydraulic head strong enough that, if allowed, might rise enough to affect evaporite layers in the Salado Formation. Anhydrite and limestone were reported at a depth of 1,165 to 1,293 feet in the well with a base of salt at about 1,000 feet. The well was judged to be inadequate for commercial production and was plugged and abandoned.

Anthropogenic (Human-caused) Subsidence

In the Delaware Basin, anthropogenic subsidence largely has occurred as a result of potash mining and activities involving the withdrawal of fluids for oil and gas production.

Subsidence from Potash Mining. Subsidence is the phenomenon or response that occurs when an underground opening is created and some of the rock is removed. The overlying and surrounding rock or soil around the opening naturally deforms in an effort to arrive at a new overall equilibrium position. This equilibrium-seeking action can result in both vertical and horizontal ground movement, and if not controlled or minimized, can cause damage to both surface and subsurface structures. In addition, it can result in the development of changes to the surface topography, such as surface cracking or collapse, sinkholes, blockage or re-channelization of streams, and modification of drainage pathways.

For the HB In-Situ Solution Mine Project, subsidence concerns relate to the method of mining utilized to extract the potash ore, the “room-and-pillar” mining method (see **Figure 3.2-6**). In this mining method a substantial proportion of the target mineral is locked up in the pillars and is often removed during the latter stages of mining (e.g., on retreat, often referred to as “pillar robbing” or “second mining”), usually to the extent that the number, size, or distribution of remaining pillars is insufficient to continue to support the roof.

The removal of potash ore via historical underground mining operations in the project area resulted in localized surficial depressions and near-vertical stress cracks, both of which are expressions of subsidence (Intrepid Potash Inc./Shaw 2008b). The areal extent of subsidence extends beyond the limits of the mine workings and is defined by the angle of influence. The angle of influence has been observed at various local mines to range from 45 to 55 degrees. The HB potash mines have an angle of influence of approximately 45 degrees (measured from the horizontal).

Specific examples of surface exposures of subsidence effects in the project area include the alluvium contained “in a depression south of Section 2 and adjacent to Highway 31” (Intrepid Potash Inc./Shaw 2008c). This feature shows ditch-like, parallel depressions that resemble typical subsidence fractures over mining subsidence. South of Highway 31 is an area where drainage has been disturbed by a series of parallel trends that presumably also depict the effects of subsidence over mined areas. Stress cracks are present in areas of Sections 23 and 26, T20S, R29E. It is likely that these types of features may be present throughout the project area wherever historic underground workings exist.

Other possible mining-related subsidence features occurred on Eddy County Road 238 (Section 23, T20S, R29E) (Goodbar 2010). Located over the HB Eddy Mine and observed in 1993, the features were described as long tension fractures running across the paved county road and extending on both sides of the road for 50 to 100 feet. The fractures were approximately 0.5 to 1.0 inch wide and more than 3.0 feet deep. Up to 5 fractures were parallel to each other, perhaps 8 to 10 feet apart.

Other incidents have occurred in the vicinity of the mines, but they may not be related to mine subsidence (Goodbar 2010). A reported collapse occurred along Eddy County Road 360 in 1987 (Section 23, T19S, R30E). The location is at the north end of HB North Mine and the road was a state highway at the time. The collapse was approximately 35 to 40 feet deep and 20 feet across. Representatives from the potash company that owned the mine at the time were present at an on-site inspection with the New Mexico State Highway Department and the BLM. The potash company representative did not state whether the collapse was mine-related or confirm that the location was over mine workings. The highway department further collapsed the sides of the hole, backfilled it with packed debris, and reconstructed the road.

Subsidence Related to Oil and Gas Production. Oil and gas exploration and production in the Delaware Basin has been prolific. Thousands of wells have been drilled through evaporite formations to explore for and produce oil and gas. Drilling and completion operations must be conducted in a manner that prevents the dissolution of the salt and protects the well during drilling and throughout the productive lives of the wells, often 20 to 30 years or more.

From the 1920s until the 1950s, oil wells were commonly drilled with cable tool rigs (Cearley 2000). In cable tool drilling, the hole is advanced by pulling a weighted bit up and down with a cable. The method required "bailing" the well occasionally to remove rock cuttings that accumulate in the bottom of the well. Drilling could not commence if the cuttings were not removed because the bit would pulverize the cuttings without deepening the bore. If water were encountered, the well had to be cased through the water zone before drilling could resume. If hydrocarbons were encountered, drilling would have to stop for safety. In early cable tool practice, the casing was pounded into the well, but not cemented. Although standardized cementing practices were developed in the 1930s, cementing was often based on guess-work, especially when determining proper setting times. As technology progressed, and cementing became more standardized, procedures and practices were codified into regulations to ensure that cement jobs were done properly. In the Permian Basin, completion practices into the 1950s required cement at the bottom of intermediate and production casing strings, but allowed unprotected casing to be exposed to as much as 2,000 feet of salt formation (Giroux et al. 1988). Current well construction rules in the SPA require cement to be installed through the entire salt interval to protect the casing string and to decrease the risk of the salt being exposed to unsaturated water.

There are several examples in the Permian Basin of catastrophic subsidence suspected to be the result of oil field casing corrosion and dissolution of salt, including the Wink Sinks I and II and the Jal sinkhole (Johnson et al. 2003a; Powers 2003a,b). There are other similar incidents that occurred in areas underlain by salt formations in Texas and in Kansas (Walters 1978). The Wink Sinks developed in the Hendrick oil field in Winkler County, Texas, near the Town of Wink (**Figure 3.2-9**).

The Jal sinkhole is located about 8 miles northwest of Jal, New Mexico. The geologic settings of the Wink Sinks and the Jal sinkhole are similar to the project area, occurring at the basin margin above the Capitan Reef. In each incident, sinkholes formed around a well location. Although the exact cause of sinkhole development is unknown, it is suspected that casing failure allowed unsaturated water to come into contact with, and subsequently dissolve, salt layers. **Figure 3.2-10** shows the postulated development of the Wink sink showing cavitations and subsidence caused by leaking casing, with ultimate surface collapse not occurring until years after the well was plugged.

A major concern regarding oil field cement is the potential vulnerability of cements to brine fluids (LaFleur and Lovelace 1969). The damage brine can inflict is dependent on many variables, but if cement is vulnerable, brine can cause deterioration within 24 hours of exposure. If casings were breached adjacent to an uncemented salt zone, the brine created by dissolution could attack the cement. Cementing casings in oil and gas wells that penetrate salt sections is often problematic and there is no generally accepted method of preventing damage (Hunter et al. 2009).

The following is a summary of observations regarding well integrity and adequacy of plugging for wells in the Barber and Getty oil fields (see **Figure 3.2-7**). The Barber and Getty oil fields lie within and adjacent to mined out areas proposed for solution mining. Because there are many abandoned wells, drilled from the 1920s into the 1950s, in and near the proposed solution mine flood pools, it is likely that the wells did not have adequate cement between the casings or liners and the salt formations. The geology technical report (AECOM 2010a) prepared for the BLM in support of this EIS provides observations on well integrity and adequacy of plugging wells within the Barber and Getty fields, as well as detailed documentation of the status and location of the wells. The report also describes evidence from oil, gas, and salt water disposal wells in the area that suggests subsidence or other contamination problems have resulted and may continue if left untreated.

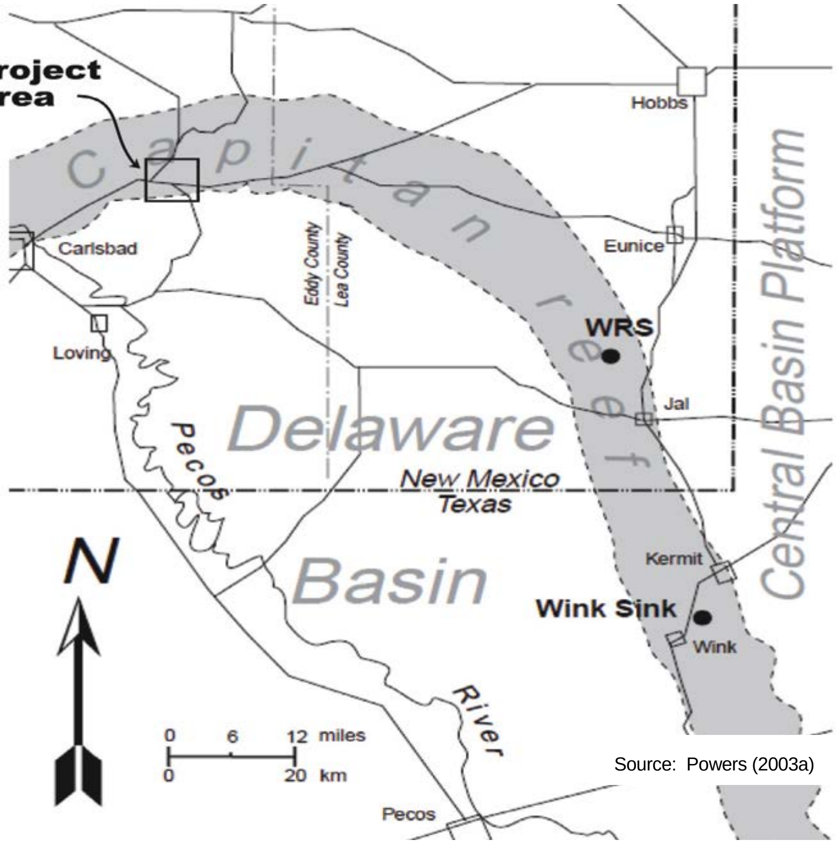


Figure 3.2-9 Location of Wink Sink

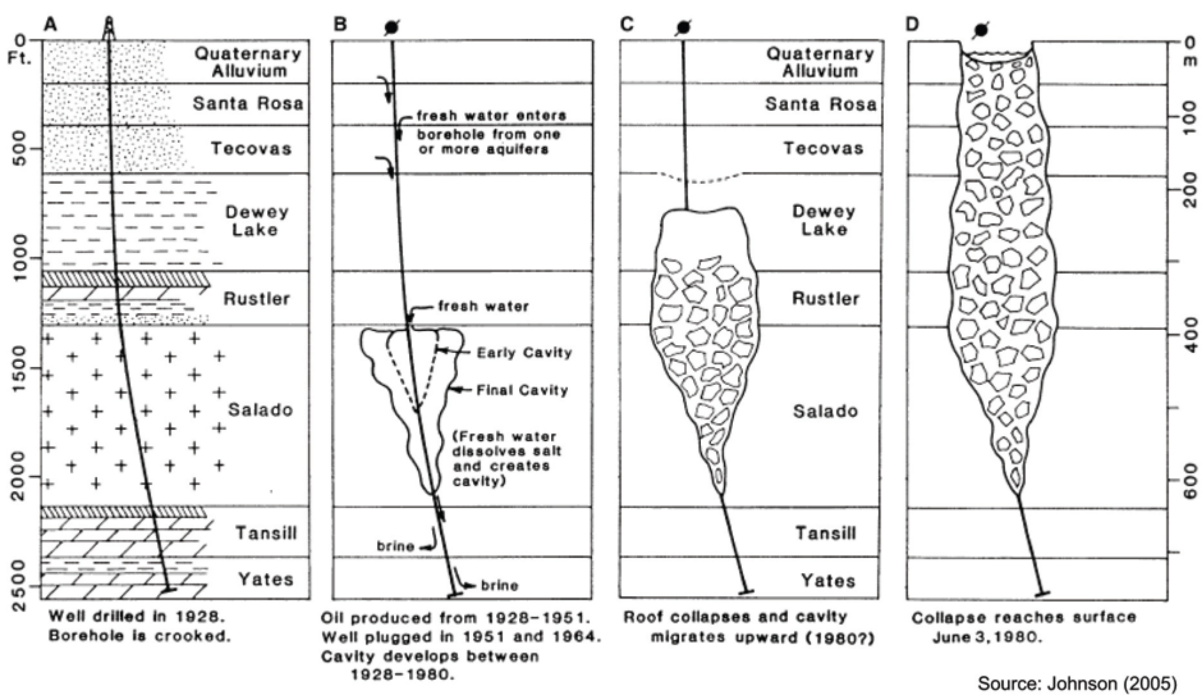


Figure 3.2-10 Development of Wink Sink

USGS topographic mapping and information in OCD (2009a) environmental incident files indicate evidence of a closed, shallow depression in the vicinity of the Barber Oil Field. The origin of the depression is not known, it may be subsidence from mining, dissolution of soluble beds due to unrestricted unsaturated fluids that have escaped from oil wells, disposal of unsaturated produced water, or the result of natural karst processes.

Subsidence Related to Halite Solution Mining. Salt can be extracted from subsurface formations by using wells that inject fresh water to dissolve the salt. The saturated brine is then extracted. In the Delaware Basin, these wells are referred to as brine wells. Brine wells in the Delaware Basin are used to extract salt for oil and gas well drilling and workover fluids (Griswald 2009). Recently, a few brine wells suffered catastrophic collapse.

The first collapse occurred at Jim's Water Service about 10 miles northwest of the project area in Section 24, T18S, R28E. The collapse occurred on July 15, 2008, and the sinkhole created eventually reached dimensions of 400 feet across and 120 feet deep, and reportedly continues to grow (Griswald 2009).

The second collapse occurred on November 3, 2008, at the Loco Hills Water Disposal located in Section 16, T17S, R30E, about 12 miles north of the project area. A week after the collapse, the diameter of the sinkhole was estimated to be 195 feet across. By May 2009, the sinkhole was 290 feet across and about 200 feet deep.

3.2.3.2 Seismicity

<u>Earthquakes</u>

The proposed project is located in an area with very little earthquake activity and such events that are recorded are of small magnitude. From 1973 to the present there have been 28 recorded events, the largest of which was 4.1 on March 28, 2010 (USGS 2010).

<u>Active Faults</u>

No active faults have been identified in southeastern New Mexico (USGS and New Mexico Bureau of Mines and Mineral Resources 2006). The nearest potentially active faults are located about 60 miles south of the project area in the Guadalupe and Delaware Mountains in Texas (Collins 1993a,b).

<u>Ground Motion</u>

The USGS seismic hazard mapping indicates that ground motion in the project area from a maximum credible event would be less than 10 percent of the acceleration of gravity, with a 2 percent probability of exceedence in 50 years (Petersen et al. 2008).

3.2.3.3 Landslides

Although escarpments are physiographic features in the vicinity of the proposed project, the overall landslide risk is low (National Atlas 2009).

3.2.4 Paleontological Resources

3.2.4.1 Regulatory Structure

Federal protection for scientifically important paleontological resources applies to construction or other impacts caused by disturbance of paleontological resources that occur on federally owned or managed lands. Federal legislative protection for paleontological resources stems from the Antiquities Act of 1906 (PL 59-209; 16 USC 431 et seq.; 34 Stat. 225), which calls for protection of historic landmarks, historic and prehistoric structures, and other objects of historic or scientific interest on federally administered lands. Another federal law regulating paleontological resources is the Archaeological and Paleontological

Salvage Act (23 USC 305). This act provides for funding for mitigation of paleontological resources discovered during federal highway projects, provided that "excavated objects and information are to be used for public purposes without private gain to any individual or organization." In addition to the foregoing, the National Registry of Natural Landmarks provides protection to paleontological resources.

The BLM manages paleontological resources (fossils) on federal lands under the following statutes and regulations (BLM 2010a):

- FLPMA of 1976 (P.L. 94-579).
- NEPA of 1969 (P.L. 91-190).
- Various sections of BLM's regulations found in Title 43 CFR that address the collection of invertebrate fossils and, by administrative extension, fossil plants.
- A recently enacted statute, the Paleontological Resources Preservation Act, was passed in March 2009. The law authorizes the BLM and USFS to manage and provide protection to fossil resources using "scientific principles and expertise" (BLM 2010a).
- Petrified (fossilized) wood is protected under BLM regulations at 43CFR 3620-3622.

In addition to the statutes and regulations listed above, fossils on public lands are managed through the use of internal BLM guidance and manuals. Included among these are the BLM Manual 8270 and the BLM Handbook H-8270-1 (BLM 2010a). Various internal instructional memoranda have been issued to provide guidance to the BLM in implementing management and protection to fossil resources.

Potential Fossil Yield Classification

Recently, the BLM adopted the Potential Fossil Yield Classification (PFYC) system to identify and classify fossil resources on federal lands (BLM 2007a). Paleontological resources are closely tied to the geologic units (i.e., formations, members, or beds) that contain them. The probability for finding paleontological resources can be broadly predicted from the geologic units present at or near the surface. Therefore, geologic mapping can be used for assessing the potential for the occurrence of paleontological resources.

The PFYC system is a way of classifying geologic units based on the relative abundance of vertebrate fossils or scientifically significant fossils (plants and invertebrates) and their sensitivity to adverse impacts. A higher class number indicates higher potential. The PFYC is not intended to be applied to specific paleontological localities or small areas within units. Although significant localities may occasionally occur in a geologic unit, a few widely scattered important fossils or localities do not necessarily indicate a higher class; instead, the relative abundance of significant localities is intended to be the major determinant for the class assignment.

The PFYC system is meant to provide baseline guidance for predicting, assessing, and mitigating paleontological resources. The classification should be considered at an intermediate point in the analysis, and should be used to assist in determining the need for further mitigation assessment or actions. The BLM intends for the PFYC system to be used as a guideline rather than rigorous categories. Descriptions of the potential fossil yield classes are summarized in **Table 3.2-3**.

3.2.4.2 Paleontological Resources in the Project Area

The surface units in the project area consist of the Permian Ochoan Series (Rustler Formations and Dewey Lake Red Beds), Triassic Santa Rosa Formation, Gatuña Formation, Mescalero Caliche, and recent alluvial and windblown sand deposits, as described in Section 3.2.1. **Table 3.2-4** provides a summary of the paleontological resources and potential of the geologic units in the project area.

Table 3.2-3 Potential Fossil Yield Classification

Class	Description	Basis	Comments
1	Igneous and metamorphic (tuffs are excluded from this category) geologic units or units representing heavily disturbed preservation environments that are not likely to contain recognizable fossil remains.	• Fossils of any kind known not to occur except in the rarest of circumstances. • Igneous or metamorphic origin. • Landslides and glacial deposits.	Ground-disturbing activities will not require mitigation except in rare circumstances.
2	Sedimentary geologic units not likely to contain vertebrate fossils or scientifically significant invertebrate fossils.	• Vertebrate fossils known to occur very rarely or not at all. • Age greater than Devonian. • Age younger than 10,000 years before present. • Deep marine origin. • Aeolian origin. • Diagenetic alteration.	Ground-disturbing activities are not likely to require mitigation.
3	Fossiliferous sedimentary geologic units where fossil content varies in significance, abundance, and predictable occurrence. Also sedimentary units of unknown fossil potential.	• Units with sporadic known occurrences of vertebrate fossils. • Vertebrate fossils and significant invertebrate fossils known to occur inconsistently; predictability known to be low. • Poorly studied and/or poorly documented. Potential yield cannot be assigned without ground reconnaissance.	Ground-disturbing activities will require sufficient mitigation to determine whether significant paleontological resources occur in the area of a proposed action. Mitigation beyond initial findings will range from no further mitigation necessary to full and continuous monitoring of significant localities during the action.
4	Class 4 geologic units are Class 5 units (see below) that have lowered risks of human-caused adverse impacts and/or lowered risk of natural degradation.	• Significant soil/vegetative cover; outcrop is not likely to be impacted. • Areas of any exposed outcrop are smaller than 2 contiguous acres. • Outcrop forms cliffs of sufficient height and slope that most is out of reach by normal means. • Other characteristics that lower the vulnerability of both known and unidentified fossil localities.	Proposed ground-disturbing activities will require assessment to determine whether significant paleontological resources occur in the area of a proposed action and whether the action will impact the paleontological resources. Mitigation beyond initial findings will range from no further mitigation necessary to full and continuous monitoring of significant localities during the action.

Table 3.2-3 Potential Fossil Yield Classification

Class	Description	Basis	Comments
5	Highly fossiliferous geologic units that regularly and predictably produce invertebrate fossils and/or scientifically significant invertebrate fossils, and that are at risk of natural degradation and/or human-caused adverse impacts.	• Vertebrate fossils and/or scientifically significant vertebrate fossils are known and documented to occur consistently, predictably, and/or abundantly. • Unit is exposed; little or no soil/vegetative cover. • Outcrop areas are extensive; discontinuous areas are larger than 2 contiguous acres. • Outcrop erodes readily; may form badlands. • Easy access to extensive outcrop in remote areas. • Other characteristics that increase the sensitivity of both known and unidentified fossil localities.	Mitigation of ground-disturbing activities is required and may be intense. Areas of special interest and concern should be designated and intensely managed.

Sources: BLM 2008, 2007a.

Table 3.2-4 Summary of Potential Paleontological Resources in the Project Area

Geologic Unit	Description of Paleontological Resources	Fossil Potential Based on PFYC
Alluvium and wind-blown deposits	Because such deposits are younger than 10,000 years old, there would be a low potential for fossils.	Class 2—Low potential for the presence of important fossils.
Mescalero Caliche	Caliche is formed by the precipitation of calcium carbonate from water that has percolated into soil layers (Bachman 1985). The presence of fossils is not expected since the calcium carbonate is not produced by organic processes.	Class 1—The nature of the formation of caliche would likely preclude the presence of fossils.
Cave Deposits	Cave deposits (Pleistocene to Recent in age) consisting of breccias, breakdown blocks, and water laid sediments can host a variety of vertebrate fossils (Harris 1993; Hill 1987).	Class 4—There is a high potential for scientifically important fossils to be found in caves.

Table 3.2-4 Summary of Potential Paleontological Resources in the Project Area

Geologic Unit	Description of Paleontological Resources	Fossil Potential Based on PFYC
Gatuña Formation	Although vertebrate fossils may be present in the Gatuña Formation (Harris 1993; Miller 1982); Vine (1963) did not describe fossils in the Nash Draw area and none were noted in the general vicinity of the proposed project (Dehler and Pederson 1998).	Class 2—There is a potential for the occurrence of fossils, but probably are rare. The occurrence of vertebrate fossils in the formation was not reported until 1982 (Miller 1982).
Ogallala Formation	The Ogallala has the potential to contain important vertebrate fossils, but identified localities occur mainly in Texas (Schulz 1972). However, fossil tracks have been found at the base of the Ogallala northeast of Roswell (Williamson and Lucas 1996)	Class 4. The abundance of documented vertebrate fossil occurrences indicates a high potential.
Santa Rosa Formation	Localities in Texas at the Llano Estacado escarpment contain reptile, amphibian, and other small vertebrate fossils (Lehman and Chatterjee 2005). In the Nash Draw area the formation contains “carbonaceous plant fragments and fossil reptile bones and teeth” (Vine 1963).	Class 3—Vertebrate fossils have been found in the formation, but the presence of vertebrates not predictable in the project area.
Dewey Lake Red Beds	No fossils identified by Vine (1963).	Class 2—There is a potential for the occurrence of fossils, but probably are rare.
Rustler Formation	Work by Walter (1953) described mollusks in the Culebra Member of the Rustler Formation in outcrops in Culbertson County, Texas 50 to 60 miles south of the project area. However, Walter (1953) described fossil localities in the Rustler Formation as “scarce, random occurrences.”	Class 3—Applicable only to the Culebra Member since fossils are present and potentially important for scientific purposes, however widespread and rare. The remaining members of the formation would be considered Class 2.

3.3 Water

3.3.1 Surface Water

Surface water resources have been characterized in this report for two overlapping areas, the SPA and the project area. When discussing the project area, subwatersheds that contain any portion of the project area will be discussed and addressed. Beyond the SPA area, there also is discussion of the Pecos River, more specifically the water rights related interstate compact between New Mexico and Texas, known as the Pecos River Compact of 1948.

3.3.1.1 Precipitation and Evaporation

The climatic conditions in the SPA were characterized through the records of seven weather stations in and near the project area maintained by the Western Regional Climate Center (WRCC 2010). The climate of the area is semi-arid with average annual precipitation ranging from 12 to 16 inches. The average monthly minimum and maximum temperatures range from 94 to 98 degrees Fahrenheit (°F) in July with average monthly minimums of 28 to 30°F in December and January. Average annual potential evaporation rates far exceed average annual precipitation. Evaporation rates may approach 73 inches per year in this area (WRCC 2010), resulting in a large moisture deficit for many months of the year. The large moisture deficit limits stream flow because most precipitation is easily absorbed by the dry soils. However, during times of heavy precipitation the capacity of soils for infiltration is surpassed by the rate of rainfall, causing surface water runoff. Streamflows in the area are limited to periods of heavy precipitation.

3.3.1.2 Subwatersheds and Stream Channels

The Watershed Boundary Dataset (WBD) (National Resources Conservation Service [NRCS] 2005) divides the entire nation into drainages or subwatersheds. The nation (including Alaska, Hawaii, and the U.S. Virgin Islands) is divided into 21 Regions. Each region is divided into approximately 15 subregions, which are further divided into a similar number of basins, subbasins, watersheds, and subwatersheds. Each level is represented by a 2-digit code, known as the Hydrologic Unit Code (HUC). Effectively, each subwatershed has a unique 12-digit HUC identification number. The project area falls within six subwatersheds (NRCS 2005), shown in **Figure 3.3-1**. **Table 3.3-1** lists the six subwatersheds that contain a portion of the project area.

Table 3.3-1 Subwatersheds that Contain Portions of the Project Area

Region	Basin	Subbasin	Watershed	Subwatershed	Connected/ Closed	HUC-12 ID
Rio Grande	Upper Pecos[1]	Upper Pecos-Black	Burton Flat	Burton Flat	Connected	130600110104
			Clayton Basin	Little Lake	Closed	130600110203
				Clayton Basin	Closed	130600110204
				Scanlon Draw	Connected	130600110205
			Pamilla Draw	Lone Tree Draw	Connected	130600110308
			Salt Lake[2]	Maroon Cliffs	Connected	130600111701

1 Upper Pecos is name of Subregion (HUC-4) and Basin (HUC-6).

2 Salt Lake Watershed (HUC-8) is a closed basin.

Source: NRCS 2005.

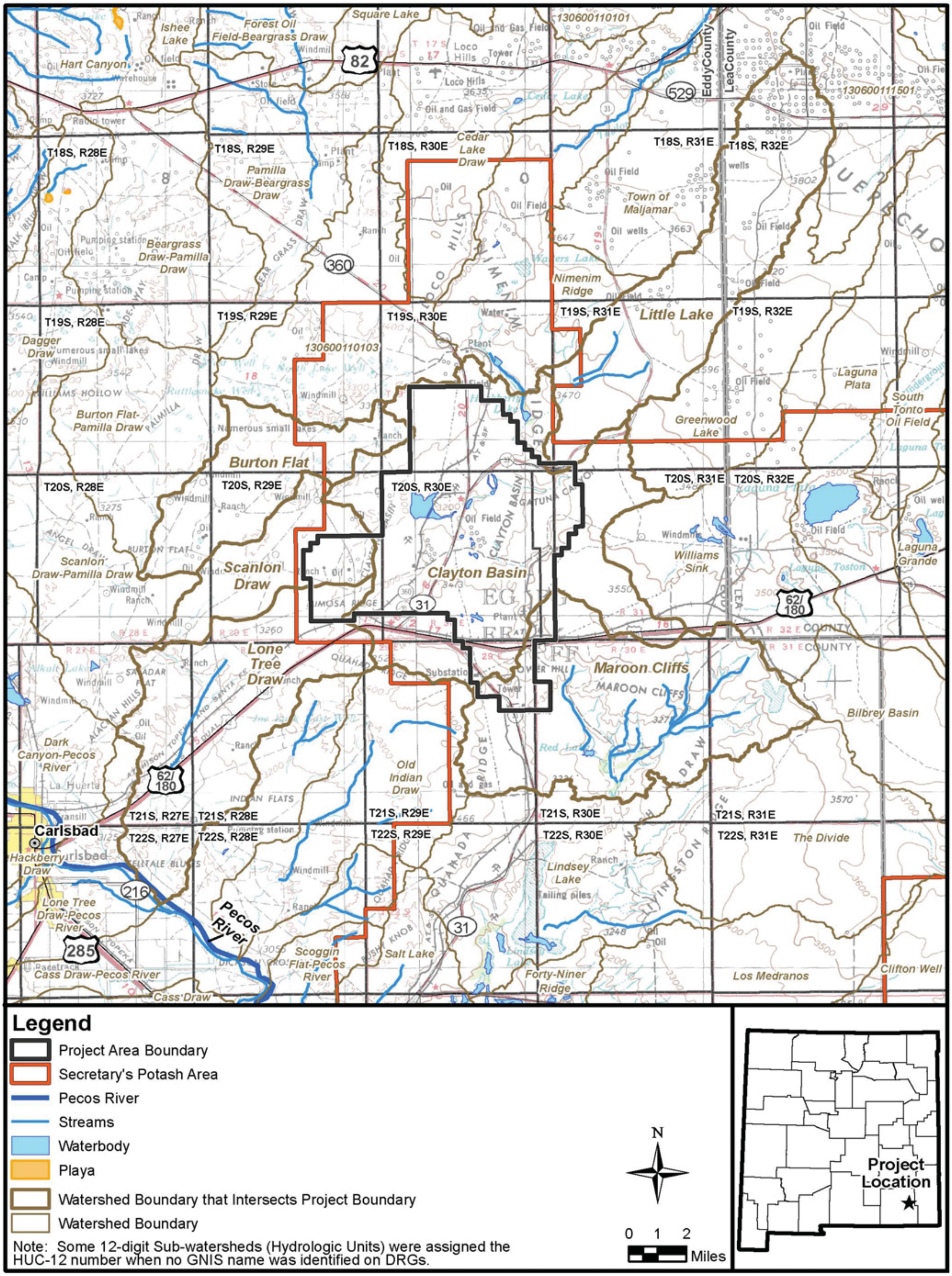


Figure 3.3-1. Subwatersheds in Project Area

Stream channels have been identified using the National Hydrography Dataset (NHD) (USGS 2009b). This dataset is associated with the WBD 12-digit HUC numbers. Stream reaches are coded using the corresponding WBD numbers and then additional digits are added to the number to differentiate each stream reach. The NHD also defines the flow regime of identified streams, within the confines of the dataset, and provides a flow network (when one exists) for water resource analyses. **Figure 3.3-1** includes the NHD features within and near the project area.

The subwatersheds listed above relate to other drainages in and near the SPA area in two ways. Some watersheds are hydrologically connected to another subwatershed through the flow of surface water in stream channels or as overland runoff. When a drainage basin is a closed basin, it does not have an outlet into an adjacent drainage or basin. Therefore, precipitation falling inside a closed basin will remain within the boundaries of the watershed.

Connected Subwatersheds

Burton Flat. This subwatershed encompasses a very small portion of the project area in the northeast, or most upslope portion of the drainage area. Burton Flat can be characterized as sloping from approximately 3,350 feet amsl in the northeast to approximately 3,220 feet amsl in the southwest where it empties into Scanlon Draw-Pamilla Draw. Water could then flow to Lone Tree Draw, and eventually to the Pecos River. Burton Flat is a relatively flat subwatershed that does not contain mapped channels of streamflow.

Scanlon Draw. The project area intersects with approximately one-fifth of this subwatershed in the eastern portion of the drainage area. Scanlon Draw can be characterized as sloping from approximately 3,320 feet amsl in the east to approximately 3,200 feet amsl in the southwest, where it empties into Scanlon Draw-Pamilla Draw for a short distance. Water could then flow to Lone Tree Draw, and eventually to the Pecos River. Scanlon Draw contains only two ephemeral stream channels at the lower elevations of the western portion of the subwatershed.

Lone Tree Draw. Only a small portion of the project area is contained within this subwatershed in the northeastern corner of the drainage. It can be characterized as sloping from approximately 3,480 feet amsl in the northeast to approximately 3,050 feet amsl in the southwest where it drains to the Pecos River. Lone Tree Draw has several mapped ephemeral stream channels in the steep, upper areas and in the mid-elevation area to the northwest where water might be contributed from Scanlon Draw.

Maroon Cliffs. Only a small portion of this subwatershed intersects with the project area, in the northwest portion of Maroon Cliffs. This drainage area can be characterized as sloping generally from approximately 3,600 feet amsl in the northern portion to approximately 3,100 feet amsl in the southern portion, where it could flow into Lindsey Lake Subwatershed. Lindsey Lake Subwatershed is considered a closed basin, where flows from Maroon Cliffs accumulate through Nash Draw into a series of lakes near the southern edge of this drainage.

Closed Subwatersheds

Clayton Basin. Clayton Basin contains a major portion (approximately ¾) of the project area. This drainage area is a closed basin, characterized by relatively high elevations surrounding an area of relatively low elevation. Clayton Basin is bounded on the west by the higher elevation areas of Burton Flat, Scanlon Draw, and Lone Tree Draw subwatersheds. It is bounded on the south by the higher elevation areas of Maroon Cliffs and Old Indian Draw subwatersheds, where elevations reach approximately 2,520 feet amsl. To the east, it is bounded by Williams Sink, Greenwood Lake, and Little Lake subwatersheds where elevations range from 3,600 to 3,400 feet amsl. The boundary on the north is created by watersheds where elevations range from 3,260 to 3,400 feet amsl. The low elevation areas in Clayton Basin consist of several locations where surface water collects near the middle at elevations ranging from 3,340 to 3,200 feet amsl. Very few ephemeral stream channels have been mapped along areas in the eastern portion of this subwatershed where steep slopes have likely caused erosion features to develop.

Little Lake. This subwatershed contains a very small portion of the northeast corner of the project area. Little Lake subwatershed can be characterized as a closed basin that generally slopes from elevations of approximately 4,500 feet amsl in the northeast towards the lowest elevations in the southwest portion of the drainage, approximately 3,390 feet amsl. Little Lake subwatershed is separated from Clayton Basin to the southwest by a minor ridge at approximately 3,400 feet amsl. There is only one mapped ephemeral channel in this subwatershed, located near the lower elevations and in an area of steeper slopes.

<u>Playas and Salt Ponds</u>

Within the project area, the closed Clayton Basin subwatershed contains 45 waterbodies identified by the NHD (USGS 2009a). No other subwatershed contains any NHD waterbody features in the project area. Of the 45 waterbodies, two are perennial. These perennial features have little surface area and are located next to one another along U.S. 180-62. The perennial features are located at a relatively high elevation compared to other waterbodies within the subwatershed. There also are three features classified as treatment reservoirs, which are the largest NHD features and have likely been used for discharge of water extracted from oil and gas wells. The remaining waterbodies are identified as intermittent salt lakes, which also could be interpreted as playas characteristic of the area. Playas are created when precipitation runoff leaches salts from the soil during runoff, collects in the low-lying areas, and then evaporates. The salts left behind decrease infiltration rates into the soil and allow water to pool.

<u>Floodplains</u>

The Federal Emergency Management Agency (FEMA) maintains maps of flood-prone areas throughout the nation that they use for administering the National Flood Insurance Program. In Eddy County, New Mexico, these maps are part of the Flood Insurance Rate Map (FIRM) series. FIRM maps are coded according to flood potential and level of analysis performed regarding that potential. The project area includes only two zones. Zone A is defined as areas that are within the 100-year floodplain (area with 1 percent or greater probability of a flood occurring in any given year). Projected elevations where flooding occurs in Zone A have not been determined. Zone X is defined as areas outside the 500-year floodplain (0.2 percent or less probability of a flood occurring in any given year) (FEMA 1991).

The Zone A areas in the project area correspond very closely with low-lying areas that are defined as waterbodies by the NHD (see Section 3.1.2.3). In addition, there is one additional topographic depression west of the largest treatment reservoir that has been identified as Zone A, the designation for the 100-year floodplain.

3.3.1.3 Wetlands and Riparian Areas

The USFWS maintains a series of maps that depict wetlands across the nation, called the National Wetlands Inventory (NWI). These maps were consulted to determine the types and extents of wetlands present in the project area.

Wetlands are classified according to Cowardin et al. (1979). Classifications include Palustrine and Lacustrine systems. Systems are further classified by hydrology that defines flooding as either semi-permanent, seasonal, intermittent, or temporary (USFWS 1990, 1984a). Palustrine wetland systems are relatively flat areas dominated by hydrophytic vegetation. Palustrine wetlands may be isolated or connected wet areas and include marshes, swamps, bogs, and small shallow ponds. Lacustrine wetland systems are deeper topographic depressions with vegetative coverage of less than 30 percent and are generally located along lakes.

Mapped wetlands in the project area are mostly located within floodplains and near NHD-defined waterbodies. The project area contains both palustrine and lacustrine wetlands, concentrated within the low-lying areas of Clayton Basin. The palustrine systems in the project area generally consist of the numerous smaller wetlands and are further classified on the larger scale maps as being temporarily flooded (USFWS 1990, 1984a). The lacustrine systems in the project area account for 7 of the approximately 30 wetlands identified by the USFWS (1990, 1984a), and consist of the larger mapped wetlands. These systems are further classified on the larger scale maps as being temporarily to semi-permanently flooded (USFWS 1990, 1984a).

3.3.1.4 Surface Water Quality

The New Mexico Water Quality Control Commission (NMWQCC) is responsible for setting water quality standards and designating beneficial uses for waterways. All surface waters of the state are assigned the beneficial uses of aquatic life, livestock watering, wildlife habitat, and secondary contact (NMAC 2009). Surface water quality is regulated in New Mexico by the Environment Department, Surface Water Quality Bureau. Water quality parameters are reported to the USEPA under the requirements of the CWA, specifically sections 303(d) and 305(b). The 303(d)/305(b) Integrated Report lists any streams that are considered impaired because they do not meet water quality standards or are not suitable for assigned beneficial uses. New Mexico's current 303(d)/305(b) Integrated Report was published in 2008 (NMWQCC 2008).

<u>Naturally Occurring Water Quality</u>

No waterbodies in the project area are reported as having impairments (NMWQCC 2008). Downstream from the project area, the Pecos River is listed as impaired from the confluence of the Black River near Malaga Bend to the Texas border. The impaired rating is due to the beneficial use, irrigation, in this reach not being supported because there are exceedences of dissolved boron limits, which may be attributable to inputs from the brine springs at Malaga Bend (Hopkins 2006).

<u>Previous and Current Sources of Impacts to Water Quality</u>

Although no waterbodies within the project area are considered impaired, there are historic impacts that have been documented. High total dissolved solids (TDS) concentrations occur from natural salt deposits near the surface and potentially from two anthropogenic sources: discharges from oil and gas wells and runoff from potash mine tailings (Geohydrology 1978).

3.3.1.5 Surface Water Use

Water use in the State of New Mexico is administered by the New Mexico Office of the State Engineer (NMOSE) under the prior appropriation doctrine, or "first in time, first in right." Any use of water must be permitted through the NMOSE, and is given a priority date based on when the application was received. All rights with "senior" (earlier) priority dates must be satisfied prior to "junior" (later) rights. The lack of surface water rights within the project area reflects the absence of surface water flows.

<u>NMOSE Recorded Beneficial Uses</u>

Intrepid Potash holds the only surface water right found in the project area, as returned by the NMOSE database (2010). The beneficial use of the right is for industrial purposes of tailings disposal and brine recovery.

<u>Pecos River Compact</u>

The Pecos River is downstream from the project area, and therefore hydrologically connected by surface water flows. The State of New Mexico and the State of Texas are parties to a compact ratified by Congress in 1949, the Pecos River Compact. After the ratification, the agreement was the subject of litigation that eventually came before the U.S. Supreme Court. In 1988, the Supreme Court entered an Amended Decree and appointed a River Master to administer the decree.

The Compact and Amended Decree apportion the flows of the Pecos River between the two states. Along with flows coming from Fort Sumner Dam (upstream from the project area) being specifically divided, flood inflows between the dam and the state line must be delivered to Texas. New Mexico is responsible for fulfilling the decreed amount of water that must cross the state line into Texas. If New Mexico does not comply, the River Master must create a plan to remedy any shortfall (Johnson et al. 2003b).

3.3.2 Groundwater

Groundwater resources are discussed in two different scales and geographic areas depicted in **Figure 1-1**: the first being the SPA and the second the project area. The groundwater resources in the SPA are discussed regionally, and the groundwater resources of the project area are discussed in greater detail. Estimated water balance for the SPA outlines and defines groundwater input and output parameters. Discussion of the groundwater resources northeast of the SPA includes detailed information regarding the aquifers in the Caprock well field area.

Physical properties of the aquifers discussed vary greatly, and are categorized by their relative magnitudes as described in **Table 3.3-2**. Water quality of the aquifers discussed is summarized by the TDS concentration. New Mexico considers all groundwater with a TDS of 10,000 mg/L or less to be protected for “present and potential future use as domestic and agricultural water supply” (NMAC 20.6.2.3101).

Table 3.3-2 Aquifer Property Categories and Values

	Units	Range		Classification in Text	Source
		High	Low		
Hydraulic Conductivity	ft/d	greater than	$1x10^{-1}$	High Flow Potential	
		$1x10^{-1}$	$1x10^{-4}$	Moderate Flow Potential	
		$1x10^{-4}$	or less	Low Flow Potential	
Transmissivity[1]	ft^2/d	greater than	1	High Flow Potential	
		1	$1x10^{-5}$	Moderate Flow Potential	
		$1x10^{-5}$	or less	Low Flow Potential	
TDS	mg/L	10,000	or less	“Protected” for future uses	NMAC 20.6.2.3101
		greater than	10,000	Not Protected	

[1] Transmissivity equals Hydraulic Conductivity multiplied by Saturated Thickness (Depth) of Aquifer.

Notes: ft/d = feet per day.
ft^2/d = square feet per day.
mg/L = milligrams per liter.

3.3.2.1 Groundwater Aquifers in the SPA

The SPA is underlain by the northern part of the Delaware Basin, whose northern border is formed by the Permian-age Capitan Reef complex. This area contains aquifers in many of the Permian stratigraphic units, but not in the Dewey Lake Red Beds or the Santa Rosa Formation. The Salado and Castile formations locally contain water with high TDS levels, but neither unit acts as an aquifer. The important aquifers that are potentially affected by potash mining and refining activities are located in the Rustler Formation and the Capitan Limestone. See Section 3.2.1 for detailed descriptions of the geologic formations.

There are five main aquifers in the northern part of the Delaware Basin that lie beneath the SPA. In addition, several other major formations act as aquitards. An aquitard is a geologic layer of low permeability adjacent to an aquifer that may store groundwater. Aquifers and aquitards in the vicinity of the project area are listed below from oldest (deep) to youngest (shallow):

- Bell Canyon aquifer of the Delaware Mountain Group
- Capitan aquifer
- Castile Formation aquitard
- Salado Formation aquitard
- Los Medaños aquifer of the Rustler Formation
- Culebra Dolomite aquifer of the Rustler Formation
- Tamarisk aquitard of the Rustler Formation
- Magenta Dolomite aquifer of the Rustler Formation
- Forty-niner aquitard of the Rustler Formation

The Dewey Lake Red Beds and the Santa Rosa Formation that overlie the above formations do not act as regional aquifers. **Figure 3.3-2** depicts the geology of the SPA from the Salado through the Dewey Lake Red Beds.

Bell Canyon Aquifer

The Bell Canyon is the upper member of the Delaware Mountain Group. The Lamar Shale member of the Bell Canyon and the overlying Castile Formation both act as impermeable aquitards that confine the aquifer in the Bell Canyon. These siltstone and shale layers have low flow potential and limit the vertical movement of water in the aquifer, while the horizontal movement of water in the sandstone layers is much less restrictive and has moderate flow potential (Mercer 1983). Well yields are low, less than 5 gpm. Groundwater flows northeast with a potentiometric surface (top of the groundwater) of 3,600 feet amsl by Malaga Bend and a potentiometric surface of 3,400 feet amsl beneath WIPP, and a gradient of approximately 25 to 40 feet per mile (Intrepid/Shaw 2008a).

Water quality in the Bell Canyon is unprotected saline, consisting of sodium chloride brine with TDS ranging from 180,000 to 270,000 mg/L (Mercer 1983).

Castile Formation Aquitard

The Bell Canyon's high hydraulic head is limited vertically by the overlying Castile Formation. The Castile Formation consists of thick anhydrite with thin interbedded salt layers, which acts as an aquitard. Water is found in weathered sections of the Castile where it is exposed. It does not have a regional flow system and is not considered an aquifer. However, the water is used locally for wells used for stock watering. The Castile is 1,500 to 1,850 feet thick in the WIPP area (Mercer 1983). Hydraulic tests conducted at WIPP found the hydraulic conductivity to be too low for field measurement. This formation has very low flow potential (Mercer 1983). Local brine pockets containing gas have been encountered by oil/gas drilling in the region. The flow of brine in these exploration wells has been as high as 20,000 barrels per day (bpd) (Powers et al. 1978).

Capitan Aquifer

The Capitan Aquifer consists of the Capitan Limestone, the Goat Seep Formation, and the forereef and backreef facies associated with the Guadalupian Reef Complex (Richey and Wells 1984). The Capitan Aquifer's width at the north end of the Delaware Basin is about 10 to 14 miles and has a maximum

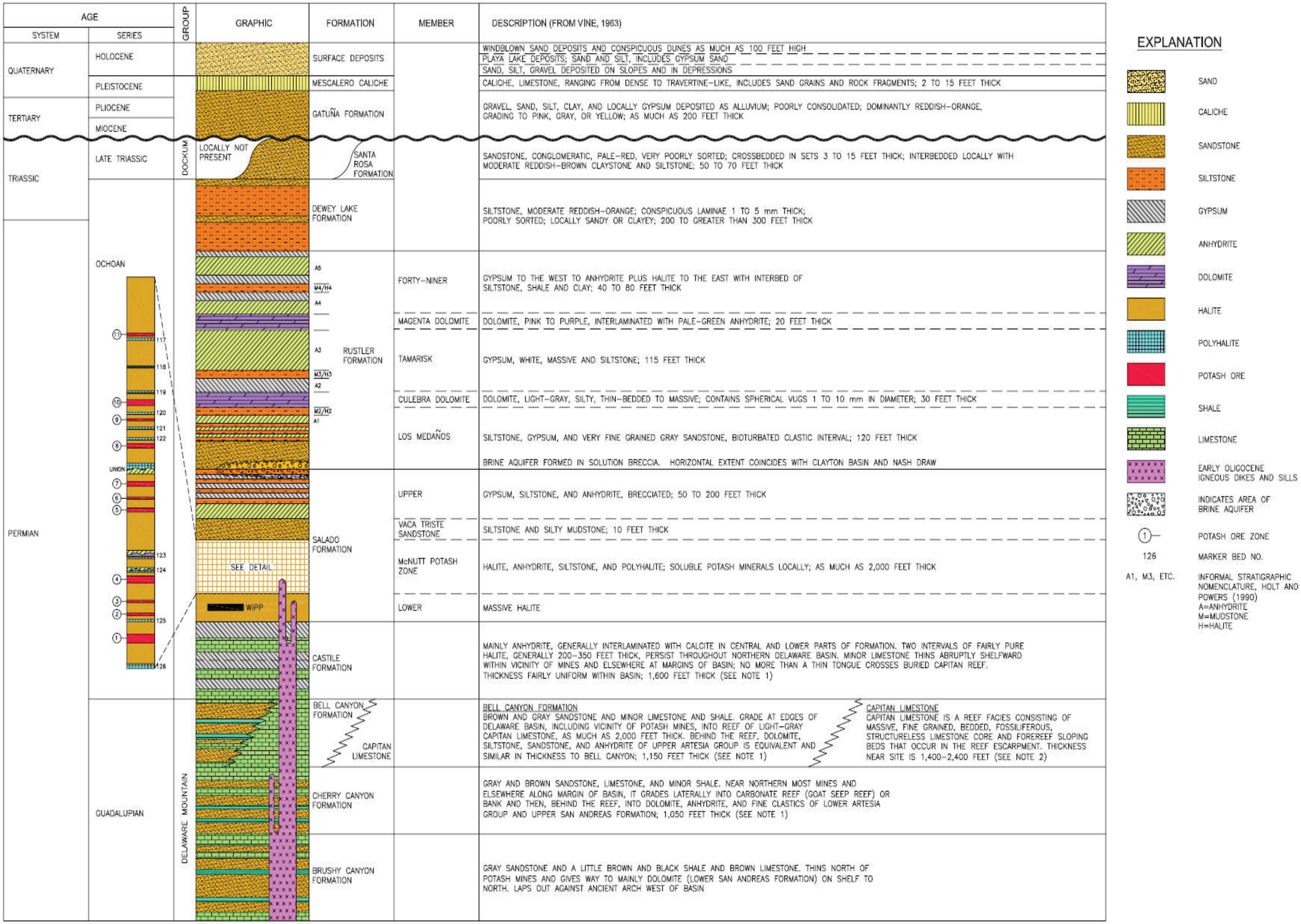


Figure 3.3-2. Stratigraphic Column of the Salado and Rustler Formations (Intrepid Potash, Inc./Shaw 2008a)

thickness of 2,400 feet and an average thickness around 1,500 feet (Mercer 1983). West of the Pecos River, the Capitan Aquifer is unconfined and recharged by precipitation from the Guadalupe Mountains. East of the Pecos River, the Capitan Aquifer is confined and artesian (under pressure).

The Capitan Aquifer discharges into the Pecos River at Carlsbad Springs. The Castile Formation prevents lateral movement of water from the Capitan into the basin. The underlying Delaware Mountain Group has higher hydraulic head that prevents downward seepage of water from the Capitan. Recharge to the Capitan west of the Pecos ranges from 10,000 to 20,000 acre-feet per year, and discharges around 4,500 acre-feet per year to Carlsbad Springs (Richey and Wells 1984). Water in the Capitan west of the Pecos is used for domestic consumption. East of the Pecos, water in the Capitan is used for agricultural and industrial consumption. The Capitan is a potential source of water in the SPA.

The hydraulic conductivity of the Capitan depends on the layers tested, but in general flow potential is high (Mercer 1983). East of the Pecos River and in the area of the SPA, the groundwater gradient is nearly flat, suggesting limited lateral flow in the Capitan.

Water quality in the Capitan is variable. West of the Pecos, the water quality is considered good and is protected for future use by the State of New Mexico (Richey and Wells 1984). East of the Pecos in Eddy County, the water quality can become saline with high TDS and chloride values.

Salado Formation Aquitard

The Salado Formation lies above the Castile, and contains the McNutt Potash Zone. It is not an aquifer except for in areas where it has been altered by dissolution. Flow potential is low in this formation (Mercer 1983). In the WIPP area, the unit is unaltered and 1,700 to 2,300 feet thick (Mercer 1983).

In places where the top of the Salado has undergone dissolution, a brine aquifer has formed between the Salado and the overlying Rustler Formation. The brine aquifer is considered to be part of the overlying Los Medaños member of the Rustler Formation and is discussed in more detail below.

Rustler Formation Aquifers

The Rustler Formation consists of five members listed from deepest to shallowest:

- Los Medaños member
- Culebra Dolomite
- Tamarisk evaporite member
- Magenta Dolomite
- Forty-niner evaporite member

The Tamarisk may act locally as an aquifer, especially in lower Nash Draw near Salt Lake where dissolution has caused considerable collapse of the Rustler (Mercer 1983). The Los Medaños contains a brine aquifer that is found throughout Nash Draw, and both the Culebra and the Magenta are aquifers.

Los Medaños Brine Aquifer

Dissolution of the upper 200 feet of the Salado Formation along the contact with the overlying Rustler produced the Los Medaños brine aquifer, a zone of clay residuum containing seams of brecciated gypsum and sandstone. The brecciated seams are 10 to 60 feet in thickness and average around 24 feet in thickness (Mercer 1983). This zone underlies Nash Draw and ranges from 2 to 8 miles in width and has a total length of about 26 miles.

The Los Medaños discharges to the Pecos River at Malaga Bend at a rate of about 200 gpm, delivering around 342 tons of NaCl per day (Mercer 1983). Comparison of water quality data and ratios of key constituents suggest the Los Medaños brine aquifer does not discharge to Salt Lake or Surprise Spring (Mercer 1983).

Groundwater flow in the brine aquifer of the Los Medaños member of the Rustler is generally to the southwest, as indicated by the potentiometric surface documented in 1982 (Mercer 1983). The gradient is generally moderate in the project area, but increases to a higher gradient to the southwest near Salt Lake in lower Nash Draw, where the Rustler section has collapsed due to erosion of the Salado. At WIPP, the brine aquifer is present only in the far western part of the site. Recharge for the Los Medaños member of the Rustler may be in Bear Grass Draw (T18S, R30E), similar to other members of the Rustler (Mercer 1983). The Los Medaños aquifer contains unprotected brine with high TDS values (Mercer 1983).

Culebra Dolomite Aquifer

At WIPP, the Culebra acts as a confined aquifer and is considered the first aquifer above the Salado, because the Los Medaños at WIPP does not contain the brine aquifer. At Nash Draw, the Culebra has collapsed into blocks forming drape structures and karst mounds due to dissolution in the Los Medaños and Salado below and the Tamarisk above (Mercer 1983). The Culebra outcrops at the Pecos River. Fluid flow in the Culebra at WIPP is mainly fracture flow along bedding planes and fractures in the formation (Mercer 1983). In Nash Draw, fluid flow in the Culebra is complex because of the collapse of the unit, formation of blocks, and intense fracturing that allows for hydraulic communication between the Culebra and the Magenta (Mercer 1983).

The Culebra is likely recharged at Bear Grass Draw and discharges to Salt Lake. The Tamarisk, the Culebra, and possibly the Magenta have all collapsed into one another near Salt Lake due to dissolution in the Tamarisk. As a result, they are likely water sources for Surprise Spring and Salt Lake. The water discharges to Surprise Spring and Salt Lake at approximately 115 to 125 gpm (Mercer 1983).

The potentiometric surface of the Culebra at WIPP and in Nash Draw is generally to the south. Gradient changes are related to permeability changes and groundwater flow is controlled by variable fracture orientation. Flow potential in the Culebra varies considerably from WIPP to Nash Draw and especially within Nash Draw. Flow potential is moderate near the east side of WIPP, and increases to a high flow potential in Nash Draw. The Culebra and the Magenta are in hydraulic communication near Nash Draw, as suggested by similar transmissivity values, minimal head difference, and similar water quality (Mercer 1983).

Water quality in the Culebra is highly variable and as such could be considered as protected water in some places such as at WIPP, but is not protected in Nash Draw. The major constituent of water quality is NaCl (Mercer 1983).

Magenta Dolomite Aquifer

In the Magenta Aquifer, water is found in the siltstone and silty dolomite beds, along bedding planes, and in fractures. The aquifer is confined at WIPP and generally unconfined in Nash Draw where it is extensively fractured. In places in Nash Draw, the Magenta Aquifer can be confined and unsaturated.

In Nash Draw, the nature of the Magenta depends on dissolution in the Tamarisk and the presence of gypsum in both the Tamarisk and the Forty-niner members. In the northern, central, and along the eastern boundary of Nash Draw the Magenta is a relatively continuous bed (Mercer 1983). In the southwestern part of Nash Draw and near Malaga Bend, the Magenta has been removed by erosion, collapsed into isolated blocks, or formed karst sinks and collapse breccias (Mercer 1983). Exposures of the Magenta along the west side of Nash Draw near Quahada Ridge are fractured and often dry due to loss of water through the fractures. Groundwater flow in the Magenta Aquifer depends on the degree of fracturing and collapse. In Nash Draw, groundwater flow is fracture flow and very complex because of the collapse and brecciation, especially in the southern part of Nash Draw. The 1982 potentiometric surface for the Magenta Aquifer indicates groundwater flow in this unit is generally to the west (Mercer 1983). Flow potential in this aquifer ranges from moderate near WIPP to high flow potential in the Nash Draw area. The groundwater gradient at WIPP is around 16 to 20 feet per mile, increasing to 32 feet per mile on the west side of WIPP by Nash Draw. The gradient down Nash Draw is 13 feet per mile. Static head differences between the Magenta and the Culebra are less than 8 feet at wells in Nash Draw, suggesting hydraulic communication between the two aquifers (Mercer 1983). At WIPP, static head differences between the Magenta and the Culebra are around 115 to 155 feet. Recharge for the Magenta probably takes place in Bear Grass Draw. Discharge is through downward flow to other units in Nash Draw, and through contributing flows to either Salt Lake or the Pecos River at Malaga Bend (Mercer 1983).

Water quality in the Magenta is highly variable ranging from protected to unprotected TDS values.

<u>Formations Above the Rustler</u>

None of the formations above the Rustler in the SPA contain continuous zones of groundwater, so none constitute aquifers. The Dewey Lake Red Beds consist of a sequence of alternating beds of siltstone, mudstone, and lenticular sandstone deposited after the period of evaporite deposition in the late Permian. These beds of sands and silts thicken to the southeast up to 541 feet thick east of WIPP (Mercer 1983). The Dewey Lake is present only in low bluffs north and east of Nash Draw. It has been eroded from most of the Nash Draw area, and no water was encountered in drill holes (Mercer 1983). At the James Ranch (Sections 6 and 7, T23S, R31E), saline groundwater used for stock watering has been found at depths of 94 and 212 feet. The Dewey Lake is a low permeability unit that protects the underlying Rustler from infiltration of precipitation and removal of halite (Mercer 1983).

The Santa Rosa has a thickness ranging from less than a few feet to 176 feet at WIPP. It is found in the low bluffs at the north end of Nash Draw and along the east side of Nash Draw. It serves as the principal aquifer in southern Lea County, but in the SPA it only has water in the lower part of the formation at WIPP where yields are low.

The Gatuña is a discontinuous bolson deposit that ranges up to 143 feet thick at WIPP, but it is generally less than 46 feet thick (Mercer 1983). The Gatuña has an erratic distribution and no permanent water. It is not an aquifer.

Alluvium along the Pecos River west of the SPA serves as an aquifer with high flow potential and communication both to the river and possibly to underlying formations. Wind-blown sands and other thin alluvium within the SPA may be wet at times, but do not constitute an aquifer.

3.3.2.2 Project Area Hydrogeology and Groundwater Chemistry

In the project area, groundwater pumping is proposed from Sections 1 and 2, T21S, R29E from the Magenta member of the Rustler Formation (Rustler South), and from Section 4, T20S, R30E from the collapsed Magenta and Culebra members of the Rustler Formation (Rustler North). For this reason, most of the detailed field analyses and data gathering for the proposed project has been in these areas. The following discussion of the project area hydrogeology and groundwater chemistry focuses on the Rustler South and Rustler North areas. **Figures 3.3-3** through **3.3-6** present the structure contours for important geologic units in the Rustler South and North areas, in order from bottom to top strata.

<u>Rustler Formation</u>

The Los Medaños basal member of the Rustler is approximately 13 feet thick in the project area.

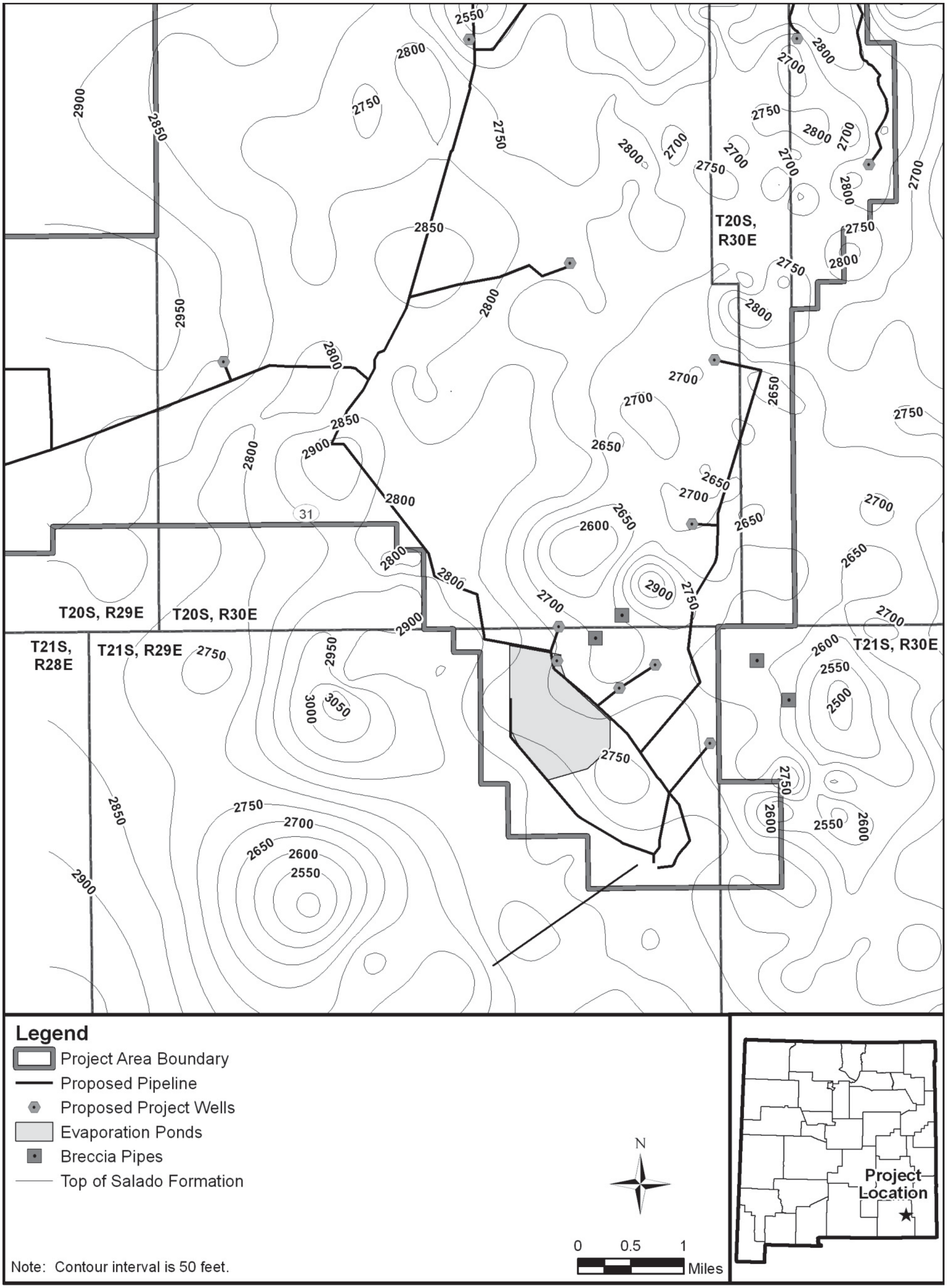


Figure 3.3-3. Top of Salado Formation in the Rustler North and South Areas

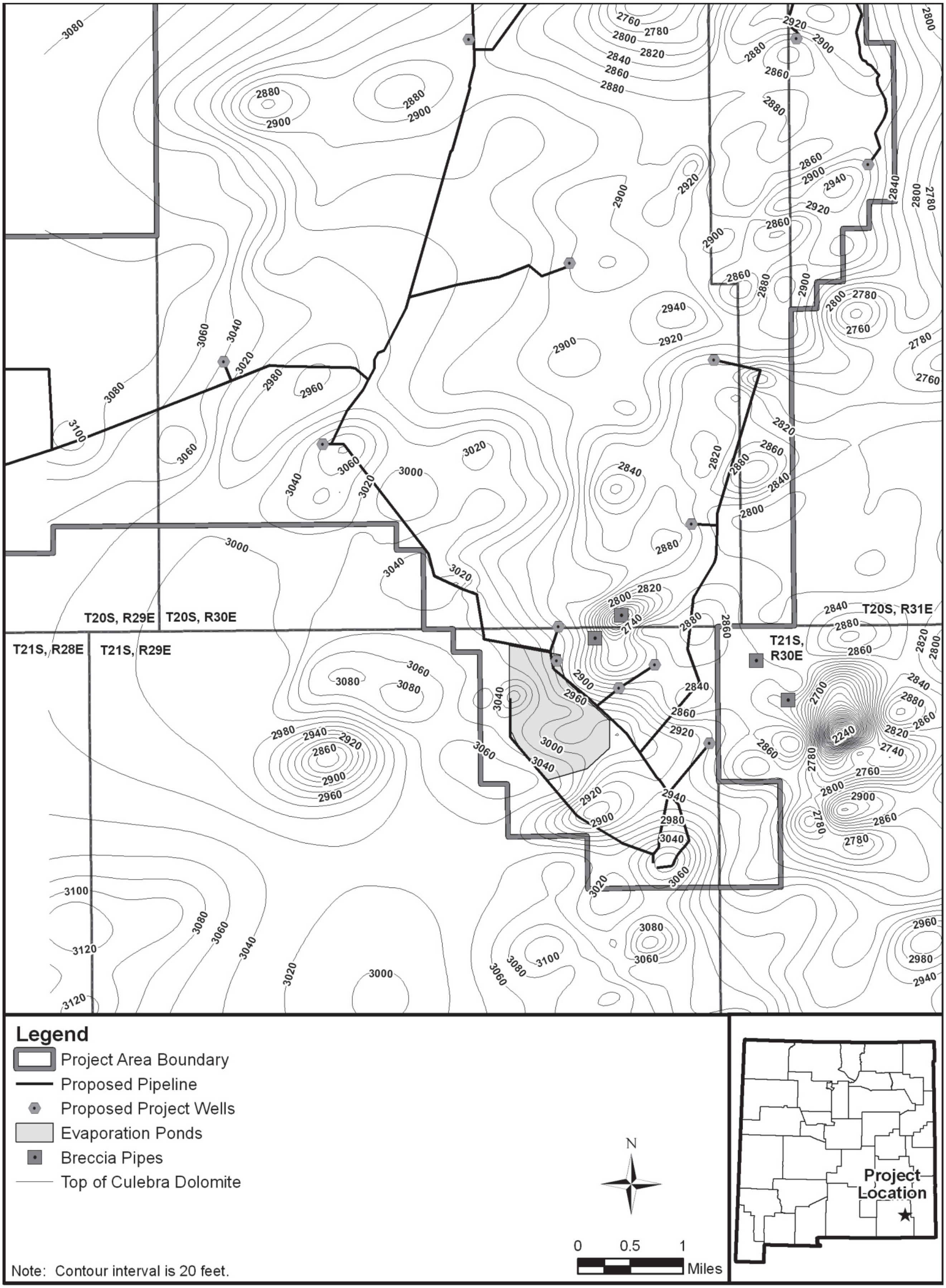


Figure 3.3-4. Top of Culebra Dolomite Member, Rustler Formation in the Rustler North and South Areas

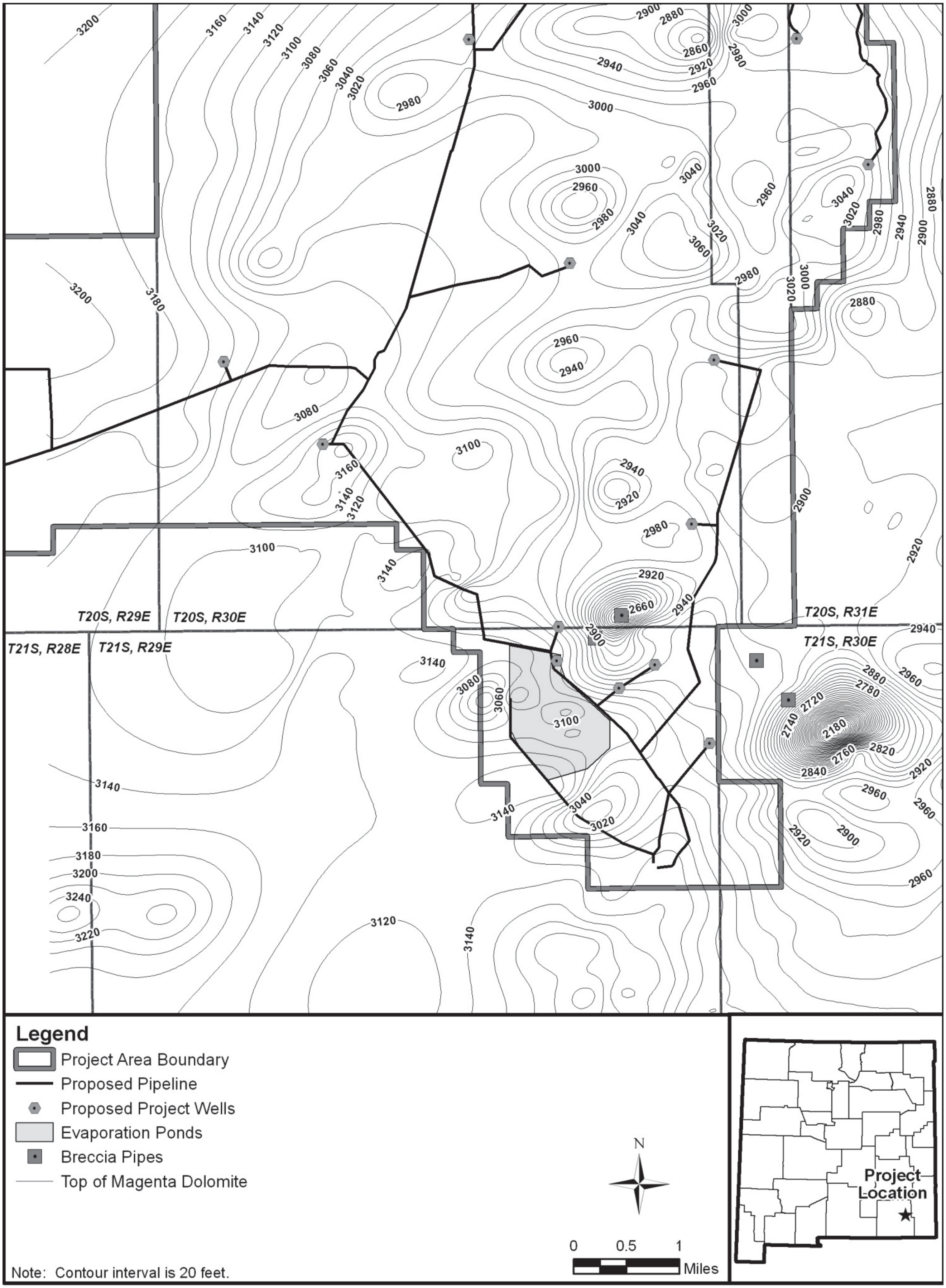


Figure 3.3-5. Top of Magenta Dolomite Member, Rustler Formation in the Rustler North and South Areas

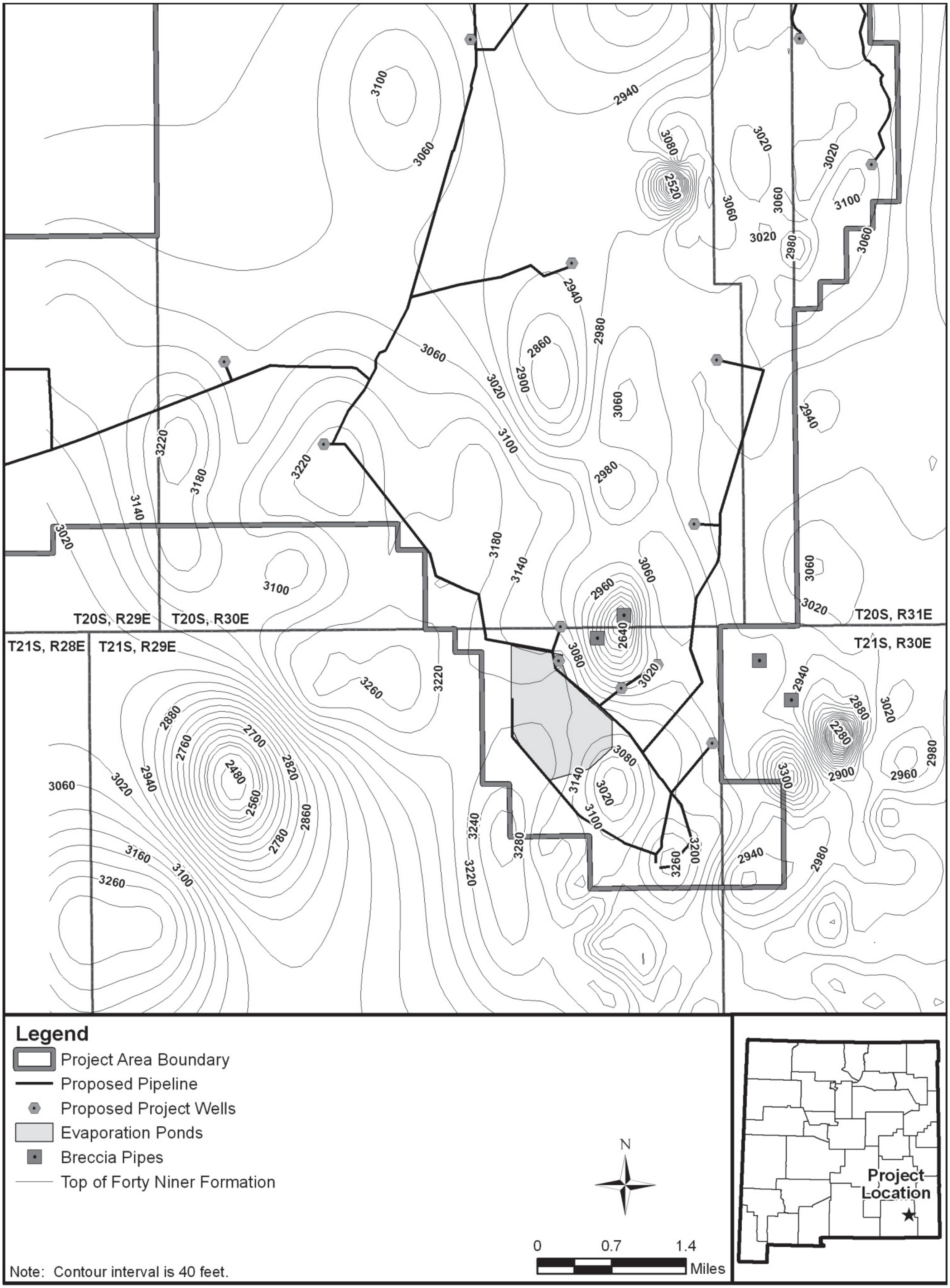


Figure 3.3-6. Top of Forty-niner Member, Rustler Formation in the Rustler North and South Areas

The Culebra Dolomite member is approximately 24 feet thick, dipping to the northeast at 80 to 120 feet per mile, and yielding water at 49 gpm (Intrepid Potash Inc./Shaw 2008a). **Figure 3.3-4** is a structure contour map drawn on the top of the Culebra. The Culebra dips to the northeast and does not show influence from the collapse associated with the breccia pipes that is evident in the Dewey Lake Red Beds and on top of the Forty-niner member.

The total thickness of the Tamarisk encountered during borings in the project area was 84 feet. No water was encountered in the Tamarisk (Intrepid Potash Inc./Shaw 2008a)

The Magenta Dolomite member ranges from 29 to 37 feet thick and averages 31.7 feet thick. Fractures in the dolomite contain chlorite and calcite. The unit dips to the northeast at about 85 feet per mile in the Rustler South area. South of this area, the dip is to the southeast at 155 feet per mile. There is water in the Magenta and the unit acts as a confined aquifer due to the limitations of the overlying Forty-niner member. Protection from the Dewey Lake Red Beds has prevented dissolution of the Forty-niner and the Tamarisk. Effectively, the Magenta has not collapsed or formed blocks of breccia as it has in Nash Draw. Water yields in most of the recent borings were less than 3 gpm. One boring had a yield of around 100 gpm in a fracture zone at a depth of 371 feet, and one well approximately 1,000 feet south of the Rustler South area yielded water at a rate of 200 gpm at a depth of 387 feet. **Figure 3.3-5** shows the structure contour on the top of the Magenta. The Magenta does not show influence from the collapse associated with the breccia pipes that is evident in the Dewey Lake Red Beds.

The Forty-niner member of the Rustler consists of an upper anhydrite layer ranging from 21 to 38 feet thick The lower anhydrite layer is 11 to 17 feet thick (Intrepid Potash/Shaw 2008a). There is no water in the Forty-niner member.

Hydrogeology

The groundwater levels in the Magenta and Culebra members in the project area documented in December 2007 are shown in **Figure 3.3-7**. Well IP-WW-002 produces from the Culebra and well IP-WW-007 in the northern area of Rustler South produces from the Dewey Lake Red Beds. Groundwater in the Magenta generally flows to the southeast toward Nash Draw at a gradient of approximately 0.005 feet per feet. The aquifer in the Magenta Dolomite is confined and potentiometric levels range from 24 to 70 feet above the top of the unit. One exception is well IP-WW-006, where the potentiometric surface is 255 feet above the top of the Magenta (Intrepid Potash Inc./Shaw 2008a).

For the Magenta in well IP-WW-001, the transmissivity based on a short-term single-well aquifer test appears to be around 2,200 to 2,700 $feet^2$ per day with a hydraulic conductivity of 75 to 92 feet per day (Intrepid Potash Inc./Shaw 2008a). Well IP-WW-001 had a flow rate of 90 gpm from a fracture at 371 feet below the ground surface. Short-term aquifer tests in fractured rock are not representative of the system because they tap only the water in the fracture and do not pump long enough to drain the fracture. The short-term test in this well suggests a high transmissivity but low storage capacity for the fracture system intercepted. A more representative analysis of the data might be the Moench fracture flow match yielding a transmissivity value of 1,363 $feet^2$ per day and a hydraulic conductivity for the fracture of about 47 feet per day. Fractures can produce high flow rates for short periods of time with considerable transmissivity.

For the Culebra in well IP-WW-002, fracture flow is also a possibility (Intrepid Potash Inc./Shaw 2008a) and the solution of Moench transmissivity of 13 $feet^2$ per day with an estimated hydraulic conductivity of 0.55 feet per day is possible.

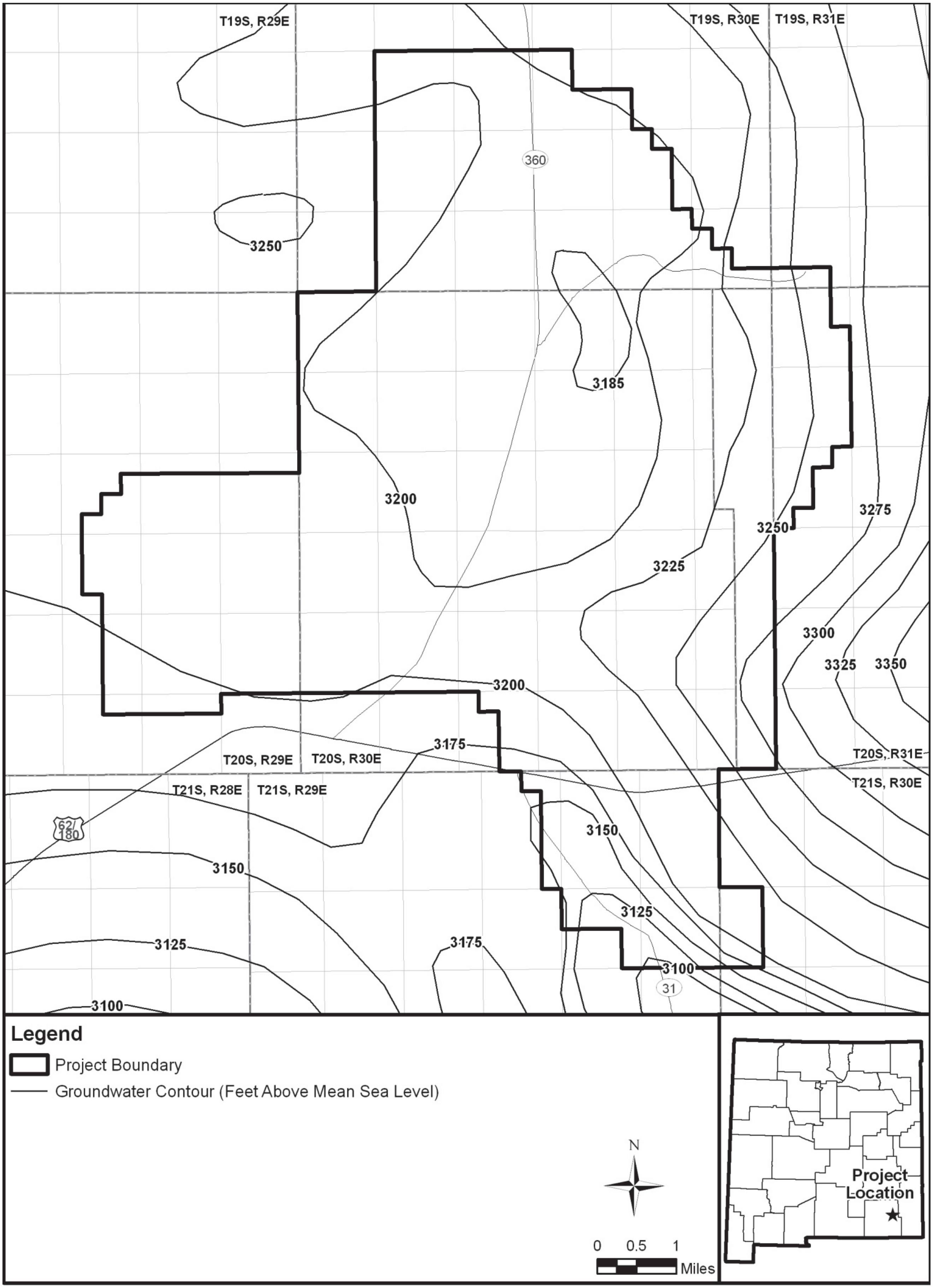


Figure 3.3-7. Groundwater Potentiometric Surface Contours in Project Area

Overall, the aquifer tests conducted by Intrepid and Shaw (2008a) suggest that fracture flow is dominant in the Magenta and Culebra members of the Rustler Formation in Rustler South. The short-term single well tests also suggest relatively low transmissivity, similar to the transmissivity found at WIPP, when compared to the extremely high values of transmissivity that characterize the Magenta and Culebra in Nash Draw. These values remain high but are not extreme in the Rustler South area because the Rustler has not undergone the dissolution of halite, conversion of anhydrite to gypsum, and the collapse of the formation that characterizes Nash Draw and the middle of Clayton Basin.

According to groundwater elevation contours (Geohydrology 1979) and ground surface elevations, groundwater near the project area is encountered within 40 feet below the ground surface in the center of Clayton Basin. It also is encountered in areas in Nash Draw just below the Maroon Cliffs and towards the lakes near the bottom of the draw. These locations, depicted in **Figure 3.3-8**, are areas where drawdown of the potentiometric surface might have a direct impact on surface resources.

Groundwater Chemistry

The seven monitoring wells installed in Rustler South have been sampled by Intrepid and Shaw (2008a) for water quality parameters. TDS increases to the northeast toward the area of breccia pipes in Section 2. Well IP-WW-007 is in the Dewey Lake Red Beds and its TDS value was not compared with the other TDS values in the Rustler. Values in the southwest corner of Section 2 are less than 10,000 mg/L and thus fall within the NMED guideline for protectable waters. Values in the northeast corner exceed 10,000 mg/L and exceed 100,000 mg/L. There is an abrupt increase in TDS starting around the middle of Section 2, northeast of well IP-WW-004.

Sulfate values in the southwest corner of Section 2 are below 3,000 mg/L. There is a sharp increase in sulfate starting northeast of well IP-WW-004 and values range from 4,800 to 7,000 mg/L. Well IP-WW-006, located in the far northeast corner of Section 2, and closest to the breccia pipes shows a drop in sulfate values to 2,700 mg/L. Chloride also increases sharply toward the northeast corner of Section 2. Values in the southwest part of Section 2 are below 500 mg/L. Within the central part of Section 2, values jump to 1,000 mg/L in well IP-WW-004, and in the northeast corner of Section 2 values for chloride range from 45,000 to 72,000 mg/L.

Calcium, magnesium, sodium, and potassium are elevated in the groundwater in the Rustler. The ratio of sodium to potassium decreases from southwest to northeast across the section. Water with a high ratio of potassium to sodium, or a low ratio of sodium to potassium, is indicative of potash refinery waste water and tailings water. North of the Section 2 area in the southern part of Clayton Basin, the Duval Mine operated in the 1950s and 1970s and discharged waste water to holding ponds and tailings (Geohydrology 1979). The discharge may be responsible for the sharp increase in chloride, TDS, and the drop in the sodium to potassium ratio in the northeast corner of Section 2. An alternative explanation may be that water from the Salado is moving upward along the ring fractures that surround the breccia pipes (Intrepid/Shaw 2008a). This would account for the elevated chloride and TDS, but not the low sodium to potassium ratio in the northeast corner of Section 2 near the breccia pipes.

Breccia Pipes Near Rustler South

Snyder and Gard (1982) evaluated many of the breccia pipes within the SPA and WIPP. The breccia pipe in Section 35, T20S, R30E was drilled by Snyder and Gard (1982), which revealed 1,981 feet of brecciated rock consisting of drown-dropped, folded, brecciated Santa Rosa, Dewey Lake Red Beds, Rustler Formation units, and Salado Formation.

The breccia pipe is relatively impermeable, with low flow potential based on drill stem tests (Snyder and Gard 1982). The pipe is surrounded by a zone of fractured rock and was created by cavern collapse in the underlying Capitan Limestone. Water may have moved upward from the Capitan Limestone to cause the dissolution of the evaporite units in the Rustler evident around the pipe (Snyder and Gard 1982).

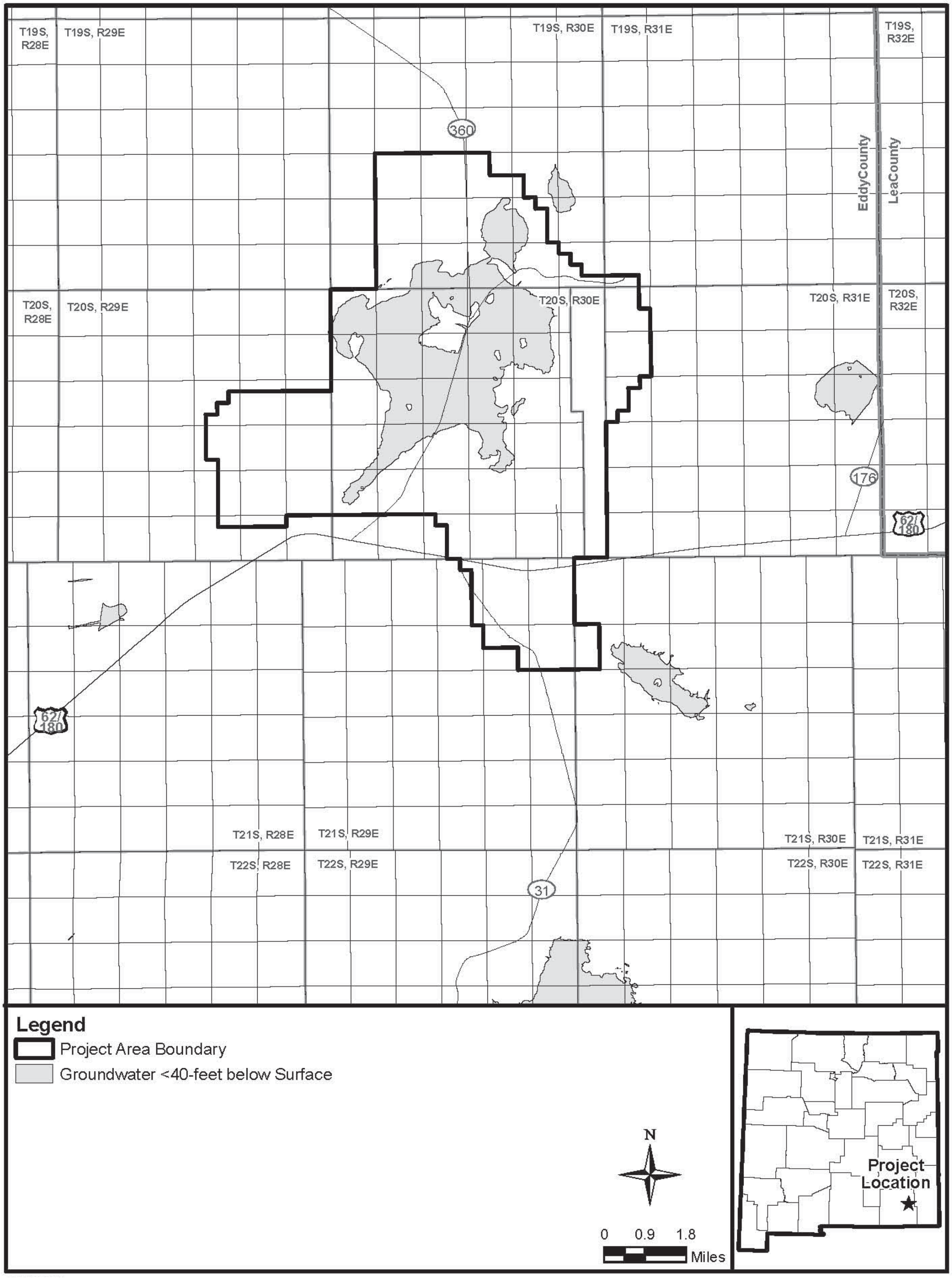


Figure 3.3-8. Top of Groundwater Surface within 40 Feet of Ground Level

Rustler Formation Near Rustler North

In the Rustler North area, the Rustler Formation layers that are separate in the Rustler South area have collapsed into one hydrologic unit and function as one aquifer due to dissolution of layers between. The aquifer is approximately 400 feet deep with a high flow potential due to the depth and hydraulic connection between the layers. Recent water tests of the former PCA wells that are currently unused indicate that there are relatively high levels of lead (approximately 0.3 mg/L) in these wells (American West Analytical Laboratories 2010). As a means of comparison, the EPA identifies an action level for lead in drinking water to be 0.015 mg/L. If drinking water exceeds the action level, steps must be taken to treat the water or the system to protect human health.

Units Above the Rustler Formation

The units above the Rustler are the Caliche and Alluvial Sand, the Gatuña Formation, the Santa Rosa Formation, and the Dewey Lake Red Beds. Water from the Dewey Lake Red Beds was found only in one boring, IP-WW-007. Well IP-WW-007 in the Dewey Lake Red Beds encountered an unconfined water body with an approximate transmissivity of 61 $feet^2$ per day and a corresponding hydraulic conductivity of 0.77 feet per day. A vertical pumping test between IP-WW-006 (Magenta) and IP-WW-007 (Dewey Lake) did not show any interaction between the two formations, probably because of the intervening dry Forty-niner member of the Rustler.

3.3.2.3 SPA Water Balance

Developing a water balance for the SPA is difficult to execute due to the movement of water through the aquifers that lie above the Salado Formation. Geohydrology Associates, Inc. were the first to attempt finding a water balance for the SPA (Geohydrology 1978).

As part of their assessment, Geohydrology developed a water balance for Clayton Basin and Nash Draw that accounted for:

- The influx of refinery discharge into the Rustler Formation.
- The rise in surface water levels from 1973 to 1978.
- The increase in brine ponds and natural pond surface areas due to refinery discharge.
- The rise in groundwater levels.

The water balance estimate of Geohydrology (1978) was focused on the discharge of refinery waste water to spoil piles and brine ponds in the “Carlsbad Potash District,” which encompassed the western SPA.

The water balance assessment for the WIPP project was developed for the region from the Pecos River to WIPP and east to the San Simon Swale by Hunter (1985). This water balance estimate relied on the work of Geohydrology (1978) for the western SPA. It also incorporated an assessment of the Pecos River, and an estimate for the loss of groundwater through the San Simon Swale. Recharge to the Ogallala Formation in the eastern part of the regional domain was not included because the study focused on aquifers between the Salado and the Ogallala formations. As a result of the larger area studied by Hunter (1985), the water balance estimates differed from Geohydrology’s estimates (1978).

Both of these approaches have their merits. The work of Geohydrology (1978) was detailed in its estimate of evapotranspiration from plants and evaporation from brine ponds. It involved field measurements and data from the operating potash refineries. Geohydrology’s studies only focused on Clayton Basin and Nash Draw. Hunter (1985) provides a regional look at water flows, which is more applicable to a groundwater model that encompasses more than just the SPA. Both of these water balances were considered and combined to produce a water balance for use in the groundwater model developed for the proposed project.

3.3.2.4 Summary of Groundwater in the Project Area

The hydrology of the SPA and the surrounding area is complex and varied. Clayton Basin and Nash Draw are both collapse features with different hydraulic characteristics. Clayton Basin is a closed hydrologic system and Nash Draw is a major groundwater sink drawing water from the Quahada Ridge area to the west and the WIPP area to the east. Nash Draw is an open system with discharge to the Pecos River. The Pecos River and its associated alluvial aquifer are in hydraulic communication and provide a major source of water for irrigation in Eddy County. The Rustler Formation at WIPP contains confined aquifers in the Magenta and Culebra members that are probably not in hydraulic communication, which is likely true for the Rustler Formation in the project area. In Nash Draw and Clayton Basin, dissolution of halite in the Rustler Formation and collapse have resulted in the entire Rustler acting as a single aquifer. There is considerable evidence that, in both Clayton Basin and Nash Draw, there is hydraulic communication between the members of the Rustler and between all aquifers overlying the Salado (Mercer 1983; Geohydrology 1978).

Some key points relative to the water balance of the SPA and adjacent areas are:

- Precipitation recharge to groundwater is about 3 percent of precipitation.
- Precipitation recharge for the SPA is about 28,000 acre-feet per year; Precipitation recharge for a larger area from the Pecos River to the San Simon Swale is about 44,000 acre-feet per year.
- Clayton Basin is a closed basin receiving about 16,000 acre-feet of groundwater recharge per year. Some of this is evapotranspired by natural ponds, lakes, and associated plants.
- Nash Draw is a groundwater sink open to the south with groundwater flow to the Pecos River. Flow to the Pecos is around 323 to 387 acre-feet per year based on estimates by Geohydrology (1978) and Hunter (1985).
- Precipitation recharge to Nash Draw is around 7,600 to 8,300 acre-feet per year. This recharge to groundwater must find its way to the Pecos River, suggesting that flow to the Pecos may be greater than previously estimated.
- The Pecos River is a major source for irrigation water. Irrigation return to the Pecos is about one-third of water withdrawn for irrigation. Consumptive loss of water is around 50 to 58 percent.
- The WIPP area has a distinct hydrologic system that is not found in either Nash Draw or Clayton Basin. The Rustler is intact and the Magenta and Culebra members are separate confined aquifers with distinctly different potentiometric surfaces. Groundwater flow is west to Nash Draw.
- Refinery discharge ponds leak and seep about 60 to 70 percent of the discharge to groundwater. This leads to a rise in groundwater levels near the ponds and an increase in the surface area of nearby natural ponds. Discharge by refineries directly to natural ponds, like in Clayton Basin and Salt Lake from 1950 to the 1980s, resulted in increased evaporation from the ponds due to the larger surface area. Water balance estimates by Hunter (1985) and Geohydrology (1978) suggest that refinery discharge to ponds is either lost by evapotranspiration or results in a rise in groundwater levels.
- Under natural conditions where there is no potash refinery discharge, rangeland plants take up 96 percent of precipitation and one percent is held as soil moisture (Geohydrology 1978). The 3 percent that becomes groundwater recharge is either lost by increased evapotranspiration in closed basins (Clayton Basin) due to a rise in water levels or natural pond surface area, or it flows out of the system toward the Pecos River (via Nash Draw).

3.3.2.5 Caprock Area Hydrogeology and Groundwater Chemistry

Northeast of the SPA, the Caprock area is underlain by the High Plains Aquifer, which has a large areal extent, underlying portions of South Dakota, Wyoming, Colorado, Nebraska, Kansas, Oklahoma, Texas, and New Mexico. The predominant water source in Lea County is the Ogallala Aquifer, which provides water for municipal, domestic, irrigation, and other uses (NMOSE 1999). The High Plains aquifer consists mainly of the Tertiary-aged Ogallala Formation consisting of clays, silts, sands, gravels, and caliches. There are localized areas with Quaternary alluvial dune sands that overlie the Ogallala Formation and constitute part of the aquifer.

Depth to water of the Ogallala Aquifer in the Caprock area ranges from approximately100 feet in the southeast near Buckeye to 150 feet or greater to the west towards Maljamar. The saturated thickness of the aquifer increases from approximately 100 feet near Maljamar to 150 feet or greater near Buckeye. Groundwater flow is generally to the southeast (NMOSE 1999; Tillery 2008).

According to the Lea County Regional Water Plan (NMOSE 1999), water from the Ogallala Aquifer in Lea County is consistently good quality, typically ranging from 300 to 415 mg/l, which is high but acceptable for potable water. Fluoride concentrations are high but acceptable, chloride concentrations are moderate, and sulfate concentrations are low.

3.3.2.6 Groundwater Use

Groundwater use was investigated through searches of the NMOSE water rights database. Groundwater use in the project area is minimal. Half of the wells are designated for mining, oil, and natural resource development. **Table 3.3-3** summarizes the existing permitted wells in the project area.

Table 3.3-3 Summary of Groundwater Wells in Project Area

Well Use	Count
Domestic	1
Livestock	4
Prospecting or Development of Natural Resources	4
Mining or Milling or Oil	1
Total	**10**

Groundwater use in the Caprock area is greater due to larger populations, a much more extensive and high-yielding aquifer, and few other suitable water sources. The total water rights appropriation for all of Intrepid's Caprock wells is over 16,000 acre-feet per year. Ogallala Aquifer available water levels have been in decline since the mid-1900s as groundwater demand increased and storage has been depleted. The estimated annual recharge to the Ogallala Aquifer in Lea County is between 37,500 to 75,000 acre-feet. From 1995 to 1998, it is estimated that 14 million acre-feet of water was recoverable for use from the Ogallala Aquifer in Lea County (NMOSE 1999). Diversions from Lea County groundwater sources, predominantly from the Ogallala Aquifer, were 178,522 acre-feet of water in 1998 (NMOSE 1999) and 185,952 acre-feet in 2005 (NMOSE 2005).

The total annual water rights appropriation for all of Intrepid's Caprock wells is 16,090 acre-feet, or approximately 9 percent of the total county water usage. In 2009, Intrepid used 5,051 acre-feet, or 31 percent, of its permitted Caprock area water. Intrepid's Caprock water rights are recorded at the NMOSE with the following file numbers:

- L-2675 through L-2680-Combined (8,330 acre-feet)
- L-2724 (2,410 acre-feet)
- L-4247-A (1,400 acre-feet)
- L-1880 through L-1884-combined-enlarged (3,950 acre-feet)

Similar to the project area, the majority of designated uses for Caprock area water are for oil, mining, and industrial uses. **Table 3.3-4** summarize the well numbers and uses in the Caprock area within 3 miles of Intrepid's well fields.

Table 3.3-4 Summary of Groundwater Wells within 3-mile Radius of Intrepid's Caprock Wellfields

Well Use	Count
Commercial	9
Domestic	32
Exploratory	19
Industrial	51
Irrigation	3
Mining & Refining	14
Oil Well Drilling	212
Secondary Recovery Oil Well	11
Livestock	22
Total	**373**

3.4 Soils

A variety of data sources were used to identify the baseline soil characteristics in the project area. Information on Major Land Resource Areas and Soil Types was obtained from NRCS literature or databases, including the Land Resource Regions and Major Land Resource Areas of the U.S., the Caribbean, and the Pacific Basin, U.S. Department of Agriculture Handbook 296 (NRCS 2006) and the Soil Survey Geographic Database (SSURGO). Soil baseline characterization for the project area is based on SSURGO review and analyses. SSURGO is the most detailed level of soil mapping done by the U.S. Department of Agriculture (USDA) NRCS. The SSURGO database for Eddy County, New Mexico (NRCS 2008a) is the source for the soils data in this section.

3.4.1 Major Land Resource Areas

The proposed project boundary lies within Major Land Resource Area (MLRA) 70D, The Southern Desert Foothills (NRCS 2006), which is in the southern part of the Sacramento Section of the Basin and Range Province of the Intermontane Plateaus. The Sacramento Section is characterized by nearly level to rolling or steep limestone hills with intermittent drainageways. The soils are derived from limestones, sandstones, shales, and dolomites. The dominant soil orders in this MLRA are aridisols and mollisols. Aridisols are well developed soils that have a very low concentration of organic matter and form in an arid or semi-arid climate. In contrast, mollisols are fertile soils with high organic matter and a nutrient-enriched, thick surface. The soils in the MLRA are well to excessively drained and range from shallow (0 to 20 inches) to very deep (60 or more inches) with areas of dune land, gypsum land, and rock outcrop.

3.4.2 Soil Types and Limitations in Project Area

The project area contains 20 soil map units, each of which contain one or two components. Soil textures range from sands to clay loams. Most of the soils in the project area are deep to very deep, well-drained, and formed from alluvial or residual materials derived from sedimentary rocks. The soil series is the most specific category of the national soil classification system, commonly used to designate soil map units. Soil series describe soils that have similar chemistry, physical properties, and perform similarly for land use purposes. Following is a brief description of each of the soil series present within the project area.

- Reeves series: very deep, well drained, moderately permeable soil that formed in calcareous and gypsiferous fine textured alluvium derived from gypsum beds. These soils are on hillslopes, plateaus, and basin floors with slopes ranging from 0 to 9 percent. Reeves soils are moderate to highly saline.
- Kermit series: very deep, excessively drained soil that formed in eolian sands. Kermit soils are on sandy plains with slopes of 0 to 12 percent.
- Bippus series: very deep, well drained, moderately permeable soils that formed in loamy alluvial sediments of the Ogallala Formation of Miocene-Pliocene age. These soils are on nearly level to very gently sloping floodplains or draws with slopes of 0 to 2 percent.
- Berino series: very deep, well drained soil that formed in mixed alluvium, which has repeatedly been reworked by wind. These soils are on sandy plains, fan piedmonts, piedmont slopes, and valley floors with slopes of 0 to 7 percent.
- Simona series: shallow to very shallow, well drained soil that formed in calcareous sandy sediments over fractured indurated caliche. Simona soils are on upland plains, mesa tops, and low ridges and have slopes of 0 to 10 percent.
- Pajarito series: very deep, well drained soils that formed in sandy to moderately sandy mixed sediments from mixed sources. These soils are typically on plains, bajadas, and alluvial fans with slopes of 0 to 15 percent, dominantly 1 to 3 percent.
- Potter series: very deep, well drained, moderately slowly permeable soil that formed in calcareous sediments of fractured and highly weathered calcrete derived mainly from the Ogallala Formation of Miocene-Pliocene age. Potter soils are on very gently sloping to steep draws, scarps, or valley sides with slopes of 1 to 30 percent.
- Largo series: very deep, well drained soils that formed in loamy calcareous alluvium derived from redbed formations of Jurassic, Triassic, Permian and Pennsylvanian age. These soils are on channeled valley bottom terraces, alluvial fans and piedmont slopes of 0 to 5 percent. They have moderate to moderately slow permeability.
- Reagan series: very deep, well drained, moderately permeable calcareous soils that formed in calcareous loamy materials. These nearly level to gently sloping upland soils are on broad flats, filled valleys, and fans with slopes of 0 to 3 percent. Reagan soils are moderate to highly saline.
- Tonuco (very shallow to shallow), Cacique (moderately deep to a cemented layer), and Likes (very deep) series occur in the project area but to a lesser extent along with areas of dune land, gypsum land, rock land, mined land, and stony and rough broken land.

The soil map unit symbols, soils series and component names, slope range, acreage, and some key characteristics derived from the SSURGO database are listed in **Table 3.4-1**.

Soil characteristics such as susceptibility to erosion and the potential for revegetation are important to consider when planning for construction activities and stabilization of disturbed areas. These hazards or limitations for use are a function of many physical and chemical characteristics of each soil, in combination with the climate and vegetation. **Table 3.4-2** and **Table 3.4-3** summarize important soil characteristics to be considered when evaluating the effects of surface-disturbing activities. Explanations of the meanings of each column follow the table.

Table 3.4-1 Relevant Characteristics of Soils in the Project Area

MUID[1]	Map Unit Name	Component Name	Comp %	Slope	Wind Erosion[2]	Water Erosion[3]	Topsoil Suitability	Limiting Factors[4]	Map Unit Acres
BA	Berino loamy fine sand, 0 to 3 percent slopes	Berino	100	0-3	Severe	Not Severe	Good	C, OM, E	575
BB	Berino complex, 0 to 3 percent slopes, eroded	Berino	60	0-3	Severe	Not Severe	Good	C, OM, E	2,435
BB	Berino complex, 0 to 3 percent slopes, eroded	Pajarito	25	0-3	Severe	Not Severe	Fair	C, OM, E	
CA	Cacique loamy sand, 0 to 3 percent slopes, eroded	Cacique	100	0-3	Severe	Not Severe	Fair	CP, D, OM, E	256
ML	Mined land	Mined land	100	0-50	N/A	N/A	Not rated	NR	1,109
GA	Gypsum land	Gypsum land	100	0-75	N/A	N/A	Not rated	NR	2,065
KM	Kermit-Berino fine sands, 0 to 3 percent slopes	Berino	35	0-3	Severe	Not Severe	Good	C, OM, E	7,122
KM	Kermit-Berino fine sands, 0 to 3 percent slopes	Kermit	50	0-3	Severe	Not Severe	Poor	D, OM, R, SD, E	
LA	Largo loam, 1 to 5 percent slopes	Largo	100	1-5	Moderate	Severe	Good	OM, E	1,331
LS	Likes loamy fine sand, 1 to 5 percent slopes	Likes	100	1-5	Severe	Not Severe	Fair	D, OM, SD, E	73
PA	Pajarito loamy fine sand, 0 to 3 percent slopes, eroded	Pajarito	100	0-3	Severe	Not Severe	Good	OM, E	1,498
PD	Pajarito-Dune land complex, 0 to 3 percent slopes	Dune land	45	-		Not Severe	Not rated	NR, OM	
PD	Pajarito-Dune land complex, 0 to 3 percent slopes	Pajarito	45	0-3	Moderate	Not Severe	Good	OM	1,609
PS	Potter-Simona complex, 5 to 25 percent slopes	Potter	80	5-25	Low	Not Severe	Poor	C, CP, D, OM, R, S	1,776
PS	Potter-Simona complex, 5 to 25 percent slopes	Simona	15	5-10	Moderate	Not Severe	Poor	CP, D, OM, R	
RA	Reagan loam, 0 to 3 percent slopes	Reagan	100	0-3	Low	Severe	Fair	C, OM, Na, E	284
RG	Reeves-Gypsum land complex, 0 to 3 percent slopes	Gypsum land	30	0-3	N/A	Not Severe	Not rated	NR	
RG	Reeves-Gypsum land complex, 0 to 3 percent slopes	Reeves	55	0-1	Moderate	Severe	Fair	C, D, OM, Na, E	13,021
RO	Rock land	Rock land	100	-	N/A	Not Severe	Not rated	NR	439
SA	Simona sandy loam, 0 to 3 percent slopes	Simona	95	0-3	Moderate	Severe	Poor	CP, D, OM	169

Table 3.4-1 Relevant Characteristics of Soils in the Project Area

MUID[1]	Map Unit Name	Component Name	Comp %	Slope	Wind Erosion[2]	Water Erosion[3]	Topsoil Suitability	Limiting Factors[4]	Map Unit Acres
SG	Simona gravelly fine sandy loam, 0 to 3 percent slopes	Simona	95	0-3	Moderate	Not Severe	Poor	CP, D, OM, R	218
SM	Simona-Bippus complex, 0 to 5 percent slopes	Bippus	30	0-5	Moderate	Not Severe	Fair	C, CL	
SM	Simona-Bippus complex, 0 to 5 percent slopes	Simona	55	0-3	Moderate	Not Severe	Poor	CP, D, OM, R	2,881
SR	Stony and Rough broken land	Stony and rough broken land	100	-	N/A	N/A	Not rated	NR	836
TF	Tonuco loamy fine sand, 0 to 3 percent slopes	Tonuco	100	0-3	Severe	Not Severe	Poor	CP, D, OM, SD, E	402
TN	Tonuco loamy fine sand, 0 to 3 percent slopes, eroded	Tonuco	100	0-3	Severe	Not Severe	Poor	CP, D, OM, SD, E	356
								Total Acres	38,453

[1] Map Unit Identification.

[2] Wind erosion hazard class based on Wind Erodibility Group Rating.

[3] Water erosion potential determined by Kw >0.28.

[4] Limiting Factors:

BR = Depth to Bedrock
C = High Carbonate Content
CL = Too Clayey
CP = Cemented Pan
D = Droughty
E = Erosion
NA = Salinity
NR = Not Rated
OM = Low Organic Matter
R = Rock Fragments
S = Slope
SD = Too Sandy

Source: NRCS 2008a.

Table 3.4-2 Summary of Soil Limitations in the Project Area

Soil Limitation	Good (ac./%)		Fair (ac./%)		Poor (ac./%)		Not Rated (ac./%)	
Wind Erosion	1,705	4	3,806	10	11,284	33	17,570	51
Water Erosion	30,356	79	—	0	—	0	4,009	12
Road Construction	9,907	26	14,516	38	864	3	9,078	26
Shallow Excavations	7,920	21	6,301	18	11,066	32	9,078	26
Potential for Revegetation	—	0	2,779	8	23,232	68	8,354	24
Topsoil Suitability	8,082	21	9,248	27	7,958	23	9,078	26

Source: NRCS 2008a.

Table 3.4-3 Proposed and Existing Pipeline Corridors

Soil Limitation	Good (ac./%)		Fair (ac./%)		Poor (ac./%)		Not Rated (ac./%)	
Existing Caprock Pipelines								
Wind Erosion	-	0%	8	1%	139	21%	168	25%
Water Erosion	316	47%	-	0%	-	0%	-	0%
Road Construction	244	37%	127	19%	15	2%	13	2%
Shallow Excavations	10	2%	73	11%	251	38%	3	<1%
Potential for Revegetation	-	0%	2	<1	333	50%	3	<1%
Topsoil Suitability	-	0%	46	7%	36	5%	234	35%
Proposed Pipeline								
Wind Erosion	<1	<1	119	18%	102	15%	2	<1
Water Erosion	220	33%	-	0%	-	0%	4	1%
Road Construction	24	4%	10	2%	-	0%	2	<1
Shallow Excavations	7	1%	49	7%	167	25%	2	<1
Potential for Revegetation	-	0%	3	<1	218	33%	4	1%
Topsoil Suitability	31	5%	20	3%	171	26%	2	<1

Water erosion is the detachment and movement of soil by water. Natural erosion rates depend on inherent soil properties, slope, soil cover, and climate. Approximately 23 percent of the soils within the project area are highly erodible to water. Wind erosion is the physical wearing of the earth's surface by wind. Wind erosion removes and redistributes soil. Small blowout areas may be associated with adjacent areas of deposition at the base of plants or behind obstacles, such as rocks, shrubs, fence rows, and roadbanks (Soil Quality Institute 2001). Wind erodible soils comprise approximately 29 percent of the project area. The occurrence of wind erodible soils is illustrated in **Figure 3.4-1**.

Soil limitations within the project area related to road construction and use include soil strength issues, slope, flooding frequency, soil stickiness, and sand content. Only 2 percent of the project area would have potential issues related to flooding. Approximately 11 percent of the project area is identified as having high sand content and 18 percent of the project area has slopes in the range of 6 to 12 percent. About 22 percent of the project area has soils with stickiness limitations. Approximately 27 percent of the project area has potential soil strength limitations. In total, 64 percent of the project area has at least one soil limitation for construction of natural surface roads.

Soil limitations within the study area related to shallow excavations include cutback caving, flooding, large stones, slope, and a cemented pan within the soil profile. Only 2 percent of the project area would have potential issues related to flooding. Approximately 4 percent of the soils in the project area have a thick cemented pan (40 to 60 inches thick) while 6 percent have a thin cemented pan (20 to 40 inches thick). Slopes of 8 to 15 percent occur in approximately 17 percent of the project area. Approximately 22 percent of project area soils have large stones in the soil profile. Approximately 47 percent of soils in the project area have limitations associated with cutback caving. In total, 67 percent of the project area has at least one soil limitation related to shallow excavations. The distribution of soils with limitations associated with shallow excavation in the project area is illustrated in **Figure 3.4-2**. Approximately 65 percent of the existing pipeline corridors have poor soil limitations related to shallow excavations. However, the soil profile in this area was previously disturbed by prior excavation. The original soil profile may have been modified such that the limitations have been reduced or removed in relation to large stones or a cemented pan. Approximately 25 percent of the proposed new Caprock pipeline corridor has poor soil limitations related to shallow excavations.

Topsoil suitability describes soil material used to cover an area for the establishment and maintenance of adapted vegetation. Soil properties that are used to rate the soil as topsoil are those that affect plant growth; the ease of excavation, loading, and spreading; and the reclamation of the borrow area. The physical and chemical soil properties and qualities that influence plant growth include the presence of toxic substances, soil reaction, and those properties that are inferred from the soil texture, such as the available water capacity, and fertility. The properties that influence the ease of excavation, loading, and spreading are the amount of rock fragments, slope, depth to the water table, soil texture, and thickness of suitable material. The properties that influence the reclamation of the borrow area are the slope, depth to the water table, amount of rock fragments, depth to rock, and the presence of toxic material. The existing and proposed new Caprock pipeline corridors would require the salvage and replacement of topsoil. Approximately 9 percent of the existing pipeline corridors contain soils with poor topsoil suitability. Approximately 26 percent of the proposed new Caprock pipeline corridor contain soils with poor topsoil suitability.

Soils with low revegetation potential have chemical characteristics such as high salts, sodium, or pH that may limit plant growth. Saline soils affect plant uptake of water and sodic soils and often have drainage limitations. In addition, the success of stabilization and restoration efforts in these areas may be limited unless additional treatments and practices are employed to offset the adverse physical and chemical characteristics of the soils. The distribution of soils with characteristics that limit revegetation within the project area is displayed in **Figure 3.4-3**.

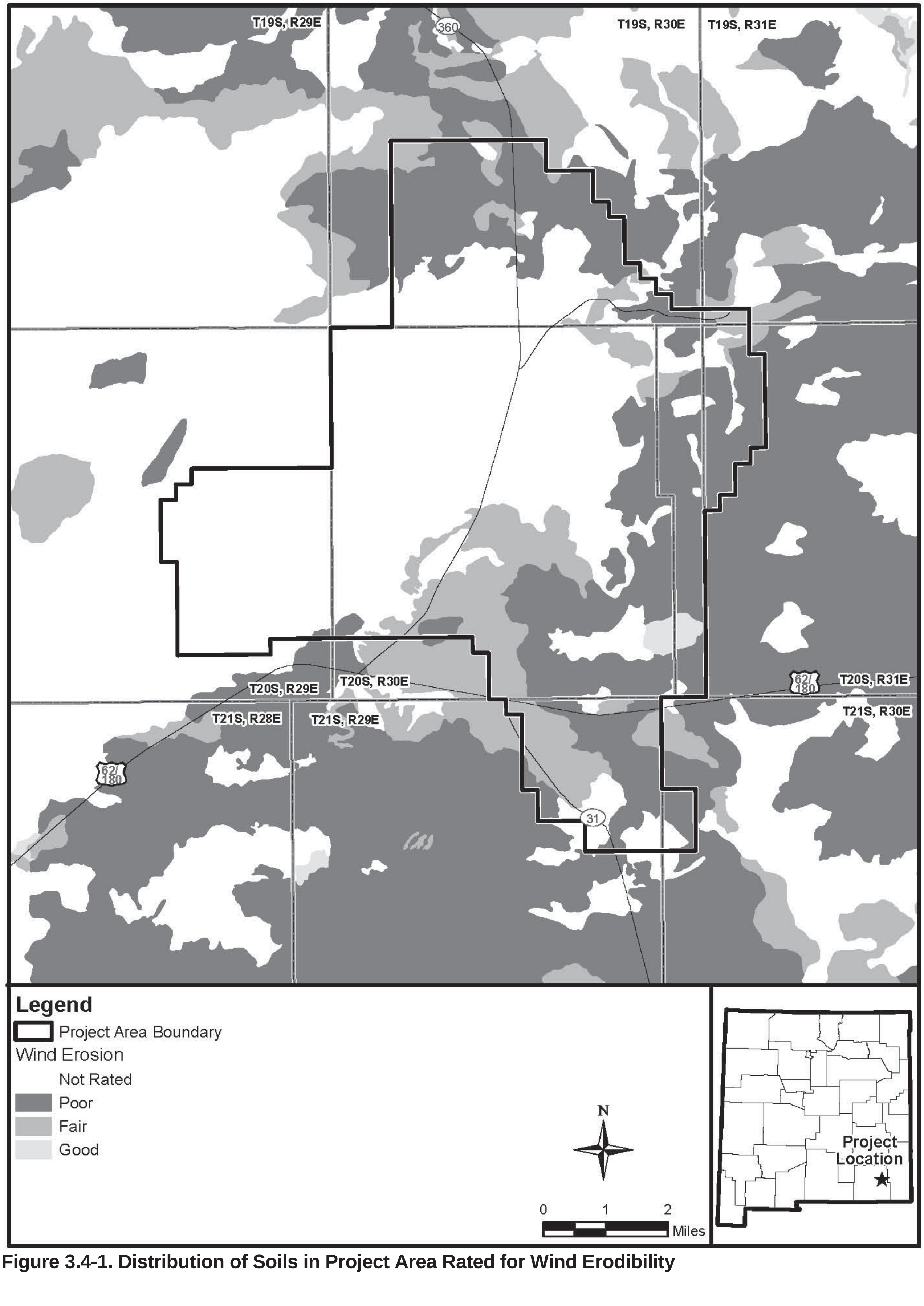


Figure 3.4-1. Distribution of Soils in Project Area Rated for Wind Erodibility

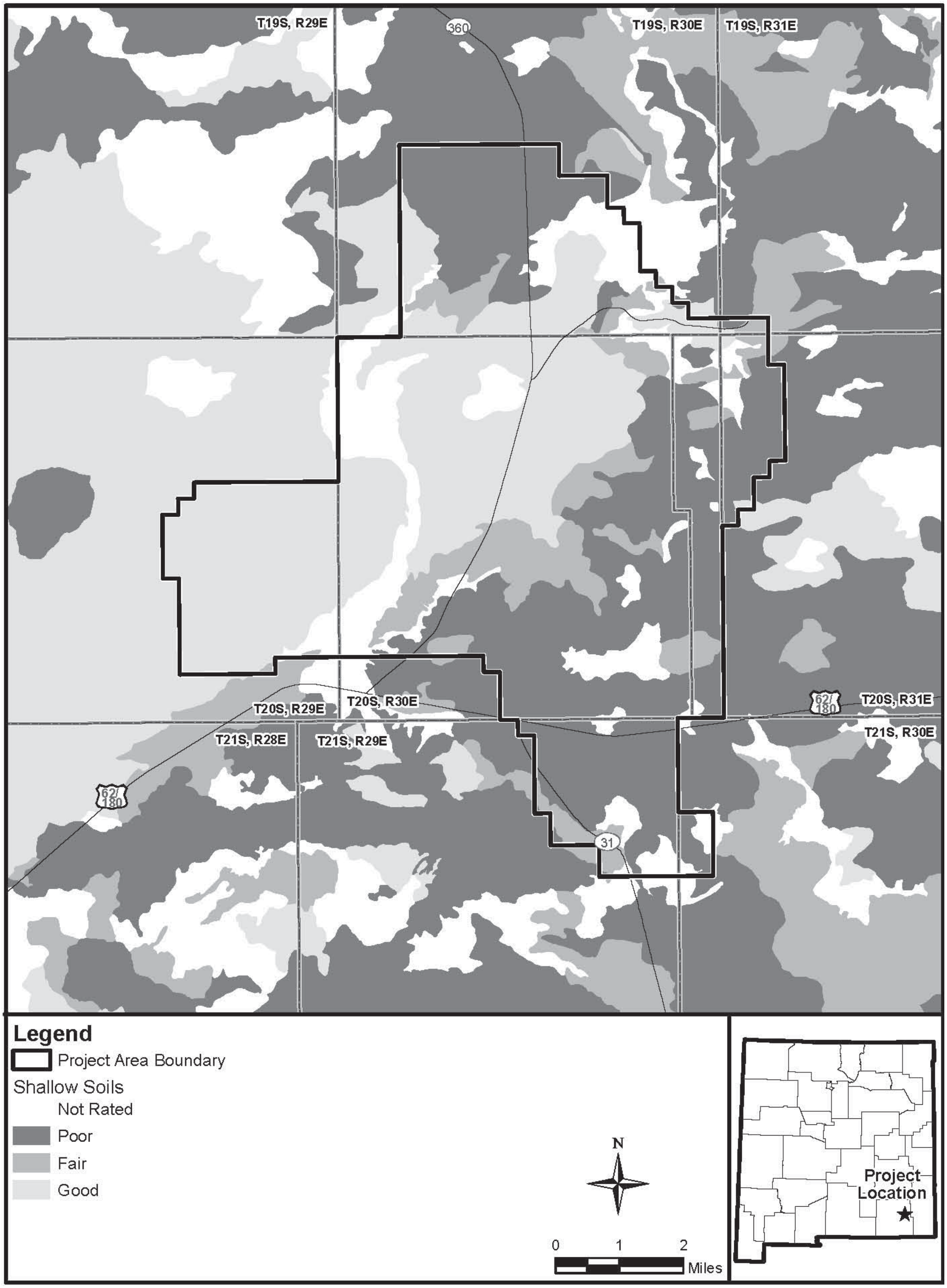


Figure 3.4-2. Distribution of Shallow Soils in Project Area

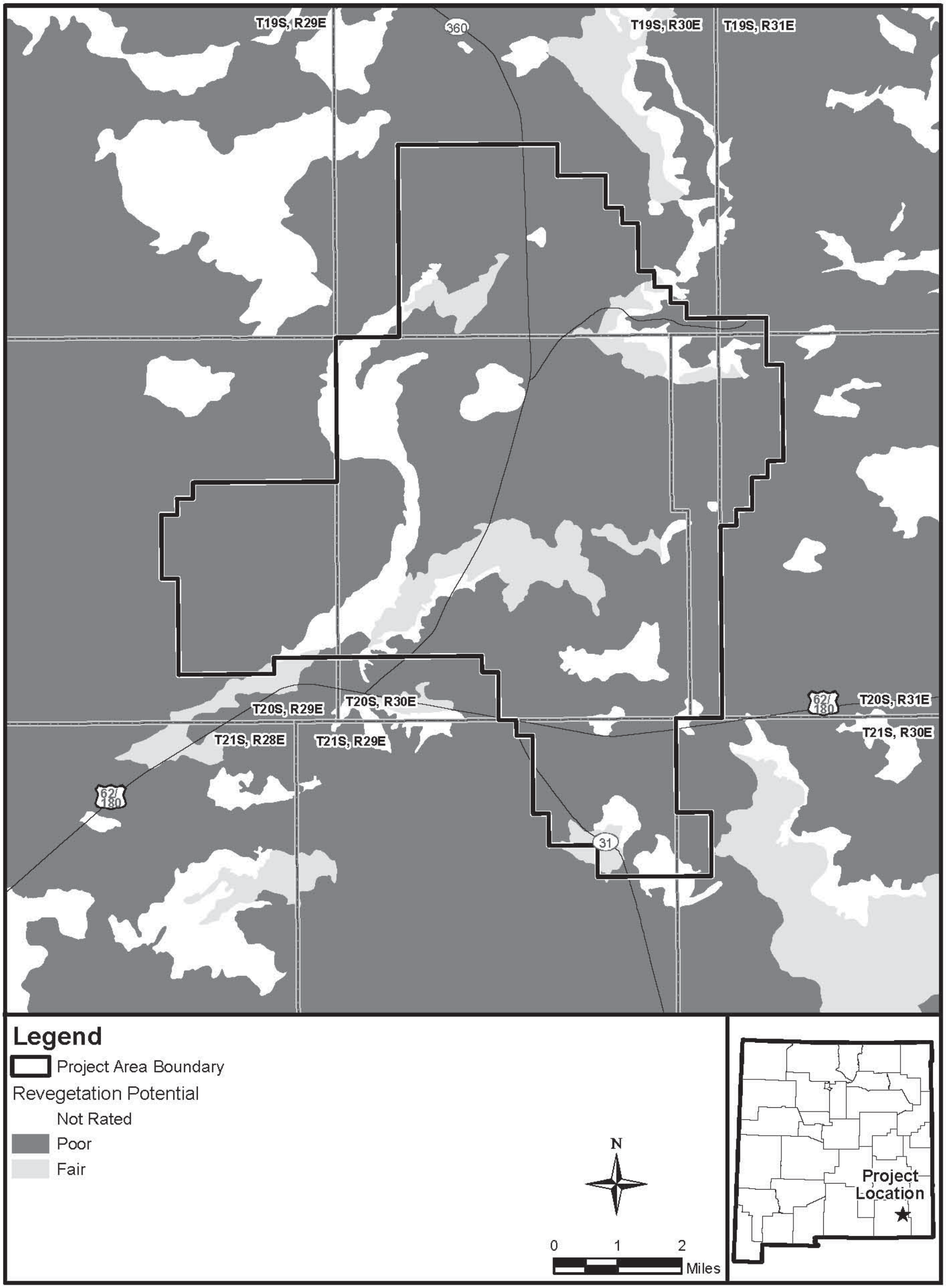


Figure 3.4-3. Distribution of Soils in Project Area by Revegetation Potential

Prime farmland is land that has the best combination of physical and chemical characteristics for producing crops and is available for these uses. It has the combination of soil properties, growing season, and moisture supply needed to produce sustained high yields of crops in an economic manner if it is treated and managed according to acceptable farming methods. These soils have the capability to be prime farmland, but may have not yet been developed for irrigated agriculture uses. No prime farmland occurs within the project area.

Hydric soils are soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. These soils are commonly associated with floodplains, lake plains, basin plains, riparian areas, wetlands, springs, and seeps. No hydric soils are mapped within the project area. However, due to the scale of mapping, small areas of hydric soils may not be captured.

The project area has been previously disturbed by mining and oil and gas activities. Environmental reports (OCD 2009a) indicate that spills of saline produced water have occurred within the project area, which may have increased the extent of saline soils in the surface horizon. However, this increased extent of saline soils may not be accurately quantified by the current soil survey.

3.5 Air Quality

Air quality in a given location is defined by pollutant concentrations in the atmosphere and generally is expressed in units of parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). Visibility also is a measure of ambient air quality. Regional air quality is affected by natural events such as windstorms and wildfires, and larger emissions generating sources such as power plants, large manufacturing facilities, and transportation activities in urban corridors. Natural events generally are short lived, lasting from several hours to several weeks.

Both long-term climatic factors and short-term weather fluctuations are considered part of the air quality resource because they control dispersion and affect ambient air concentrations. The physical effects of air quality depend on the characteristics of the receptors (human or environmental) and the type, amount, and duration of exposure. This section describes the existing air quality resource of the region and the applicable air regulations that would apply to the Proposed Action and alternatives.

3.5.1 Regulatory Framework

The CAA of 1970 (42 USC 7401 et seq.) as amended in 1977 and 1990 is the basic federal statute governing air pollution. Provisions of the CAA that are relevant to the proposed HB In-Situ Solution Mine Project include:

- National Ambient Air Quality Standards (NAAQS)
- Prevention of Significant Deterioration (PSD)
- Nonattainment New Source Review and General Conformity Requirements
- New Source Performance Standards (NSPS)
- Maximum Achievable Control Technology Standards
- Federal Operating Permits Program

In addition to federal regulations, the CAA provides states with the authority to regulate air quality within state boundaries.

3.5.1.1 National and New Mexico Ambient Air Quality Standards

The federal CAA and the amendments of 1990 require all states to control air pollution emission sources so that NAAQS are met and maintained, enforced by the USEPA (USEPA 2004). The CAA directs the USEPA to delegate primary responsibility for air pollution control to state governments. The State of New Mexico adopted the NAAQS as state air quality standards and has added more stringent ambient air quality standards applicable only to New Mexico.

The NAAQS establish maximum acceptable concentrations for oxides of nitrogen (NO_X), CO, sulfur dioxide (SO_2), particulate matter (PM) with an aerodynamic diameter less than or equal to 10 microns (PM_{10}), PM with an aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$), ozone (O_3), and lead (Pb). These pollutants are known as criteria pollutants. Primary standards set limits to protect public health, including the health of “sensitive” populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against visibility impairment, and against damage to animals, crops, other vegetation, and buildings. These standards represent the maximum allowable atmospheric concentrations that may occur without jeopardizing public health and welfare, and include a reasonable margin of safety. An area that does not meet the NAAQS is designated as a nonattainment area on a pollutant-by-pollutant basis. A list of the criteria pollutants regulated under the CAA for which specific concentration levels have been established, their currently applicable NAAQS, and State of New Mexico Ambient Air Quality Standards (NMAAQS) are listed in **Table 3.5-1**.

Table 3.5-1 National and New Mexico Ambient Air Quality Standards

Pollutant	Averaging Period	Significance Level[D] (µg/m^3)	NAAQS	NMAAQS
CO	8-hour	500	9 ppm (10 mg/m^3)[1]	8.7 ppm
	1-hour	2,000	35 ppm (40mg/m^3)[1]	13.1 ppm
Hydrogen sulfide (H_2S)	1-hour	1.0	—	0.010 ppm[A,1]
	1/2-hour	5.0	—	0.100 ppm[B]
	1/2-hour	5.0	—	0.030 ppm[C]
Pb	Rolling 3-month	—	0.15 µg/m^3	—
NO_2	Annual	1.0	0.053 ppm (100 µg/m^3)	0.050 ppm
	24-hour	5.0	—	0.10 ppm
	1-hour	5.0	0.100 ppm[2]	—
O_3	1-hour	—	0.12 ppm[3]	—
	8-hour	—	0.075 ppm[4]	—
$PM_{2.5}$	Annual	0.30	15 µg/m[3, 5]	—
	24-hour	1.17	35 µg/m[3, 6]	—
PM_{10}	Annual	1.0	revoked[7]	—
	24-hour	5.0	150 µg/m[3, 1]	—

Table 3.5-1 National and New Mexico Ambient Air Quality Standards

Pollutant	Averaging Period	Significance Level[D] ($\mu g/m^3$)	NAAQS	NMAAQS
Particulates (total suspended particulates [TSP])	Annual Geometric Mean	1.0	—	60 $\mu g/m^3$
	30-day	—	—	90 $\mu g/m^3$
	7-day	—	—	110 $\mu g/m^3$
	24-hour	5.0	—	150 $\mu g/m^3$
Sulfur Dioxide (SO_2)	Annual	1.0	Revoked[8]	0.02 ppm
	24-hour	5.0	Revoked[8]	0.10 ppm
	3-hour	25.0	0.50 ppm	—
	1-hour	—	0.075 ppm[9]	—

[A] For the state, except for the Pecos-Permian Basin Intrastate Air Quality Control Region (AQCR).

[B] For the Pecos-Permian Basin Intrastate AQCR.

[C] For within 5 miles of the corporate limits of municipalities within the Pecos-Permian Basin AQCR.

[D] Significance levels are listed in 20.2.72.500 NMAC.

[1] Not to be exceeded more than once per year.

[2] The 3-year average of the 98th percentile of the daily maximum 1-hour average is not to exceed this standard.

[3] (a) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is <= 1, as determined by Appendix H.
(b) The 1-hour NAAQS will no longer apply to an area 1 year after the effective date of the designation of that area for the 8-hour ozone NAAQS. The effective designation date for most areas is June 15, 2004 (40 CFR 50.9; see *Federal Register* of April 30, 2004 [69 FR 23996]).

[4] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm.

[5] To attain this standard, the 3-year average of the annual arithmetic mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 $\mu g/m^3$.

[6] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 $\mu g/m^3$.

[7] The annual PM_{10} NAAQS of 50 $\mu g/m^3$ was revoked by USEPA on September 21, 2006; FR Volume 71, Number 200, 10/17/06.

[8] The 24-hour and annual SO_2 NAAQS was revoked by USEPA on June 22, 2010; 75FR35520.

[9] The 3-year average of the annual 99th percentile of the 1-hour daily maximum must not exceed this standard.

Source: New Mexico Environment Department-Air Quality Bureau (NMED-AQB) 2010a; USEPA 2010a.

There are eight Air Quality Control Regions (AQCRs) designated in New Mexico. The proposed project is located in Eddy County, which is part of the Pecos-Permian Basin ACQR 155. When the minor source baseline date has been triggered in AQCR 155, an increment analysis is required if the modeling significance levels for a designated pollutant are exceeded.

3.5.1.2 New Source Review

New Source Review (NSR) requires stationary sources of air pollution to get permits before starting construction. NSR also is referred to as construction permitting or pre-construction permitting. There are three types of NSR permitting requirements that a source may need to meet. The three types of NSR requirements are:

- PSD permits that are required for new major sources or existing major sources making a major modification in an attainment area
- Nonattainment NSR permits that are required for new major sources or existing major sources making a major modification in a nonattainment area
- Minor source (non-PSD) permits.

3.5.1.3 Prevention of Significant Deterioration

PSD regulations apply to proposed new or modified sources in an attainment area that have the potential to emit criteria pollutants in excess of predetermined de minimis values (40 CFR Part 52). PSD regulations restrict the degree of ambient air quality deterioration allowed. Allowable deterioration to air quality can be expressed as the incremental increase to ambient concentrations of criteria pollutants, or PSD increment. Increments for criteria pollutants are based on the PSD classification of the area. Class I designations allow the lowest amount of permissible deterioration by precluding development near designated areas. Class II areas are designed to allow for moderate, controlled growth, and Class III areas allow for heavy industrial use. However, no Class III areas have yet been defined in the United States.

Federal PSD Class I areas, which include certain national wilderness areas, national memorial parks, and national parks, are afforded the highest level of protection. Ambient air quality criteria that apply within Class I areas are the most stringent and include the regulation of air quality related values (AQRVs). Federal Land Managers (FLMs) are responsible for the management of PSD Class I areas. The nearest Class I areas are Carlsbad Caverns National Park (NP) approximately 32 miles (52 kilometer [km]) and the Guadalupe Mountains NP about 60 miles (97 km) southwest of the project area.

PSD Increment

A project's PSD increment consumption is typically determined through the use of an air quality dispersion model. Intrepid's facilities within the project area are classified as an existing source. Therefore, air dispersion modeling is required to demonstrate compliance with NAAQS and PSD increments as part of the air quality permit application to the NMED. The allowable PSD increments for Class I and Class II areas are presented in **Table 3.5-2**.

Air Quality Related Values

In addition to the more stringent PSD increments, Class I areas are protected by the FLMs who manage AQRVs. AQRVs include the potential air pollutant effects on visibility, atmospheric deposition, and the acidification of sensitive lakes and streams. They are applied to Class I areas, sensitive Class II areas, and set the level of acceptable change for each value. AQRVs reflect the land management agency's policy and are not legally enforceable standards.

Visibility

Visibility can be defined as the distance one can see (a standard visual range) or by the ability to perceive changes in color, contrast, and detail. The most commonly used reference for measuring visibility is the deciview, which is defined as a change in visibility that is perceptible to the average person.

Table 3.5-2 Class I and Class II Area PSD Increments

PSD Class	Pollutant	Allowable Increment (µg/m^3)		
		Annual Arithmetic Mean	24-hour Maximum	3-hour Maximum
Class I	NO_2	2.5	-	-
	SO_2	2	5	25
	PM_{10}	4	8	-
Class II	NO_2	25	-	-
	SO_2	20	91	512
	PM_{10}	17	30	-

[1] Modeled NO_X values were adjusted with an ARM of 0.75 to determine the NO_2 impacts. Values in parentheses represent the modeled NO_X values.

[2] The modeled value of 5.02346 is for the annual averaging period and the modeled value of 17.55345 is for the 24-hour averaging period.

N/A – Not available as Class I increment modeling and Class II SO_2 increment modeling was not required.

Source: Intrepid Potash 2010b.

Regional haze is visibility impairment that is caused by the cumulative air pollutant emissions from numerous sources over a wide geographic area. Scattering and absorption of light by fine pollutant particles results in the development of regional haze and consequent visibility reduction. Some particles and gases scatter light while others absorb light. The primary cause of regional haze in many parts of the country is light scattering from fine particles (i.e., $PM_{2.5}$) in the atmosphere. Coarse particles between $PM_{2.5}$ and PM_{10} can contribute to light extinction. Each of these components of regional haze can be naturally occurring or the result of human activity. The natural levels of these components may result in some visibility impairment, even in the absence of human influences, and will vary with season, weather, and geography (USEPA 2003).

The primary contributors to the reduction of visibility at Guadalupe Mountain NP, in order of decreasing contribution, are sulfates, soil or crustal material, and organic compounds. The monthly average contribution of sulfates to visibility reduction varies between 30 percent to 60 percent. The monthly average contribution of soil to visibility reduction varies between 10 percent to 40 percent. The highest reduction in visibility tends to occur in the month of September, with the clearest days occurring in winter months (IMPROVE undated). This is also representative of the effects on visibility at Carlsbad Caverns NP.

Atmospheric Deposition and Acid Neutralization Capacity

Atmospheric deposition, wet and dry, is the process whereby airborne particles and gases are removed from the atmosphere and deposited on the earth's surface.

Wet deposition is defined as the portion of atmospheric deposition contained in precipitation. Wet deposition is monitored by the National Atmospheric Deposition Program, a consortium of a large number of federal, regional, state agencies, and academic institutions.

Dry deposition is the fraction of atmosphere deposited in dry weather through processes such as settling, impaction, and adsorption. The factors that influence dry deposition include whether the substance is in gaseous or particulate form, the solubility of the species in water, the amount of precipitation in the region, terrain, and type of surface cover.

Mixing of specific compounds in the atmosphere can lead to acid deposition. Acidic wet deposition is called acid precipitation or, more commonly, acid rain. Acidity in precipitation is measured by collecting samples of rain and measuring its pH, which is lower when acidic compounds are present. "Clean" or unpolluted rain has a slightly acidic pH of 5.6, because carbon dioxide (CO_2) and water in the air react together to form carbonic acid, a weak acid.

The National Atmospheric Deposition Program (NADP) monitors the atmospheric deposition of air containments to the ground surface via both wet deposition and dry deposition processes. The NADP has a monitoring site at Guadalupe Mountain NP. In general, the precipitation at the Guadalupe site has generally experienced an increase in pH levels (equivalent to decreasing acidity) since monitoring was initiated in 1984. Changes to the inputs of nutrients, such as ammonium, can have effects to ecosystems, particularly in areas that have adapted to low levels of nutrients, such as desert environments (NADP 2011).

3.5.1.4 Nonattainment New Source Review and Conformity for General Federal Actions

While new emissions sources in attainment areas are required to follow PSD regulations, Nonattainment New Source Review is required for major stationary sources locating or expanding in nonattainment areas. According to Section 176 of the CAA (40 CFR 51.853), a federal agency must make a conformity determination in the approval of a project with air emissions that exceed specified thresholds in nonattainment and/or maintenance areas. This General Conformity Rule ensures that the actions taken by federal agencies in non-attainment and maintenance areas meet national standards for air quality and/or do not cause further degradation to air quality that would be inconsistent with the attainment and maintenance of ambient air quality standards. The proposed project is not located within a non-attainment or maintenance area identified by NMED-AQB or USEPA; therefore, a general conformity analysis would not be required for evaluating impacts to air quality before implementing the proposed project.

3.5.1.5 New Source Performance Standards

Under Section 111 of the CAA, USEPA is authorized to establish NSPS, which impose federal technology-based requirements on new, modified and reconstructed stationary sources of pollution. USEPA has developed NSPS for numerous source categories, which are published at 40 CFR Part 60. Although USEPA has responsibility for implementing and enforcing the NSPS regulations, Section 111(c) authorizes USEPA to delegate primary implementation and enforcement responsibility to state and local agencies that develop and submit acceptable procedures for implementing and enforcing the NSPS.

NSPS standards define emission limitations that would be applicable to a particular source group. The NSPS potentially applicable to the project include the following subparts of 40 CFR Part 60:

- Subpart A—General Provisions
- Subpart OOO—Standards of Performance for Nonmetallic Mineral Processing Plants.

<u>Subpart A— General Provisions</u>

Certain provisions of Subpart A apply to the owner or operator of any stationary source subject to a NSPS. Provisions of Subpart A potentially would apply depending on the applicability of emission generating units to be installed as part of the proposed new facilities.

<u>Subpart OOO—Nonmetallic Mineral Processing Plants</u>

Subpart OOO applies to certain activities located at portable or fixed nonmetallic mineral processing plants, including crushers, grinding mills, screening operations, bucket elevators, belt conveyors, storage bins, and enclosed truck loading stations. If a nonmetallic mineral is processed by an affected facility as part of the proposed project, the requirements of Subpart OOO would apply to material handling activities if the equipment is manufactured after the applicability date in the rule. The requirements of Subpart OOO include an emission limit of 0.014 grains per dry standard cubic foot and 7 percent opacity on stack emissions with capture systems, 7 percent opacity from fugitive emissions from affected facilities, and 12 percent opacity from fugitive emissions from crushers. Compliance is determined using USEPA Reference Method 5 or Method 17 for stack emissions and Reference Method 9 for opacity determinations. Recordkeeping and reporting must follow the requirements contained in CAA §60.676.

3.5.1.6 Maximum Achievable Control Technology Standards

The CAA requires USEPA to regulate toxic air pollutants from large industrial facilities and to develop standards for controlling the emissions of air toxics from sources in an industry group (or source categories). Under the National Emission Standards for Hazardous Air Pollutants (HAPs), the USEPA promulgated standards pursuant to Section 112 of the 1990 CAA Amendments. The rules are provided in 40 CFR 63. The standards for these sources are known as Maximum Achievable Control Technology (MACT) standards, and are based on emissions levels that are already being achieved by the better-controlled and lower-emitting sources in an industry.

USEPA is required to identify categories of industrial sources that emit one or more of the listed 187 toxic air pollutants. These industrial categories include both major and area sources, including those listed below:

- Major sources of air toxics that emit 10 tons per year (tpy) of a single air toxic or 25 tpy of a combination of air toxics.
- Area sources release smaller amounts of toxic pollutants into the air—less than 10 tpy of a single air toxic, or less than 25 tpy of a combination of air toxics. Although emissions from individual area sources are often relatively small, cumulatively their emissions can be of concern (USEPA 2009).
- In the Integrated Urban Air Toxics Strategy, the USEPA identifies the toxic air pollutants that pose a health threat in the largest number of urban areas and regulates sufficient area source categories to ensure that the emissions of these “urban” air toxics are reduced.

The proposed project will be a minor source of HAPs, and there are currently no applicable area source MACT standards that apply to the proposed project.

3.5.1.7 Federal Operating Permits Program

All major stationary sources (primarily industrial facilities and large commercial operations) emitting certain air pollutants are required to obtain Title V operating permits under the Federal Operating Permits Program outlined in 40 CFR Part 70 of the CAA. Whether a source meets the definition of “major” depends on the type and amount of air pollutants it emits and, to some degree, on the overall air quality in its vicinity. Generally, major sources include stationary facilities that emit 100 tons or more per year of a regulated air pollutant including compounds such as CO, PM_{10}, $PM_{2.5}$, volatile organics, SO_2, and NO_X. Major sources of toxic air pollutants (i.e., any source that emits more than 10 tpy of an individual toxic air pollutant or more than 25 tpy of any combination of toxic air pollutants) are also covered under the Federal Operating Permits Program.

The proposed project will be a minor source with respect to the Federal Operating Permits Program; therefore, a Title V operating permit will not be required.

3.5.1.8 Hazardous Air Pollutants

HAPs are those pollutants known or suspected to cause cancer or other serious health effects, such as damage to reproduction, birth defects, or adverse environmental impacts. The USEPA has classified

187 air pollutants as HAPs, including formaldehyde, benzene, toluene, ethylbenzene, and xylenes (BTEX) compounds, and normal hexane (n-hexane).

The largest sources of HAPs in Eddy County come from oil and gas operations. These existing sources of HAPs include emission sources such as compressor engines (benzene, ethylbenzene, formaldehyde, toluene, xylenes, and hexane) and glycol dehydrators (benzene, toluene, ethylbenzene, H_2S, and xylenes). Neither the State of New Mexico nor the USEPA have established ambient air quality standards for HAPs; however, the 1990 CAA amendments established a program to regulate emissions of 189 HAPs from particular industrial sources. The Act required the USEPA to regulate emissions of these HAPs by developing and promulgating technology-based standards based on the best-performing similar facilities in operation. The NESHAP established by USEPA are part of the MACT standards. MACT standards are designed to reduce HAP emissions to a maximum achievable degree, taking into consideration the cost of reductions and other factors.

The criteria used by the USEPA to assess HAP impacts are reference concentrations (RfC) for chronic inhalation exposure and Reference Exposure Levels (RELs) for acute inhalation exposures. The RfC represents the maximum concentration at which no appreciable risk of harmful health effects would occur with the human population, including sensitive groups. The REL is the maximum acute concentration (1-hour average) for which no adverse health effects would occur within the human population. The levels of HAPs that require modeling in New Mexico are the Title V major source thresholds of 10 tpy for any HAPs and 25 tpy for total HAPs, regulated by NMED-AQB under 20.2.70 NMAC.

The NMED-AQB developed criteria for use in evaluating potential health and environmental impacts and obtaining more detailed information during the air permitting process. The NMED-AQB adopted Occupational Exposure Level (OEL) based upon threshold values developed by the American Conference of Governmental Industrial Hygienists (ACGIH) as guidelines for potential toxic emissions of permitted facilities. The reference concentrations and levels of toxicity for screening HAPs that are commonly used for HAP analyses are listed in **Table 3.5-3**. If air quality analyses show that the maximum 8-hour average concentration of all toxics is less than 1 percent of the OEL for that HAP, then the analysis of that toxic pollutant is determined to be complete for New Mexico (NMED-AQB 2010b).

Table 3.5-3 Selected Hazardous Air Pollutants Reference and Screening Levels

Hazardous Air Pollutant	Reference Exposure Level (1-hour average) (μg/m^3)	Reference Concentration (annual average) (μg/m^3)	Toxic Screening Level (acute exposure) (μg/m^3)
Benzene[1]	1,300	30	53
Toluene[1]	37,000	400	6,280
Ethylbenzene[1]	350,000	1,000	14,473
Xylenes[1]	22,000	100	14,473
n-Hexane[1]	390,000	200	5,875
Formaldehyde[2]	94	9.8	37

[1] Toxic screening level (TSL) level from 24-hour averaging time.
[2] TSL level from 1-hour averaging time.
Source: USEPA 2009.

3.5.2 Regional Air Quality

Most of the current emission sources in the region are oil and gas facilities and mining locations. There are fugitive dust sources associated with these facilities, construction activities, and from roadways.

Existing disturbance within the project area is approximately 4,822 acres or 12.5 % (BLM 2010b). Principal facility sources of criteria pollutants in Eddy County, and the estimated amounts emitted in 2002 (the last year reported by USEPA) are indicated in **Table 3.5-4**. Updated combined air emissions information for Chaves, Eddy, and Lea counties can be found in the Southeast New Mexico Inventory of Air Pollutant Emissions and Cumulative Air Impact Analysis 2007 (BLM 2011).

Table 3.5-4 Eddy County 2002 Principal Source Facility Criteria Pollutant Emissions

Pollutant Emissions (tpy)						Facility	Industry SIC
CO	NO_X	PM_{10}	$PM_{2.5}$	SO_2	VOC		
67.7	25.1	223.0	223.0	NA	NA	Potash Mine & Mill	1474 - Potash Soda & Borate Minerals
301.0	919.0	1.9	1.9	838.0	52.6	Artesia Gas Plant	1321 - Natural Gas Liquids
91.3	604.0	2.38	2.38	0.18	7.2	Pecos River Compressor Station	4922 - Natural Gas Transmission
394.0	387.0	187.0	112.0	1,975.0	1,024.0	Navajo Refining Co. - Artesia	2911 - Petroleum Refining
298.0	381.0	1.63	1.63	0.9	31.0	Atoka #3 Compressor Station	4922 - Natural Gas Transmission
396.0	361.0	2.36	2.19	2,040.0	60.4	Indian Basin Gas Plant	1311 - Crude Petroleum & Natural Gas

VOC = volatile organic compound

NA = not available.

Source: USEPA 2002a.

Analysis of air quality impacts from the HB In-Situ Solution Mine Project requires a representative baseline value for ambient background levels of pollutants. Ambient background levels are estimated by the NMED-AQB, as shown in **Table 3.5-5**.

Table 3.5-5 Ambient Background Levels of Criteria Pollutants in Eddy County

Pollutant	($\mu g/m^3$)
NO_2	NA
SO_2	NA
PM_{10}	20.0
$PM_{2.5}$	7.3
TSP	26.6
CO	NA

NA = not available.

Source: NMED-AQB 2010b.

3.5.2.1 Ozone

Ozone (O_3) is a photochemical oxidant and one of the components of smog. While O_3 in the upper atmosphere is beneficial because it shields the earth from harmful ultraviolet solar radiation, high concentrations at ground level can cause health problems due to lung irritation. O_3 is generated by a complex series of chemical reactions between volatile organic compounds (VOCs) and NO_X in the presence of ultraviolet radiation. High O_3 levels can result from VOCs and NO_X emissions from such sources as vehicles and industrial operations, affected by daytime wind flow patterns, mountain barriers, a persistent temperature inversion, and intense sunlight. Ozone precursors are products of combustion. Current background O_3 levels in the vicinity of the project area are shown in **Table 3.5-6**.

Table 3.5-6 2008 Air Quality Monitor Data Summary for Ozone

Location / Site ID	1st Maximum 8-hour Concentration for O_3 (ppm[1])	4th Maximum 8-hour Concentration for O_3 (ppm)	Number of Days Exceeding Federal Standard
Carlsbad, Eddy County, NM / 350151005	0.071	0.067	0
Carlsbad Caverns National Park, Eddy County, NM / 350153001	0.075	0.071	0[2]
Hobbs, Lea County, NM / 350250008	0.069	0.067	0

1 ppm = parts per million.

2 The federal standard for 8-hour concentration of O_3 is 0.075 ppm. The 8-hour standard is attained when the fourth highest 8-hour concentration each year, averaged over 3 consecutive years, is equal to or less than 0.075 ppm.

Source: USEPA20008a.

3.5.2.2 Hazardous Air Pollutants in Eddy County

Principal facility sources of HAPs in Eddy County that are most relevant to analysis of the proposed project and the estimated amounts emitted in 2002 (the last year reported by USEPA) are shown in **Table 3.5-7**. The existing potash mines and mills in Eddy County are small sources of HAPs.

Table 3.5-7 Eddy County 2002 Principal Source Facilities HAP and Potash Mine HAP Emissions

Facility	Pollutant Emissions (Pounds/Year)					
	Benzene	Ethylbenzene	Formaldehyde	Hexane	Toluene	Xylenes (Mixed Isomers)
Washington Ranch Compressor Station	8,800	800	4,400	12,620	10,800	0
Navajo Refining Co. – Artesia	7,252	9,900	3,400	10,960	35,840	23,480
Magnum Compressor Station	4,620	0	0	0	5,140	0
Peñasco Compressor Station	4,100	0	5,760	7,280	6,120	3,040
Empire Abo Plant	2,440	1,008,500	840	471,560	4,640	473,900
Mosaic Potash Mine and Mill	0.0001	0	0.0049	0	0	0
Total	**27,212**	**1,019,200**	**14,400**	**502,420**	**62,540**	**500,420**
Eddy County Total	*35,079*	*1,019,945*	*83,760*	*506,629*	*86,403*	*502,737*

Source: USEPA 2002b.

3.6 Climate Change

3.6.1 Regional Climate

New Mexico has a mild, arid or semiarid, continental climate characterized by light precipitation totals, abundant sunshine, low relative humidity, and a relatively large annual and diurnal temperature range. A climate summary for Carlsbad, New Mexico, is presented in **Table 3.6-1** (WRCC 2010). In January, the coldest month, average daytime high temperatures are in the mid to upper 50s (°F), and while minimum temperatures below freezing are common, it is rare that temperatures fall below 0°F. The coldest temperature on record at Carlsbad was -18°F on January 11, 1962. June and July are the warmest months with average daytime highs averaging in the upper 90s and occasionally exceeding 100°F. The hottest temperature recorded at the Carlsbad station was 113°F, and occurred in June 1994 and in July 1995.

State-wide average annual precipitation ranges from less than 10 inches over much of the southern desert to more than 20 inches at higher elevations in the state. A wide variation in annual totals is characteristic of arid and semiarid climates and is illustrated by annual extremes of 2.95 and 33.94 inches at Carlsbad during a period of more than 71 years. In the Pecos River Valley, summer rains fall almost entirely during brief, but frequently intense thunderstorms. July and August are the rainiest months in the proposed project area. Precipitation during the warmest 6 months of the year, May through October, adds up to about 80 percent of the annual total in the Carlsbad area. The southeastern plains of New Mexico receive on average only about 0.5 inch of precipitation each month during the period November through April.

Three important meteorological factors influence the dispersion of pollutants in the atmosphere: mixing height, stability, and wind (speed and direction). Mixing height is the height above ground at which rising warm air from the surface will mix with cooler ambient air by convection and turbulence. Local atmospheric conditions, terrain configuration, and source location determine the amount of dilution of pollutants in this mixed layer. Mixing heights vary diurnally, with the passage of weather systems, and with season. Wind speeds often are higher in the eastern plains diminishing the likelihood of long periods of stagnant air that can lead to air pollution episodes. On average, mean morning mixing heights in the project region are approximately 1,600 feet; mean afternoon mixing heights are more than 7,800 feet (Holzworth 1972). Mean morning mixing heights tend to be lowest in winter and highest in summer.

Morning atmospheric conditions tend to be stable due to the cooling of the layers of air nearest the ground. Afternoon conditions, especially during the warmer months, tend to be neutral to unstable because of the rapid heating of the surface under clear skies. During the winter, periods of stable afternoon conditions may persist for several days in the absence of synoptic (continental-scale) storm systems to generate higher winds with more turbulence and mixing. The latitude of the proposed project is within the belt of prevailing westerly winds that circle the globe around the earth's northern hemisphere. Winds are affected by local topographic features.

3.6.2 Climate Change

Greenhouse gases (GHG) consist of compounds in the earth's atmosphere that absorb outgoing long-wave radiation emitted from the earth's surface, resulting in a warming of the atmosphere. Naturally occurring greenhouse gases include water vapor, CO_2, methane (CH_4), nitrous oxide (N_2O), and O_3. Human activities also result in the release of GHG including several compounds containing fluorine, chlorine, or bromine that result, for the most part, from industrial activities. Through a natural carbon cycle, CO_2 is absorbed by the oceans and by living biomass through plant photosynthesis, and then released to the atmosphere through natural processes. As a result primarily of the combustion of fossil fuels the atmospheric concentration of CO_2 has increased about 36 percent since the beginning of the industrial age (USEPA 2008b).

In the U.S., the primary source of anthropogenic GHG emissions is fossil fuel combustion. Fossil fuel combustion accounted for 80 percent of 2008 GHG emissions (USEPA 2010a). Fossil fuels are responsible for supplying approximately 85 percent of U.S. primary energy needs and approximately 98 percent of estimated anthropogenic CO_2 emissions. N_2O is also a product of fossil fuel combustion but is largely accounted for as a byproduct of agricultural practices; methane is emitted by petroleum production operations (USEPA 2008a). The U.S. released approximately 5921.2 million metric tons of

Table 3.6-1 Monthly Climate Summary, Carlsbad Federal Aviation Administration Airport, New Mexico

Period of Record : 9/1/1942 to 12/31/2009													
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Average Maximum Temperature (°F)	57.8	62.9	70.4	79.4	88.0	95.6	95.6	93.7	87.1	78.0	65.9	58.4	77.7
Average Minimum Temperature (°F)	29.4	33.3	39.2	47.7	57.1	65.2	68.7	67.3	60.5	48.9	36.9	29.9	48.7
Average Total Precipitation (inches)	0.34	0.40	0.41	0.47	1.18	1.23	1.75	1.95	2.28	1.10	0.52	0.48	12.12
Average Total Snow Fall (inches)	1.4	1.6	0.6	0.3	0	0	0	0	0	0	0.7	1.8	6.4
Average Snow Depth (inches)	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: (WRCC 2010)

CO_2 into the atmosphere in 2008. Of this total, approximately 30.0 million metric tons were released from natural gas systems (USEPA 2010b).

CH_4 is estimated to be more than 20 times as effective for trapping heat in the atmosphere as CO_2 (USEPA 2008a). The U.S. released approximately 567.6 million metric tons of CO_2 equivalents of CH_4 into the atmosphere in 2008. Of this total, approximately 96.4 million metric tons were released from natural gas systems (USEPA 2010b).

The Intergovernmental Panel on Climate Change (IPCC) recently concluded that "warming of the climate system is unequivocal" and "most of the observed increase in globally average temperatures since the mid-20th Century is very likely due to the observed increase in anthropogenic greenhouse gas concentration" (IPCC 2007).

Climate change is not shown to have a direct effect on any criteria pollutants other than ozone. It has been found that concentrations of ground level ozone are likely to increase due to increasing temperature. Although no other criteria pollutants have been shown to be directly impacted by climate change, potential future regulations aimed to reduce GHG emissions may have an indirect effect on other pollutants (such as NO_2 or SO_2) co-emitted with GHGs.

Potential impacts to air quality and other resources due to climate change are likely to be varied. For example, if global climate change results in a warmer and drier climate, increased particulate matter impacts could occur due to increased wind-blown dust from drier and less stable soils. Spatial ranges of cool season plant species are predicted to move north and to higher elevations, and extinction of endemic threatened/endangered plants may be accelerated. Due to loss of habitat, or due to competition from other species whose ranges may shift northward, the population of some animal species may be reduced. Less snow at lower elevations would be likely to impact the timing and quantity of snowmelt, which, in turn, could impact aquatic species.

The assessment of climate-changing pollutant emissions and climate change is in its formative phase; therefore, it is not yet possible to know with confidence the net impact to climate. The lack of scientific tools designed to predict climate change on regional or local scales limits the ability to quantify potential future impacts, so there is no established mechanism to accurately predict the effect of local decisions on global climate change.

3.7 Vegetation

The study area for vegetation resources including general vegetation, noxious weeds and invasive species, and special status plant species is defined as the proposed project area. The following section presents general vegetation resources, noxious weeds and invasive species, and special status plant species for the project area.

3.7.1 Plant Communities

The project area is located within the Chihuahuan Desert ecoregion, which is composed of two subregions: the Chihuahuan Basins and Playas and Chihuahuan Desert Grasslands. The Chihuahuan Desert ecoregion extends from the southeastern Arizona to south-central Texas, and more than 500 miles south into Mexico (Griffith et al. 2006). The Chihuahuan Desert ecoregion historically has been dominated by desert grasslands, and shrublands dominated by creosotebush (*Larrea tridentata*). Over the last several hundred years, the extent of desert grasslands has declined, and desert shrublands have become increasingly dominant. The gradual desertification is thought to be caused by grazing, and other anthropogenic activities (Griffith et al. 2006; New Mexico State University 2007). The Chihuahuan Basins and Playas subregion is located mostly below 4,500 feet amsl. It is composed of saline and alkaline soils, salt flats, dunes, and windblown sand (Griffith 2006). The Chihuahuan Desert Grasslands are found at higher elevations, such as elevated basins between mountain ranges, low mountain benches, plateau tops, and north-facing mountain slopes (Griffith 2006). Both the Chihuahuan subregions are extremely arid; however, the Chihuahuan Desert Grasslands have higher annual precipitation than the Chihuahuan Basins and Playas.

In the project area, the climate is arid, with annual rainfall ranging from 10 to 15 inches a year (NRCS 2008a). Elevation varies typically from 3,000 to 4,500 feet (NRCS 2008a). Vegetation types and acreages were analyzed using the Southwest Regional Gap Analysis Project (SWReGAP) Land Cover data (USGS 2004). The SWReGAP land cover type categories were grouped into eight general vegetation cover types: desert scrub, dune and sand flat scrub, grassland, mesquite upland scrub, riparian, woody riparian, sandhill shrubland and open water. **Table 3.7-1** summarizes acreages for each vegetation cover type within the project area. The acreage of each vegetation cover type within the two existing pipelines (Caprock East Pipeline and HB/Eddy Caprock Pipeline) and the new proposed Caprock pipeline are listed in **Table 3.7-2**. Descriptions of the plant communities for each vegetation cover type are provided in the following text. Community characterizations were compiled based on SWReGAP Land Cover descriptions (USGS 2005), and soil survey habitat descriptions (NRCS 2008a). Species nomenclature is consistent with the NRCS Plants Database (NRCS 2008b), the New Mexico Rare Plant List (NMRPTC 1999, NMAC 19.21.2.1 to 19.21.2.15), the BLM Carlsbad Field Office, and the New Mexico State Noxious Weed List (NMSA 76-7-1 to 76-7-30). **Figure 3.7-1** illustrates the vegetation cover types present within the project area.

Table 3.7-1 Vegetation Cover Types within the Project Area

Vegetation Cover Type	Acres	% of Project Area
Desert scrub	12,302	32
Dune and Sand Flat Scrub	7	< 1
Grassland	5,733	15
Mesquite Upland Scrub	17,264	45
Riparian	429	1
Woody Riparian	751	2
Sandhill Shrubland	834	2
Water	1,132	3
Total	**38,453**	**100**

Table 3.7-2 Vegetation Cover Types within the Caprock Pipeline Routes

Vegetation Cover Type	Pipeline Routes	
	Existing East Caprock and HB/Eddy Pipelines	Proposed New Caprock Pipeline
	Acres	
Desert scrub	41	30
Dune and Sand Flat scrub	5	5
Grassland	103	89
Mesquite Upland Scrub	188	120
Riparian	0	0
Woody Riparian	0	2
Sandhill Shrubland	49	15
Water	0	1
Total	**386**	**262**

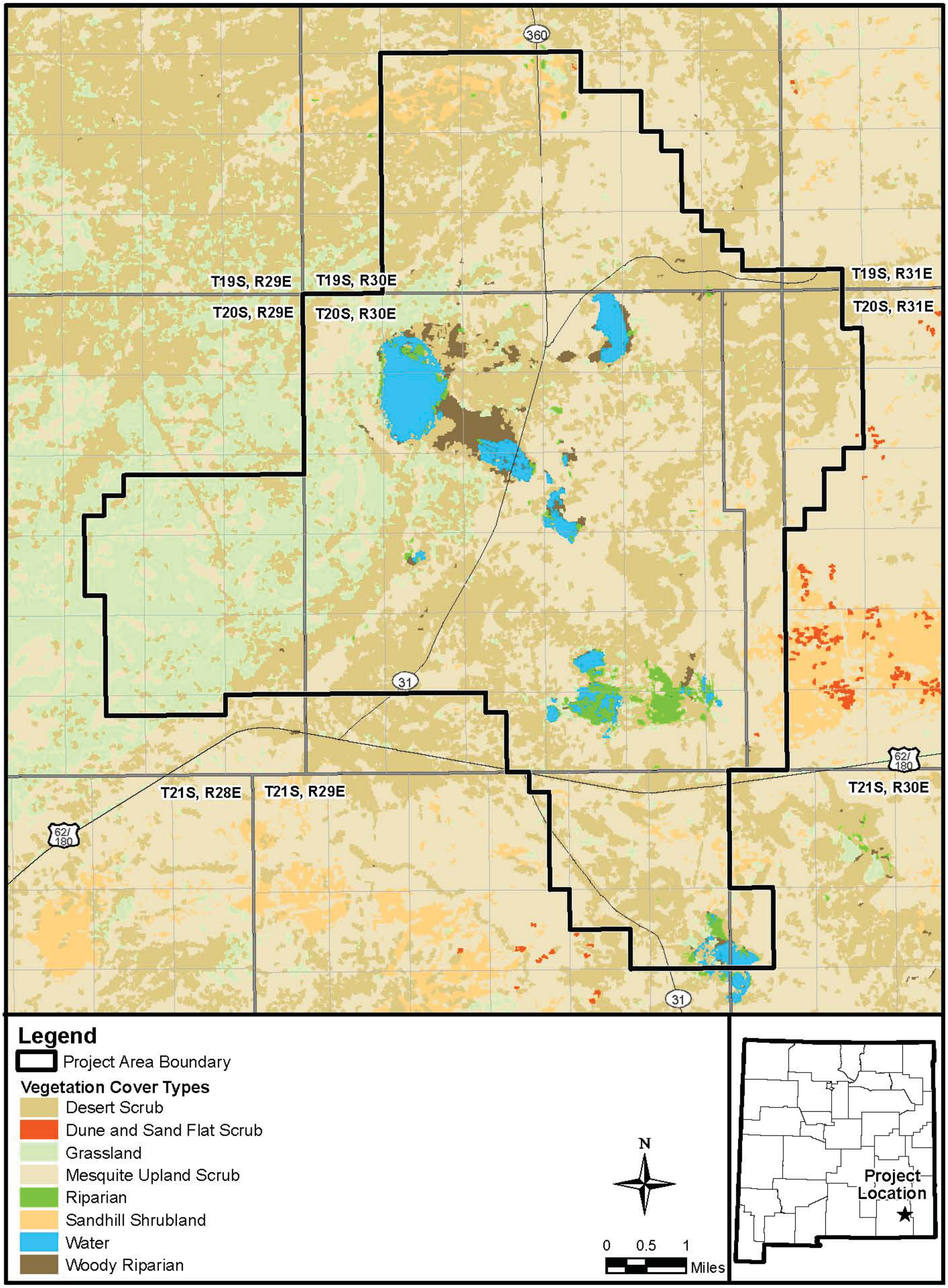


Figure 3.7-1. Vegetation Cover Types in the Project Area

Desert Scrub

Desert scrub is the second most common cover type in the project area and is found in combination with the Mesquite Upland Scrub vegetation cover type throughout the majority of the project area. It is composed of several land cover types: the Chihuahuan Creosotebush Xeric Basin Desert Scrub, the Chihuahuan Mixed Desert and Thorn Scrub, and Chihuahuan Mixed Salt Desert Scrub. The Chihuahuan Creosotebush Xeric Basin Desert Scrub landcover type occurs in xeric basins and plains, the Chihuahuan Mixed Desert and Thorn Scrub is found in the transition zone between the foothills and lower montane woodlands, and the Chihuahuan Mixed Salt Desert Scrub occurs in saline basins, alluvial flats and around playas. Vegetation consists of creosotebush often found with other desert scrub species such as American tarwort (tarbush) (*Flourensia cernua*), catclaw mimosa (*Mimosa aculeaticarpa* var. *biuncifera*), junipers (*Juniperus* spp.), honey mesquite (*Prosopis glandulosa*), and plumed crinklemat (*Tiquilia greggii*). In the Chihuahuan Mixed Salt Desert Scrub areas, the dominant shrub species tend to be salt tolerant such as fourwing saltbush (*Atriplex canescens*) and other atriplex species (*Atriplex* spp.) associated with the above shrub species. Herbaceous species have lower cover than shrubs in these areas and common species include side-oats grama (*Bouteloua curtipendula*), black grama (*Bouteloua eriopoda*), bush muhly (Muhlenbergia porter), Tobosagrass (*Pleuraphis mutica*), Plains bristlegrass (*Setaria* spp.), Plains lovegrass (*Eragrostis intermedia*), and alkali sacaton (*Sporobolus airoides*).

Dune and Sand Flat Scrub

The Dune and Sand Flat Scrub cover type occurs in a very limited extent in the project area. It is found on vegetated coppice dunes and sandsheets. It consists of open shrublands with 10 to 30 percent cover dominated by honey mesquite. Other typical shrub species includes fourwing saltbush, Torrey's jointfir (*Ephedra torreyana*), longleaf jointfir (*Ephedra trifurca*), littleleaf sumac (*Rhus microphylla*), and broom snakeweed (*Gutierrezia sarothrae*).

Grassland

The Grassland cover type is found on a broad range of geologic areas and soil types. It is the third most common vegetation cover type, and is found on the western side of the project area. It occurs on alluvial fans, flats, slopes and basins, sandy plains and sandstone mesas. It is found on moderate to deep soils; gypsum outcrops; sandy gypsiferous and/or alkaline soils; sandy to clayey loamy, ustic soils; and soils with high sand content. The vegetated cover is typically dominated by graminoids with an open shrub layer. Graminoid species include blue grama, needle-and-thread grass (*Hesperostipa comata*), alkali sacaton, gypsum grama (*Bouteloua breviseta*), purple threeawn (*Aristida purpurea*), side-oats grama, sand dropseed (*Sporobolus cryptandrus*), hairy grama (*Bouteloua hirsuta*), and black grama (*Bouteloua eriopoda*). Shrubs and dwarf shrubs include sand sagebrush (*Artemisia filifolia*), fourwing saltbush, honey mesquite, soaptree yucca, crinklemat species (*Tiquilia* spp.), broom snakeweed, Torrey's jointfir, Apache plume (*Fallugia paradoxa*), and Torrey's yucca (Yucca torreyi). The vegetative cover is influenced by the underlying soil type. Sandy soils have higher cover of spike dropseed, soaptree yucca, and needle-and-thread grasses; while gypsum soils are dominated by gypsophilous plants such as gypsum grama. Microphytic crust can be important in some areas, while disturbance such as grazing may be necessary to maintain the shrub component.

Mesquite Upland Scrub

The Mesquite Upland Scrub cover type is the most dominant vegetation cover type and is found in combination with Desert Scrub throughout the majority of the project area. It is composed of upland shrublands and is typically found in the transition zone of foothills and piedmonts of the Chihuahuan Desert Ecoregion. It is typically found on alluvium derived substrates that are often gravelly. Vegetation is typically dominated by shrubs with little grass cover. The deep-rooted shrubs are able to exploit the deep soil moisture that is unavailable to grasses and cacti. Species include honey mesquite, littleleaf sumac, soapberry (*Sapindus* spp.) and other succulent species. Desertification has increased the extent of Mesquite Upland Scrub.

Riparian

The Riparian cover type occurs around channels, temporary springs, playas, closed basin lakes and tailings ponds in the project area. The vegetation can vary from sparse and patchy to moderately dense. Typical species can include salt-tolerant and halophytic species such as saltgrass (*Distichlis spicata*), alkali sacaton (*Sporobolus airoides*), and foxtail barley (*Hordeum jubatum*). Other typical species can include rushes (*Juncus* spp.), sedges (*Carex* spp.), bulrush (*Schoenoplectus* spp.), cattails (*Typha* spp.), desert broom (*Baccharis sarothroides*), and burrobrush species (*Hymenoclea* spp.).

Woody Riparian

The Woody Riparian cover type is located around the lakes located in the east and south portions of the project area. The vegetation is composed of a mix of riparian woodlands and shrublands. Dominant tree and shrub species can include cottonwoods (*Populus* spp.), willows (*Salix* spp.), and boxelder (*Acer negundo*). In the project area, much of the woody riparian vegetation is salt cedar.

Sandhill Shrubland

The Sandhill Shrubland cover type occurs on somewhat excessively to excessively well-drained, deep sandy soils that are often associated with dune systems and ancient floodplains. In some areas, this system may actually occur as a result of overgrazing. Sandhill Shrubland is characterized by a sparse to moderately dense woody layer dominated by sand sagebrush and shinnery oak (*Quercus havardii*) and various grass species. Graminoid species include little bluestem (*Schizachyrium scoparium*), spike dropseed (*Sporobolus contractus*), sand bluestem (*Andropogon hallii*), switchgrass (*Panicum virgatum*), and giant dropseed (*Sporobolus giganteus*). Shinnery oak is a low shrub that has large underground stem and root systems. It can resprout following a fire and thus may persist for long periods of time once established. Fire and grazing are the most important dynamic processes for maintaining this type; however, drought stress can impact this system significantly in some areas.

Water

The Water cover type consists of the open surface water in the project area, including temporary springs, playas, basin lakes, and tailings ponds.

In response to the increase of desert shrublands, and the decline of desert grasslands, the BLM and its partners have implemented vegetation treatments to restore the desert grasslands. Over two-thirds of desert grasslands in southern New Mexico has been invaded by shrub species, primarily mesquite and creosote (BLM 2009). Vegetation treatments to restore desert grasslands include chemical treatments, grazing deferments, prescribed fires, and mechanical removal. In the project area, the targeted shrub species are creosote, mesquite, and salt cedar. Recent vegetation treatment included aerial spraying of 39,435 acres to control mesquite in Clayton Basin. **Figure 3.7-2** displays the location of the recent vegetation treatment applied in the project area.

3.7.2 Special Status Plant Species

Special status plant species are species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. Included in this category are federally listed and federally proposed species protected under the ESA, species that are candidates for listing by the USFWS, species that are listed by the state as threatened or endangered, and BLM sensitive species.

In accordance with the ESA, the lead agency, in coordination with the USFWS, must ensure that any federal action to be authorized, funded, or implemented would not adversely affect a federally listed threatened or endangered species or its critical habitat. The BLM Special Status Species Management Policy 6840 requires the BLM to manage and protect any USFWS candidate species, or state listed

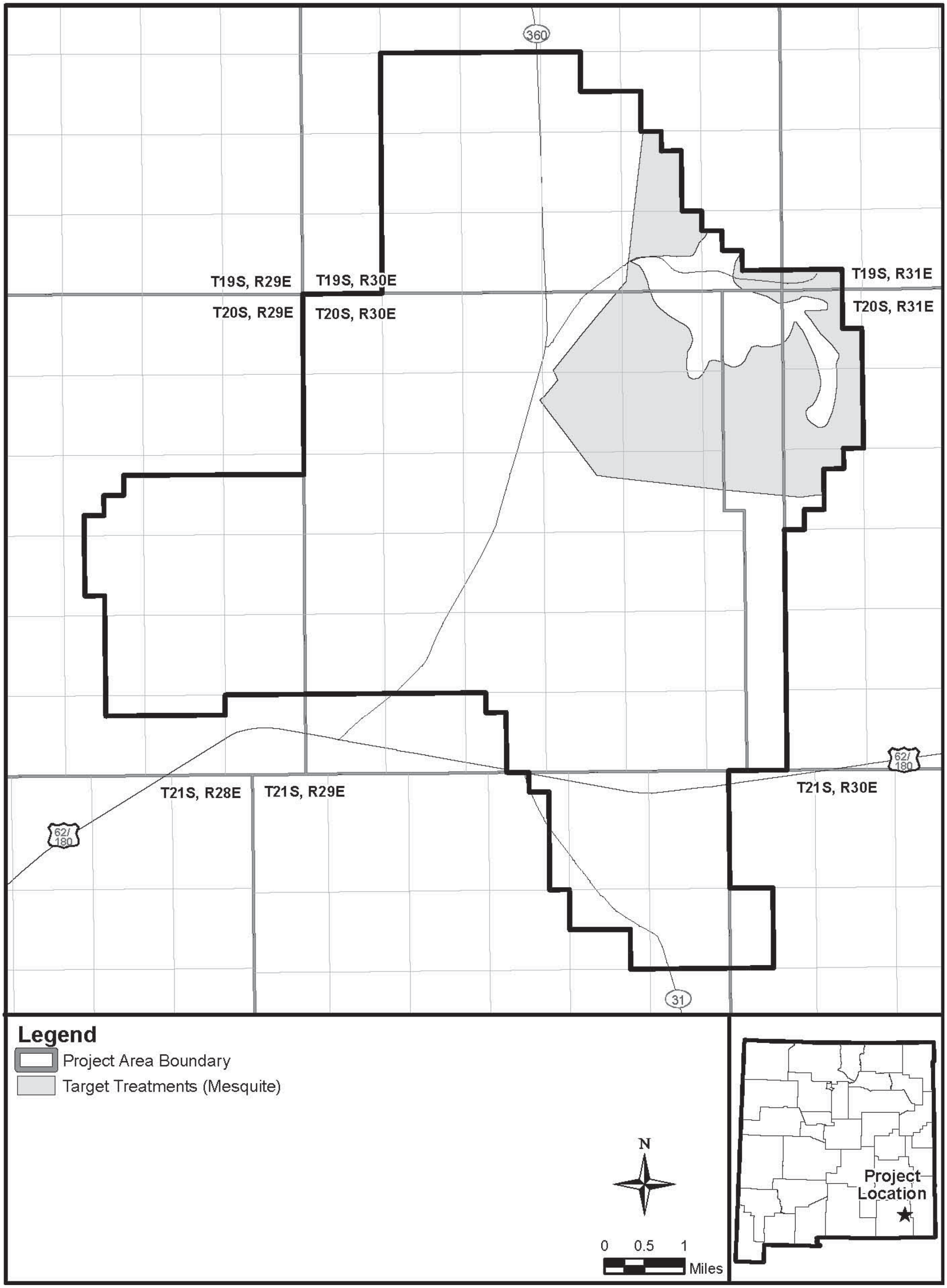


Figure 3.7-2. Recent Vegetation Treatments in the Project Area

species, to prevent the need for future federal listing as threatened or endangered. A total of 12 special status plant species (3 federally listed species, 11 BLM sensitive species, and 7 New Mexico listed species) were identified as potentially occurring within Eddy County, New Mexico (NMRPTC 1999). The potential for occurrence within the project area was evaluated for each species based on its habitat requirements and known distribution. Evaluations revealed that 10 species do not require detailed analysis because their known range is outside of the project area.

The species eliminated from further analysis include Tharp's blue-star, Wright's marsh thistle, Kuenzler's hedgehog cactus, Guadalupe rabbitbrush, Lee's pincushion cactus, shining coralroot, Wright's justicia, hairy muhly, gray sibara, and Guadalupe mescal bean. The remaining two species addressed in detail include federally listed gypsum wild buckwheat, and BLM sensitive species Scheer's beehive cactus.

Scheer's Beehive Cactus

Scheer's beehive cactus (*Coryphantha scheeri* spp. *scheeri*) is a BLM sensitive species and protected as a New Mexico endangered species. The species is a member of the cactus family and tends to be long-lived. Plants have either a single or small cluster of stems. Stems are hemispheric, tubercled, and succulent (NMRPTC 1999). The flowers are yellow, while the fruit is green, with very small brown kidney shaped seeds. The cactus flowers starting in May and usually continues to July. In some cases, cactuses can flower into November. The species occurs in nearly level areas in desert grassland and Chihuahuan desert scrub in western Texas and southeastern New Mexico (NMRPTC 1999). It is typically found on gravelly or silty soils, but occasionally is found on rocky benches or bajadas on limestone or gypsum. The elevation range for the cactus is typically 3,300 to 3,600 feet amsl. The species has been not been extensively studied, and little is known about its distribution, and status. Current threats include domestic livestock, off-road vehicles, and development activities.

Gypsum Wild Buckwheat

Gypsum wild buckwheat (*Eriogonum gypsophilum*) is a member of the buckwheat family. It was listed as federally threatened January 19, 1981 (USFWS 1981).

Fifteen populations are known to occur in three locations in Eddy County, New Mexico (NatureServe 2009). The species is a perennial herb with a woody stem that grows in dense clumps. It is approximately 7 to 8 inches tall, and has dark green basal leaves that turn bright red in the fall (USFWS 1984b). The flowers are tiny and yellow and the species flowers from May to July. Reproduction most likely occurs by vegetative reproduction, a successful seed establishment is likely uncommon (USFWS 1984b). The species is found in sparsely vegetated areas and is restricted to almost pure gypsum soils. It is typically found with other gypsophilous plants such as hairy crinklemat (*Tiquilia hispidissima*), gypsum blazingstar (*Mentzelia humilis*), and southwestern ringstem (*Anulocaulis leiosolenus*). Its elevation range is 3,280 to 3,600 feet (NMRPTC 1999). Threats to the species include gypsum mining, recreational development, grazing, and dam construction (NatureServe 2009).

3.7.3 Noxious and Invasive Species

Noxious weeds have become a growing concern in the western U.S. due to their ability to increase in cover and exclude native plants from an area. The spread of noxious weeds causes damage to endangered native species, resulting in reductions in available forage for livestock and wildlife and economic resources. As a result, the State of New Mexico passed the Noxious Weeds Management Act (NWMA), which requires the New Mexico Department of Agriculture (NMDA) to develop a list of noxious weeds, identify methods of control, and educate the public (76-7-1 to 76-7-30 NMSA 1978). The NWMA defines a noxious weed as any weed or plant that is harmful or possesses noxious characteristics, as determined by the board of county commissioners. The board of county commissioners acts as the governing body of the district.

The federal Noxious Weed Act of 1974, as amended (7 USC 2801 et seq.) requires cooperation with state, local, and other federal agencies in the application and enforcement of all laws and regulations relating to the management and control of noxious weeds. The BLM acknowledged the Act by establishing a goal to include noxious weed considerations in NEPA documents. Analysis should include the potential for the spread of noxious weed species and provide preventive rehabilitation measures for each management action involving surface disturbance.

There are four categories of noxious weeds identified by the NMDA (Class A, B, C, and watch species). **Table 3.7-3** lists the noxious weed species in the state and their associated status.

Table 3.7-3 Noxious Weed Species of Concern in the State of New Mexico.

Common Name	Scientific Name	New Mexico Noxious Weed List Classification
Alfombrilla	*Drymaria arenariodes*	A
Black henbane	*Hyoscyamus niger*	A
Camelthorn	*Alhagi psuedalhagi*	A
Canada thistle	*Cirsium arvense*	A
Dalmation toadflax	*Linaria dalmatica*	A
Diffuse knapweed	*Centaurea diffusa*	A
Dyer's woad	*Isatis tinctoria*	A
Eurasian watermilfoil	*Myriophyllum spicatum*	A
Giant salvinia	*Salvinia molesta*	A
Hoary cress	*Cardaria* spp.	A
Hydrilla	*Hydrilla verticllata*	A
Leafy spurge	*Euphorbia esula*	A
Oxeye daisy	*Leucanthemum vulgare*	A
Parrotfeather	*Myriophyllum aquaticum*	A
Purple loosestrife	*Lythrum salicaria*	A
Purple starthistle	*Centaurea calcitrapa*	A
Ravenna grass	*Saccharum ravennae*	A
Scotch thistle	*Onopordum acanthium*	A
Spotted knapweed	*Centaurea biebersteinii*	A
Yellow starthistle	*Centaurea solstitialis*	A
Yellow toadflax	*Linaria vulgaris*	A
African rue	*Peganum harmala*	B
Chicory	*Cichorium intybus*	B
Halogeton	*Halogeton glomeratus*	B
Malta starthistle	*Centaurea melitensis*	B
Musk thistle	*Carduus nutans*	B
Perennial pepperweed	*Lepidium latifolium*	B
Russian knapweed	*Acroptilon repens*	B
Poison hemlock	*Conium maculatum*	B

Table 3.7-3 Noxious Weed Species of Concern in the State of New Mexico.

Common Name	Scientific Name	New Mexico Noxious Weed List Classification
Teasel	*Dipsacus fullonum*	B
Tree of heaven	*Ailanthus altissima*	B
Bull thistle	*Cirsium vulgare*	C
Cheatgrass	*Bromus tectorum*	C
Jointed goatgrass	*Aegilops cylindrica*	C
Russian olive	*Elaeagnus angustifolia*	C
Saltcedar	*Tamarix* spp.	C
Siberian elm	*Ulmus pumila*	C
Crimson fountaingrass	*Pennisetum setaceum*	Watch
Giant cane	*Arundo donax*	Watch
Meadow knapweed	*Centaurea pratensis*	Watch
Pampas grass	*Cortaderia sellonana*	Watch
Quackgrass	*Elytrigia repens*	Watch
Sahara mustard	*Brassica tournefortii*	Watch
Spiny cocklebur	*Xanthium spinosum*	Watch
Wall rocket	*Diplotaxis tenuifolia*	Watch

Class A species are the highest priority but are not currently present in New Mexico or have limited distribution. Management of Class A species focuses on prevention of new infestations, and eradication of existing infestations.

Class B species are limited to portions of the state. For Class B species, with severe infestations, management includes containing the infestation and limiting any further spread.

Class C species are widespread in the state. For Class C species, management decisions are made at the local level based on the feasibility of control and level of infestation. Watch species are species of concern in the state that have the potential to become problematic. When these species are encountered, their location should be documented and provided to the appropriate authorities.

In the state, African rue, Malta star-thistle, and Russian knapweed are of the highest concern. In the project area, African rue and goldenrod have been identified and treated. Malta star-thistle is usually found along roadways in the project area. Along the proposed Caprock pipeline route, African rue and Malta star-thistle have been observed. Russian knapweed has not been identified in the project area, but could be present. In addition, salt cedar (tamarisk) is not prevalent in the project area, but is still a concern due to the presence of large infestations nearby. Lehmann's lovegrass (*Eragrostis lehmanniana*) is an invasive species of concern to the BLM as it is very invasive on disturbed areas. It has been observed in the project area (Daly 2010).

The BLM Carlsbad along with county, state, and federal agencies actively monitor and treat noxious weed species in the area.

3.8 Wildlife and Fish

3.8.1 Terrestrial Wildlife

Wildlife habitats within the project area consist primarily of mesquite upland shrub, desert scrub, and grasslands, with small areas of sandhill shrubland, dune and sand flat scrub, woody riparian, and open water habitats. These vegetation types support a diversity of wildlife species. This section focuses on species of high economic or recreational importance and those that are considered sensitive to human disturbance.

3.8.1.1 Big Game

Big game species potentially occurring within the project area may be limited due to lack of sufficient feed or cover. The primary big game species are mule deer (*Odocoileus hemionus*) and pronghorn antelope (*Antilocapra americana*) (BLM 1994). According to the Carlsbad Final RMP/EIS Amendment (BLM 1997), mule deer are found east of the Pecos River in isolated areas that have adequate permanent water sources, adequate cover (dunes, escarpments, blowouts, and hummocks), abundant food sources (shinnery oak and fourwing saltbush), and some topographic relief. These factors, and the proximity to oil and gas activity, are the limiting factors to the distribution of mule deer in the vicinity of the project area (BLM 1994). Habitat for pronghorn antelope primarily consists of grassy rolling uplands and shinnery oak sand dunes (BLM 1994).

Other big game species that may be encountered within the project area include javelinas (*Dicotyles tajacu*) and mountain lions (*Felis concolor*). Javelinas prefer areas of mixed desert shrub or mesquite grassland, and mountain lions may occasionally travel through the mesquite grasslands and shinnery oak dune areas in and near the project area (BLM 2007b).

3.8.1.2 Small Game Species

Small game species that potentially occur within the project area include upland game birds, waterfowl, furbearers, and small mammals. Species include mourning dove (*Zenaidura macroura*), scaled quail (*Callepepla squamata*), bobwhite quail (*Colinus virginianus*), black-tailed jackrabbit (*Lepus californicus*), and desert cottontail (*Sylvilagus audubonii*). Furbearers may include, but are not limited to, bobcat (*Lynx rufus*), coyote (*Cannis letrans*), raccoon (*Procyon lotor*), and badger (*Taxidea taxus*) (BLM 2007b, 1994).

3.8.1.3 Nongame Species

A diversity of nongame species (e.g., small mammals, raptors, passerines, amphibians, and reptiles) occupy a variety of trophic levels (levels in the food chain) and habitat types within the project area. Nongame mammal species include shrews, bats, squirrels, rabbits, woodrats, and mice. These small mammals provide a substantial prey base for the predators, such as mammals (coyote, badger, skunk), raptors (eagles, buteos, accipiters, owls), and reptiles.

Nongame birds encompass a variety of passerine and raptor species, these include a diversity of neotropical migrants (birds that breed in North America and winter in the neotropical region of South America). These birds are considered integral to natural communities and act as environmental indicators due to their sensitivity to environmental changes. Common bird species that occur within the project area may include, but are not limited to, horned lark (*Eremophila alpestris*), western meadowlark (*Sturnella neglecta*), Chihuahuan raven (*Corvus cryptoleucus*), western kingbird (*Tyrannus vertucalis*), and sage sparrow (*Amphispiza belli*) (BLM 2007b). Representative raptor species include the golden eagle (*Aquila chrysaetos*), red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*Buteo swainsoni*), rough-legged hawk (*Buteo lagopus*), ferruginous hawk (*Buteo regalis*), American kestrel (*Falco sparverius*), and great-horned owl (*Bubo virginianus*) (BLM 2007b).

Pursuant to Executive Order (EO) 13186 (2001), a Memorandum of Understanding between the BLM, USFS, and USFWS was drafted in order to promote conservation and protection of migratory birds. The EO provides guidance to federal agencies to minimize adverse effects and promote best management practices for the conservation of migratory birds.

Breeding bird surveys were conducted in May 2008 within the project area (CEHMM 2008). Avian species observed within and adjacent to the project area included Harris's hawk (*Parabateo unisinctus*), Swainson's hawk, northern harrier (*Circus cyaneus*), cactus wren (*Campylorhynchus brunneicapillus*), sage thrasher (*Oreoscoptes montanus*), mourning dove, American avocet (*Recurvirostra Americana*), and spotted sandpiper (*Actitis macularia*). Additionally, a number of the karst caves in the area are known to provide roosting, nesting, or other protective habitat for many animal species, including raptors, owls, bats, and other small animals (BLM 1981, 1978; Southwest Region National Speleogical Society 1991). Details on sensitive species such as lesser prairie chicken (*Tympanuchus pallidicinctus*), burrowing owl (*Athene cunicularia*), Baird's sparrow (*Ammodramus bairdii*), gray vireo (*Vireo vicinior*), cave myotis (*Myotis velifer incautus*), Yuma myotis (*Myotis yumanensis yumanensis*), sand dune lizard (*Sceloporus arenicolus*), and Pecos pupfish (*Cyprinodon pecosensis*) are discussed further in Section 3.8.3, Sensitive Species.

3.8.1.4 Habitat Fragmentation

Habitat fragmentation is known to affect wildlife regardless of the location, but the degree to which wildlife is affected and the species-specific impacts are inconclusive. As the number of fragments increases in a given area, the core area size decreases, reducing the patches uninterrupted by human disturbance. The amount of edge area increases with the increase of fragments, and habitat connectivity decreases with increased fragmentation (Baker and Knight 2000).

Concern for habitat fragmentation is increasing in wildlife management (Baker 2000; Baker and Knight 2000) and is considered a global concern for biological diversity (Baker and Knight 2000). The decrease of species and shifts of animal distributions have led to a focus on the causes of habitat fragmentation and the effect this may have on wildlife. Avian responses to habitat fragmentation include life cycle alterations, increased parasitism, and habitat affinity associations (Baker Knight 2000; Weller et al. 2002). Many of the documented concerns related to habitat fragmentation apply primarily to forested environments.

The effects analysis of habitat fragmentation focuses on fragmentation from roads, which are the predominant linear features on the district, based on a review of relevant studies for the western U.S. and the documented impacts to wildlife (chiefly big game). Habitat loss from roads or other linear structures has broader effects than just the conversion of a small area of land. Roads fragment wildlife habitat by changing landscape structure, which may have direct and indirect impacts, depending on the species present. Habitat effects of roads on the landscape include dissecting vegetation patches, increasing the edge-affected area, decreasing contiguous interior area, and increasing the uniformity of patch characteristics such as shape and size (Reed et al. 1966). Avoidance distances of 100 to 200 meters are common for some big game species (Lyon 1983).

The evidence is strong that roads displace some large mammals and certain birds, and that displaced animals may suffer habitat loss as a result. Effects of roads and other linear features on small mammals, songbirds, amphibians, and reptiles are generally less severe, with changes expressed as modifications of habitat that cannot readily be classified as detrimental or beneficial. Roads and their adjacent environment qualify as a distinct habitat and have various species, population, and landscape-scale effects (Baker and Knight 2000). Some research has attempted to describe habitat modifications caused specifically by roads, but most of this work is species- and site-specific (Lyon 1983).

3.8.2 Aquatic Species

No fisheries occur within the project area. The closest perennial stream to the project area is the Pecos River, which is approximately 11 miles away. The Pecos River supports warm water fisheries. Other aquatic organisms may occupy karsts features such as sinkholes, within the project area, but no detailed surveys have been completed.

3.8.3 Sensitive Species

Sensitive species identified in the project area include both special status species and species of special concern. Special status species are defined in Section 3.7.2. In addition, the USFWS and BLM have categories for non-listed species that are believed to be rare or vulnerable. The USFWS designates such species as “species of special concern” and the BLM designates them as “sensitive.” For this analysis, the USFWS species of special concern and BLM sensitive species are referred to collectively as sensitive species.

In accordance with the ESA, the lead agency, the BLM, in coordination with the USFWS, must ensure that any action they authorize, fund, or carry out would not adversely affect a federally listed threatened or endangered species. In addition, it is BLM policy that agency actions do not contribute to the federal listing of any federal candidate species, state-listed species, or sensitive species.

A total of 65 terrestrial and aquatic species (38 special status species and 27 sensitive species) were identified as potentially occurring within the project area (BISON-M 2009, USFWS 2009a). These species, their associated habitats, and their potential for occurrence within the project area are summarized in **Table 3.8-1**. The potential for occurrence was evaluated for each species based on habitat requirements and known distribution. Evaluations determined that 40 terrestrial species (27 special status species and 13 sensitive species) and 9 aquatic species (seven special status species and 2 sensitive species) are unlikely to occur within the project area. Of the remaining 16 terrestrial and aquatic species, 5 are special status species and 11 are sensitive species. All 16 species identified as potentially occurring within the project area are described below (including status).

<u>Mammals</u>

Townsend’s Big-eared Bat (BLM, USFWS). The Townsend's big-eared bat is found throughout New Mexico from low desert to high mountain habitats (Findley et al. 1975). Within its range, this bat is common in deserts, woodlands, and pine forests (AGFD 1993). This species prefers caves, mines, and buildings that maintain stable temperatures and airflow for nursery colonies, bachelor roosts, and winter shelter (AGFD 1993; Findley et al. 1975; Harvey et al. 1999). The bat does not make major migrations and appears to be relatively sedentary, not traveling far from summer foraging grounds to winter hibernation sites (Harvey et al. 1999). Its distribution is correlated with suitable roost and hibernation sites, primarily caves and underground mines. Based on the species’ known distribution and habitat requirements, the potential for this species to occur within the project area is considered to be low.

Cave Myotis (BLM). In New Mexico, the cave myotis can be found in desert floodplains, rocky canyonlands, and desert grassland, which include creosote, brittlebush, paloverde, and cacti (AGFD 1993; Findley et al. 1975; Harvey et al. 1999). Limited roost habitat such as caves, mines and occasionally man-made structures often determine the presence of Cave Myotis (Findley et al. 1975; Harvey et al. 1999). Additionally, the species roosts near water (AGFD 1993). The species is likely to hibernate in the numerous caves located in Lincoln, Chaves, and Eddy counties (Findley et al. 1975). Based on the species’ known distribution and habitat, the potential for this species to occur within the project area is considered moderate.

Big Free-tailed Bat (BLM). The big free-tailed bat prefers to roost in rugged, rocky areas in desert scrub habitats in cliff faces, crevices, and fissures (AGFD 1993; Harvey et al. 1999). Vegetation present within preferred habitat includes creosote bush, blackbrush, sandsage, snakeweed, mesquite, and rabbitbrush (AGFD 1993). The bat is known to also inhabit rocky country, where it roosts in crevices high up on cliff faces but it has also been known to roost in buildings (AGFD 1993; Harvey et al. 1999). Based on the species’ known distribution and habitat requirements, the potential for this species to occur within the project area is considered low.

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Mammals					
Pale Townsend's big-eared bat (*Corynothinus townsendii pallescens*)	BLM; USFWS	This subspecies is primarily a cave dweller and is the bat most dependent upon inactive mines in the southwest. They can be found in desert shrublands, piñon-juniper woodlands, coniferous forests and mixed grass prairies. They will roost in trees, caves, or man-made structures. This is the only subspecies of bat commonly found in New Mexico during winter.	Low. This species could occur within suitable habitats within portions of the project area.	No	Bison-M 2009; Findley et al. 1975
Cave myotis (*Myotis velifer incautus*)	BLM	Species inhabit mine shafts, tunnels, caves, and even under bridges, in desert areas of creosote bush, paloverde, brittlebush, and cacti. Even though they are found in xeric areas, they are never more than a few miles from some water source such as tanks, canals, or creeks.	Moderate. This species could occur within suitable habitats within portions of the project area.	No	Bison-M 2009; Findley et al. 1975
Big free-tailed bat (*Nyctinomops mactotis*)	BLM	This species prefers coniferous and mixed woods and depends on rocky cliffs for roosting. They can be found in piñon-juniper woodland, pine and mixed coniferous forests, desert grassland, and other desert communities. In addition to roosting on rocky cliffs, they also may roost in caves, rock fissures, bridges, and buildings.	Low. This species could occur within suitable habitats within portions of the project area.	No	Bison-M 2009; Findley et al. 1975

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Fringed myotis (*Myotis thysanodes thysanodes*)	BLM	This species occurs in a wide variety of vegetation types including mixed shrub, grassland, sagebrush, piñon-juniper woodland, pine and mixed conifer forests, riparian woodlands, and cropland. They are known to roost in caves, mines, and buildings.	Low. This species could occur within suitable habitats within portions of the project area.	No	Bison-M 2009; Findley et al. 1975
Long-legged myotis (*Myotis volans interior*)	BLM	Species is found in the encinal zone, sycamore, cottonwood, rabbitbrush, oak savanna, oak woodland, piñon-juniper woodland, chapparal woodland, and coniferous forest.	Low. Because the project area is not located within a forested area, potential for occurrence is very low.	No	Bison-M 2009; Findley et al. 1975
Western small-footed myotis (*Myotis ciliolabrum melanorhinus*)	BLM	Species is found in shortgrass plains, sacaton grassland, sycamore, cottonwood, rabbitbrush, oak savanna, oak woodlands, piñon-juniper woodland, chapparal woodlands, and coniferous forest.	Moderate. Because of the variety of habitats occupied by this species, it could occur within suitable habitats within portions of the project area.	No	Bison-M 2009; Findley et al. 1975
Yuma myotis (*Myotis yumanensis yumanensis*)	BLM	This species seems to be abundant in deserts, grasslands, and woodlands, and the riparian communities of these zones, from 4,000 to 7,000 feet in elevation. Its distribution is tied to permanent watercourses as it is a water-surface forager.	Moderate. This species could occur within suitable habitats within portions of the project area.	No	Bison-M 2009; Findley et al. 1975

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Grey-footed chipmunk (*Neotamias canipes canipes*)	BLM	This species is most commonly found in forested habitats; however, it also is found in piñon-juniper woodlands, shrublands, and desert communities. Its favorite haunts are downed logs at the edge of clearings. It also occurs in dense stands of mixed timber (Quercus, Pinus, Abies) and on brushy hillsides, particularly where crevices in rocks offer retreats.	None	Yes. This project area does not occur within the known range of this species.	BISON-M 2009; Findley et al. 1975
Black-footed ferret (*Mustela nigripes*)	FE	Species occur in Mixed Shrub habitat type. Closely associated with the prairie dog (specifically black-tailed prairie dog [*Cynomys ludovicianus ludovicianus*]) whose burrows provide excellent retreats for ferrets. The dependency of the black-footed ferret on this food item is so great that reduction in numbers of ferrets is directly related to reduction in prairie dogs.	Low. Potential occurrence would be based on the size and density of any prairie dog colonies that may occur within the project area.	Yes. No prairie dog colonies are currently known to exist within the project area.	BISON-M 2009; Findley et al. 1975: BLM 1997
Black-tailed prairie dog (*Cynomys ludovicianus ludovicianus*)	USFWS	Formerly, this species was widespread and abundant east of the Rio Grande and in southwestern New Mexico. Out of the five prairie dog species, the black-tailed prairie dog is the only one found on the short and mid-grass plains east of the Rockies. Black-tailed prairie dogs avoid areas with tall grass, heavy sagebrush, and other thick vegetation cover	Moderate. Potential habitat for the species does not currently occur within the project area.	Yes. No prairie dog colonies are currently known to exist within the project area.	BISON-M 2009; Findley et al. 1975
Arizona black-tailed prairie dog (*Cynomys ludovicianus arizonensis*)	USFWS; BLM	*See C. l. ludovicianus* for habitat associations.	Low. Potential habitat for the species does not currently occur within the project area.	Yes. No prairie dog colonies are currently known to exist within the project area.	BISON-M 2009

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Swift fox (*Vulpes velox velox*)	USFWS	The species is found in pasture or grassland in short or grass climax or subclimax conditions required for foraging or burrowing.	Low. This species could occur within suitable habitats within portions of the project area.	No	BISON-M 2009; BLM 1997; Findley et al. 1975
Guadalupe pocket gopher (*Thomomys bottae guadalupensis*)	BLM; USFWS	This pocket gopher is known to use almost any habitat that has suitable soils for burrowing. They have been found using moderate and high elevations as well as low desert zones. They have been associated with open canyon woodlands, chaparral, grasslands, and pine forests. The subspecies is essentially nocturnal.	None	Yes. This project area does not occur within known range of this subspecies.	BISON-M 2009
Pecos River muskrat (*Ondatra zibethicus ripensis*)	BLM	Muskrats need a waterway that has a constant and fairly stable source of water. An area that has a good water supply but frequently floods is usually unsuitable because the shallow sloughs and marshes inhabited by the "rats" will silt up.	None	Yes. This project area does not occur within known range of this subspecies.	BISON-M 2009
Birds					
Northern beardless tyrannulet (*Camptostoma imberbe ridgwayi)*	NM-E	This species typically occurs at lower elevations in dense stands of mesquite (*Prosopis* spp.) and associated growth-typically along stream courses. In New Mexico, it summers regularly only in Guadalupe Canyon, Hidalgo County	None	Yes. The potential occurrence by this subspecies would be highly unlikely, based on its known habitat and distribution in New Mexico.	BISON-M 2009; NMDGF 2008

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Common black-hawk (*Buteogallus anthracinus anthracinus*)	NM-T; USFWS	Found in the Southwest in cottonwood (*Populus* spp.) and other woodlands along permanent lowland streams where the principal prey of fish, amphibians, and reptiles is available.	Low. This subspecies could potentially occur as a rare visitor to the project area due to the creation of evaporation ponds.	Yes. The potential occurrence by this subspecies would be highly unlikely, based on its known habitat and distribution in New Mexico.	BISON-M 2009; Johnsgard 1990; NMDGF 2008
Varied bunting (*Passerina versicolor versicolor*)	NM-T	In New Mexico the species is a Neotropical migrant at summers regularly in small numbers, and seems to prefer dense, shrubby vegetation associated with relatively arid canyons.	None.	Yes. The project area does not occur within the known range or habitat for this subspecies.	BISON-M 2009; NMDGF 2008
Neotropic cormorant (*Phalacrocorax brasilianus*)	NM-T	This species is a widespread waterbird of Central and South America. Nesting occurs in stands of trees or shrubs in or near water in areas that are free from human disturbance.	Low. This subspecies could potentially occur as a rare visitor to the project area due to the creation of evaporation ponds.	Yes. The potential occurrence by this subspecies would be highly unlikely, based on its known habitat and distribution in New Mexico.	BISON-M 2009; NMDGF 2008
Yellow-billed cuckoo (*Coccyzus americanus occidentalis*)	USFWS	The western race of the yellow-billed cuckoo is associated with lowland deciduous woodlands, willow and alder thickets, second-growth woods, deserted farmlands, and orchards.	None.	Yes. The project area does not occur within the known range or habitat for this subspecies.	BISON-M 2009
Bald eagle (*Haliaeetus leucocephalus alascanus*)	NM-T	In New Mexico, the species nests are placed in large cottonwoods or ponderosa pines, typically in the vicinity of water with a good supply of fish and often also in close proximity to concentrations of small mammals with limited disturbance during nesting season.	Low. This subspecies could potentially occur as a rare visitor to the project area due to the creation of evaporation ponds.	Yes. Potential occurrence by this subspecies within the project area would be highly unlikely.	BISON-M 2009; Johnsgard 1990; NMDGF 2008; BLM 1997

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Aplomado falcon (*Falco femoralis septentrionalis*)	FE; NM-E	The species requires extensive, contiguous desert grasslands characterized by relatively tall, dense grass cover and scattered yucca (*Yucca* spp.) and mesquite (*Prosopis glandulosa*).	Low. This rare subspecies could occur as a rare migrant; as limited historic records near the project area are known.	Yes. Potential occurrence by this subspecies within the project area would be highly unlikely and would likely be limited to migrating individuals.	BISON-M 2009; Johnsgard 1990; NMDGF 2008; BLM 1997
Peregrine falcon, American (*Falco peregrines anatum*)	NM-T; USFWS	In New Mexico, this subspecies breeds locally in mountain areas and migrates statewide. Nests are often located on cliff faces with an overhanging ledge or rock outcrop.	Low. No falcon nest sites have been identified as occurring within the vicinity of the project area.	Yes. The project area does not occur within suitable nesting habitat for this subspecies. Potential occurrence would be limited to migrating and foraging individuals.	BISON-M 2009; Johnsgard 1990; NMDGF 2008; BLM 1997
Peregrine falcon, Arctic (*Falco peregrines tundrius*)	NM-T; USFWS	This subspecies is a very rare migrant through New Mexico.	Low. This migrant subspecies could potentially forage within suitable habitat within the project area.	Yes. Potential occurrence would be limited to migrating and foraging individuals.	BISON-M 2009; Johnsgard 1990; NMDGF 2008; BLM 1997
Southwestern willow flycatcher (*Empidonax traillii extimus*)	FEw/CH; NM-E	The species occurs in riparian habitats along rivers, streams, or other wetlands, where dense growths of willows (Salix sp.), Baccharis, arrowweed (Pluchea sp.), tamarisk (Tamarix sp.), or other plants are present, often with a scattered overstory of cottonwood (Populus sp.).	None	Yes. The potential occurrence by this subspecies would be highly unlikely, based on its known habitat and distribution in New Mexico.	BISON-M 2009; NMDGF 2008; BLM 1997

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Northern goshawk (*Accipiter gentilis atricapillus*)	BLM; USFWS	The species occurs at elevations where stream conditions provide sufficient permanent moisture for emergent plants, or for a narrow band of deciduous trees and shrubs; at low elevation characterized by cottonwood and sycamore, at mid-elevation by white alder (*Alnus rhombifolia*) and bigleaf maple (*Acer macrophyllum*), and at high elevation by willow.	None	Yes. The project area does not occur within the known range or habitat for this subspecies.	BISON-M 2009; Johnsgard 1990
Common ground-dove (*Columbina passerine pallescens*)	NM-E	This low elevation species prefers brushy, well-watered valleys, and frequents riparian woodlands and shrublands, especially mesquite thickets along streams and canyon bottoms. Within New Mexico, it occurs primarily across the southern counties that border Mexico.	None	Yes. This subspecies is extremely unlikely to occur within the project area	BISON-M 2009; NMDGF 2008
Ferruginous hawk (*Buteo regalis*)	BLM	The species is associated with open fields. Sparsely scattered shrubs in conjunction with weedy vegetation dominated about 30% of this habitat. The remaining habitat was dominated by stubble, bare ground, and desert saltgrass. Nest sites include trees, ledges, large rock outcrops, and low cliffs in sagebrush valleys and rolling grasslands.	Low. Nesting and foraging habitat for this species could potentially occur within the project area, but is unlikely.	Yes. The potential occurrence by this subspecies would be highly unlikely, based on its distribution in New Mexico.	BISON-M 2000; Johnsgard 1990.
Broad-billed hummingbird (*Cynanthus latirostris magicus*)	NM-T	The species is found primarily in riparian woodlands at low to moderate elevations. In New Mexico, this subspecies is a regular summer resident only in Guadalupe Canyon of southwestern NM (Hidalgo Co.).	None.	Yes. The project area does not occur within the known range or habitat for this subspecies.	BISON-M 2009; NMDGF 2008

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Lucifer hummingbird (*Calothorax Lucifer*)	NM-T	Habitat use by this species over much of its range seems to center on slopes and adjacent canyons in arid montane areas, especially where there are flowering species such as agaves (*Agave* spp.), ocotillo (*Fouquieria splendens*), and other chaparral-type plants. New Mexico's breeding population of this migratory species is found primarily in the Peloncillo Mountains (Hidalgo Co.).	None.	Yes. The project area does not occur within the known range or habitat for this species.	BISON-M 2009; NMDGF 2008
White-faced Ibis (*Plegadis chihi*)	BLM	The species is generally seen in association with shoreline and marsh habitats that bordered open water. Vegetation within these areas often consisted of cattails and rushes, but other plant species (including occasional woody shrub and tree sp.) were frequently present.	Low. Habitat for this species may potentially exist with the creation of evaporation ponds.	Yes. The potential occurrence by this species would be highly unlikely, based on its known habitat.	BISON-M 2009
Thick-billed kingbird (*Tyrannus crassitostris*)	NM-E	The species requires native broadleaf riparian habitats characterized by mature cottonwoods and sycamores. In New Mexico, it summers regularly only in Guadalupe Canyon, Hidalgo County.	None	Yes. The potential occurrence by this species would be highly unlikely, based on its known habitat and distribution in New Mexico.	BISON-M 2009; NMDGF 2008
Burrowing owl (*Athene cunicularia hypagaea*)	BLM; USFWS	The species inhabits desert, semi-desert shrubland, grasslands, and agricultural areas. Nesting habitat primarily consists of flat, dry, and relatively open terrain; short vegetation; and abandoned mammal burrow for nesting and shelter.	High. Habitat for this species may potentially exist with the project area.	No	BISON-M 2009;

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Mexican Spotted Owl (*Strix occidentalis lucida*)	FTw/CH	Habitat characteristics include high canopy closure, high stand density, a multi-layered canopy, uneven-aged stands, numerous snags, and downed woody matter. These are best expressed in old-growth mixed-conifer forests (usually more than 200 years old). These characteristics may also develop in younger stands that are unmanaged or minimally managed, especially when the stands contain remnant large trees or patches of large trees from earlier stands.	None.	Yes. The project area does not occur within suitable nesting habitat for this subspecies.	BISON-M 2009; BLM 1997
Brown pelican (*Pelecanus occidentalis carolinensis*)	NM-E	The species is usually found in marine habitats in warmer waters in North America; except for the lower Colorado Basin and vicinity, it only rarely occurs inland. The species feeds exclusively on fish, which it usually obtains by diving head-first from heights of up to 20 m.	Low. This subspecies could potentially occur as a rare visitor to the project area due to the creation of evaporation ponds.	Yes. The potential occurrence by this subspecies would be highly unlikely, based on its known distribution in New Mexico.	BISON-M 2009; BLM 1997
Mountain plover (*Charadrius montanus*)	USFWS	Species utilize shortgrass prairies and dry playas dominated by blue grama (*Bouteloua gracilis*) and buffalo grass (*Buchloe dactyloides*) and scattered taller vegetation during the breeding season. The species appears to require some degree of bare ground, which may be provided by livestock grazing, prairie dog (*Cynomyes* spp.) towns, disturbed areas around windmills and water tanks, and barren playas.	Low. This subspecies could potentially occur while foraging during migration through the project area.	Yes. The potential occurrence by this subspecies would be highly unlikely, based on its known distribution and habitat in New Mexico.	BISON-M 2009; BLM 1997

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Piping plover (*Charadrius melodic circumcinctus*)	FT; NM-T	Species occurs on sandflats or along bare shorelines of rivers, lakes, or coasts. The species, which occupies its breeding grounds from late March to August, nests on beaches in the Great Lakes and Atlantic Coast areas, bare areas on islands in the upper Missouri River system, and patches of sand, gravel, or pebbly mud on the alkali lakes of the northern Great Plains. During the winter, piping plovers use algal, mud, and sand flats along the Gulf Coast.	Low. This subspecies could potentially occur while foraging during migration through the project area.	Yes. The potential occurrence by this subspecies would be highly unlikely, based on its known distribution in New Mexico.	BISON-M 2009; NMDGF 2008
Lesser prairie chicken (*Tympanuchus pallidicinctus*)	FC; BLM	This species occurs in short- and tall-grass prairie and shrubsteppe with sagebrush and yucca components. Breeding occurs on lek sites (or strutting grounds) that are typically located on sparsely vegetated elevated areas, ridgelines, or hilltops.	Moderate. Lek sites for this species have been documented east of the project area.	No	BISON-M 2009
Loggerhead shrike (*Lanius ludovicianus excubitorides*)	BLM	This species occurs in creosote bush and large succulents (*Ferocactus pringlei*, and *Echinocactus platyaconthus*) habitats in southern New Mexico	High. Nesting and foraging habitat for this species could potentially occur within the project area.	No	BISON-M 2009
Baird's sparrow (*Ammodramus bairdii*)	NM-T; BLM; USFWS	In New Mexico, it is primarily a migrant. This species utilizes short-grass prairie and other grasslands.	Moderate. This winter migrant could potentially occur within the project area within suitable habitat.	No	BISON-M 2009; NMDGF 2008
Black tern (*Chlidonias niger surinamensis*)	BLM; USFWS	Species breeds and feeds in vegetated marshes with some open water.	Low. This subspecies could potentially occur as a rare visitor to the project area due to the creation of evaporation ponds.	Yes. The potential occurrence by this subspecies would be highly unlikely, based on its known habitat.	

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Interior least tern (*Sterna antillarum athalassos*)	FE; NM-E	Species are colonial nesters that prefer a flat, sandy substrate essentially devoid of vegetation, on which they place their nest scrapes. Terns were found summering at Brantley Reservoir in 2002 and 2003, and were documented nesting there in 2004.	Low. This subspecies could potentially occur while foraging during migration through the project area.	Yes. The potential occurrence by this subspecies would be highly unlikely, based on its known distribution in New Mexico.	BISON-M 2009; NMDGF 2008; BLM 1997
Bell's vireo (*Vireo bellii*)	NM-T; USFWS	Species occurs in dense shrubland or woodland along lowland stream courses, with willows (*Salix* spp.), mesquite (*Prosopis* spp.), and seepwillows (*Baccharis glutinosa*) being characteristic plant species.	None	Yes. The potential occurrence by this subspecies would be highly unlikely, based on its known habitat and distribution in New Mexico.	BISON-M 2009; NMDGF 2008
Gray vireo (*Vireo vicinior*)	NM-T	Species is found in arid juniper woodlands on foothills and mesas, these most often associated with oaks and usually in habitat with a well-developed grass component.	Low. This species could potentially occur within the project area as a migrant.	No	BISON-M 2009; NMDGF 2008
Reptiles					
Western river cooter (*Pseudemys gorzugi*)	NM-T	Primarily a stream species, preferring waters with slow to moderate current, firm bottoms, and abundant aquatic vegetation.	None	Yes. The project does not occur within the known range or habitat for this species.	BISON-M 2009; Degenhardt et al. 1996
Texas horned lizard (*Phrynosoma cornutum*)	BLM	This is a species of open deserts and grasslands with sparse vegetation. Sometimes associated with prairie dog towns. Individuals may bury themselves in loose soils that are sandy, loamy, or rocky and will hide under rocks.	Moderate to High. This species could occur within suitable habitats within portions of the project area.	No	BISON-M 2009; Degenhardt et al. 1996

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Sand dune lizard (*Sceloporus arenicolus*)	FC; NM-T; BLM	Confined to areas of shinnery oak - sand dunes and their peripheries, where the uneven sandy terrain and wind-created blowouts are essential habitat requirements.	Moderate. This species has been documented as occurring near the project area.	No	BISON-M 2009; Degenhardt et al. 1996; NMDGF 2008
Mottled rock rattlesnake (*Crotalus Lepidus Lepidus*)	NM-T	This species prefer steep, rugged mountainous areas or desert canyons and hillsides. Their primary threat is from collecting.	None.	Yes. The project does not occur within the known range or habitat for this subspecies.	BISON-M 2009; Degenhardt et al. 1996; NMDGF 2008
Grey-banded kingsnake (*Lampropeltis alterna*)	NM-E	The species does not occur much higher in elevation than the lower limit of the juniper zone. It prefers rocky igneous or limestone areas with desert vegetation. Occurs in the southern end of the Guadalupe Mountains	None	Yes. The project does not occur within the known range or habitat for this species.	BISON-M 2009; Degenhardt et al. 1996; NMDGF 2008
Western ribbon snake (*Thamnophis proximus diabolicus*)	NM-T	Favored habitats in New Mexico center on streams, ponds, marshes, and even some stocktanks, rarely found away from permanent water sources. It may be found among the dense streamside vegetation, often basking on overhanging branches.	None	Yes. The project does not occur within the known range or habitat for this subspecies.	BISON-M 2009; Degenhardt et al. 1996
Plainbelly water snake (*Nerodia erythrogaster transversa*)	NM-E	This is a semi-aquatic snake restricted to rivers, irrigation ditches, and rocky intermittent streams with abundant fish and frogs. Often hides in dense streamside vegetation.	None.	Yes. The project does not occur within the known range of this subspecies.	BISON-M 2009; Degenhardt et al. 1996; NMDGF 2008

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Fish					
Headwater catfish (*Ictalurus iupus*)	BLM; USFWS	This species occupies clear temperate waters generally with a moderate gradient in headwater streams, or in fluctuating tailwaters of dams in the Pecos River.	None	Yes. The project area does not occur within the known range or habitat for this species.	BISON-M 2009
Greenthroat darter (*Etheostoma lepidum*)	NM-T; USFWS	The species occurs in swift-flowing streams and springs, especially vegetated riffle areas with gravel and rubble substrates.	None	Yes. The project area does not occur within the known range or habitat for this species.	BISON-M 2009; NMDGF 2008; Propst 1999
Pecos gambusia (*Gambusia nobilis*)	FE; NM-E	The species is found mainly in ponded habitats and gypsum sink holes on Bitter Lake NWR and Blue Spring.	None	Yes. The project area does not occur within the known range or habitat for this species.	BISON-M 2009; NMDGF 2008; BLM 1997; Propst 1999
Bigscale logperch (*Percina macrolepida*)	NM-T	Species occurs in deep rivers, preferably with a strong current and rubble-gravel substrate; however, it is also found in rivers with nearly imperceptible flow and in impoundments	None	Yes. The project area does not occur within the known range or habitat for this species.	BISON-M 2009; NMDGF 2008; Propst 1999
Pecos pupfish (*Cyprinodon pecosensis*)	NM-T; USFWS	The Pecos pupfish is found in a variety of habitats from saline springs and gypsum sinkholes to desert streams with highly fluctuating conditions.	None	Yes. Saline habitat is known to occur within and near the project area but there is no perennial water body and it is not known to occur.	BISON-M 2009; NMDGF 2008; BLM 1997; Propst 1999

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Grey redhorse (*Moxostoma congestum*)	NM-T; USFWS	The species is most commonly found in deep, slow-velocity water over a variety of substrates (most commonly silt or limestone bedrock). Most notably in the Pecos and Black rivers.	None	Yes. The project area does not occur within the known range or habitat for this species.	BISON-M 2009; NMDGF 2008; Prost 1999
Pecos bluntnose shiner (*Notropis simus pecosensis*)	FTw/CH; NM-T	The species mainly occurs in pool and run mesohabitats within wide, shallow, sand-bed reaches of the Pecos River. Substrates are largely shifting sand and small gravel.	None	Yes. The project area does not occur within the known range or habitat for this subspecies.	BISON-M 2009; NMDGF 2008; BLM 1997; Propst 1999
Rio Grand shiner (*Notropis jemezanus*)	BLM; USFWS	Inhabits large open rivers with laminar flows and a minimum of aquatic vegetation and larger streams with gravel, sand or rubble bottoms which are sometimes overlain with silt	None	Yes. The project area does not occur within the known range or habitat for this species.	BISON-M 2009;
Blue sucker (*Cycleptus elongates*)	NM-E; BLM; USFWS	This species frequently found in smooth, hard-bottomed reaches of larger streams where current velocity is rapid and deep. Known to occur in the Pecos River from north of Carlsbad downstream to the New Mexico/Texas border and the lower reaches of the Black River	None	Yes. The project area does not occur within the known range or habitat for this species.	BISON-M 2009; NMDGF 2008; Propst 1999
Mexican tetra (*Astyanax mexicanus*)	NM-T	The species tends to be more common in low-velocity pool habitats in small streams and spring systems.	None	Yes. The project area does not occur within the known range or habitat for this species.	BISON-M 2009; NMDGF 2008; Propst 1999

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Invertebrates					
Texas hornshell (*Popenaias popeii*)	FC; NM-E	Species occurs only in larger streams, with variable substrates. The species imbeds itself in softer bottoms, exposing only the siphonal areas in such situations. In rocky sites, it lodges itself in cracks and crevices. Currently only known to occur in the lower Black River.	None	Yes. Mesic habitats occupied by this species would not be affected within the project area.	BISON-M 2009; NMDGF 2008
Pecos springsnail (*Pyrguopsis pecosensis*)	NM-T; BLM	Species is endemic to two perennial tributaries of the Black River. Species lives within a few meters of the brook issuing from Blue Springs, where it occurs under shelter of dead tree-branches and on damp soil.	None	Yes. Mesic habitats occupied by this species would not be affected within the project area.	BISON-M 2009; NMDGF 2008
Ovate vertigo snail (*Vertigo ovate*)	NM-T	Extant populations are known from mesic habitats of Blue Spring. Species occurs on a mud and pebble substrate in its spring habitat, mainly along the edges of the water. At Blue Spring, the species is most common at the spring source and along the natural channel, which is approximately 2 m in width and 1-2 m in depth	None	Yes. Mesic habitats occupied by this species would not be affected within the project area.	BISON-M 2009; NMDGF 2008
Insects					
Guadalupe Mountains tiger beetle (*Cicindela politula petrophila*)	USFWS	Reported to occur in limestone or calcareous clay areas within the Guadalupe Mountains of southeastern New Mexico and west Texas.	None	Yes. Species is endemic to the Guadalupe Mountains of southwestern Eddy county but not known within the project area.	BISON-M 2009

Table 3.8-1 Sensitive Wildlife Species Potentially Occurring Within the Project Area

Common Nam (Scientific Name)	Status[1]	Habitat Information[2]	Potential for Occurrence within the Project Area	Eliminated from Detailed Analysis	References
Obsolete viceroy butterfly (*Basilarchia archippus obsolete*)	USFWS	Known to occur in open habitats with willow and poplar vegetation in association with streams. Can only bread in areas with the presence of willow and poplar.	None	Yes. The project area does not occur within the known habitat for this species.	BISON-M 2009; NatureServe 2009

[1]Status:

FE = Federally listed as endangered.
FT = Federally listed as threatened.
FEw/CH = Federally listed as endangered with critical habitat.
FTw/CH = Federally listed as threatened with critical habitat.
FC = Federal candidate.
USFWS = USFWS species of concern.
NM-E = State-listed as endangered in New Mexico.
NM-T = State-listed as threatened in New Mexico.
BLM = BLM sensitive: New Mexico State Office (NMSO).

Fringed Myotis (BLM). The fringed myotis occupies a wide range of habitats ranging from desert scrub communities to higher elevation coniferous and pine forests (AGFD 1993; Harvey et al. 1999). Fringed myotis use mines, caves, and buildings for roosting sites (Findley et al. 1975; AGFD 1993; Harvey et al. 1999). The species seems to "prefer oak woodlands, from which it forages out into nearby habitats including low desert, chaparral, and ponderosa pine "(AGFD 1993). Based on the species' known distribution and preference for woodland habitats, the potential for this species to occur within the project area is considered to be low.

Long-legged Myotis (BLM). "The long-legged myotis primarily inhabits forested mountain regions, where it roosts in trees, rock crevices, cracks and crevices in stream bands and in buildings. It may be found in streamside and arid habitats" (Harvey et al. 1999). Based on the species' known distribution, the potential for this species to occur within the project area is considered low.

Western Small-footed Myotis (BLM). The western small-footed myotis seems to prefer arid habitats associated with cliffs, talus fields, and prairies with steep riverbanks (Harvey et al. 1999). This distribution mainly includes ponderosa pine habitats, but the species may also be found in low desert up through spruce-fir habitats (Findley et al. 1975). This species roosts in crevices in rock faces and clay banks and may use the spaces beneath and between boulders in talus fields. Hibernation sites include caves and mines (Harvey et al. 1999). Based on the species' known distribution and habitat, the potential for this species to occur within the project area is considered moderate.

Yuma Myotis (BLM). In New Mexico, the Yuma myotis is a water-surface forager (Findley et al. 1975; AGFD 1993; Harvey et al. 1999). Its distribution is tied to permanent watercourses, usually lower than the coniferous forest zone. The Yuma myotis prefers desert, grassland, woodland, and associated riparian communities, between 4,000 to 7,000 feet in elevation (Findley et al. 1975). Unlike many other bat species, the Yuma myotis is not known to roost in caves or mines, but prefers buildings and under bridges (AGFD 1993). Based on the species' known distribution, the potential for this species to occur within the project area is considered moderate.

Swift Fox (USFWS). In New Mexico, the swift fox ranges throughout the short- and mid-grass prairie, generally in areas with sparse vegetation (BLM 1997). They are most common where soils support large populations of rodent prey, especially kangaroo rats. Underground burrows are used as shelter (Findley et al. 1975). Based on the species' known distribution, the potential for this species to occur within the project area is considered low.

<u>Birds</u>

Burrowing Owl (BLM, USFWS). The burrowing owl is a ground-nesting bird that is strongly dependent on the presence of burrows constructed by prairie dogs, ground squirrels, or badgers. Prime burrowing owl habitat must be open, have short vegetation, and contain an abundance of burrows. No burrowing owls have been observed during previous surveys of the project area (CEHMM 2008); however, the potential for this species to occur within the project area is considered to be high.

Lesser Prairie-Chicken (FC, BLM). In southeastern New Mexico, lesser prairie-chickens are found in isolated areas east of the Pecos River in the shinnery oak habitat (BLM 1994; New Mexico LPC/SDL Working Group 2005; BLM 2007b). The EIS associated with the Proposed RMP Amendment (BLM 2007b) states "Lesser prairie-chicken populations south of State Highway 380 in Eddy and Lea counties are rare on BLM properties and surrounding areas; however, there have been sightings of scattered small groups and individuals."

The BLM Special Status Species Proposed RMP Amendment and EIS (BLM 2007b) identified Core Habitat Areas for the lesser prairie-chicken, known as lek sites, and vegetation and habitat composition. The Core Habitat Areas are composed of habitats required to support stable populations of lesser prairie-chickens, including lekking grounds, nesting habitat, brood-rearing habitat, and wintering habitat (BLM 2007b). The nearest Core Habitat Area is located approximately 4 miles east of the project area.

Figure 3.8-1 shows the proximity of the project area and Caprock pipelines to known lesser prairie-chicken habitat. Based on the species' known distribution and habitat requirements, the potential for this species to occur within the project area is considered moderate.

Loggerhead Shrike (BLM). The loggerhead shrike is associated with vegetation types throughout its large range (NMACP 2010). In New Mexico, this species is associated with open country and with short vegetation, including desert grasslands, shrublands, and open woodlands or juniper savannahs (NMACP 2010). Breeding is often associated with isolated trees or large shrubs, while nesting sites can be found in thorny shrubs (NMACP 2010). In desert areas, tall yucca stems are often used as hunting perches. Foraging often occurs in open areas with short grass, but the presence of shrubs is critical (NMACP 2010). Based on the species' known distribution and habitat requirements, the potential for this species to occur within the project area is considered moderate to high.

Baird's Sparrow (NM-T, BLM, USFWS). The Baird's sparrow breeds in shortgrass prairies. In New Mexico, it has been found in habitats ranging from desert grasslands in the south to prairies in the northeast, and mountain meadows in the San Juan and Sangre de Cristo mountains (BISON-M 2009). In New Mexico, they are primarily migrants moving through the eastern plains and southern lowlands, but wintering birds also occur locally in grasslands to the west of the project area (NMDGF 2008). Based on the species' known distribution and habitat requirements, the potential for this species to occur within the project area is considered moderate.

Grey Vireo (NM-T). The gray vireo prefers open pinyon-juniper woodland or juniper savannahs located along canyons, foothills, and mesas. Most chosen habitats have well developed grass or shrub components (NMACP 2010; NMDGF 2008). In southern New Mexico, the species may associate more with oak or desert shrub species (NMACP 2010). Based on the species' known distribution and habitat requirements, the potential for this species to occur within the project area is considered low.

Reptiles

Texas Horned Lizard (BLM). The Texas horned lizard inhabits flat, open, generally dry country with little plant cover, except for bunchgrass and cactus (BISON-M 2009). It can be found in open deserts and grasslands up to 6,000 feet in elevation (Degenhardt et al. 1996). Strictly terrestrial, this lizard can bury itself in loose soil that is sandy, loamy, or rocky (BISON-M 2009). Based on the species' known distribution, the potential for this species to occur within the project area is considered moderate to high.

Sand Dune Lizard (FC, NM-T, BLM). In southeastern New Mexico, the sand dune lizard is restricted to habitats associated with active and semi-stabilized sand dunes (BLM 2007b), and the associated blowouts (open, low-lying areas between active dunes) found between dunes (Working Group 2005). Habitat must support scattered stands of shinnery oak (*Quercus havardii*) and sand sage (Artemisia filifolia) as co-dominated plant species (BLM 2007b). The sand dune lizard is mainly threatened by activities that impact or remove the shinnery oak habitat (Working Group 2005). The species has been found mainly in northeastern Chaves County southward and eastward through eastern Eddy County and southern Lea County (BLM 2007b).

The BLM Special Status Species Proposed RMP Amendment and EIS (BLM 2007b) proposed a Conservation Strategy Planning Area that includes known habitats for the sand dune lizard within southeastern New Mexico. The known distribution includes a mosaic of shinnery oak dunal habitat types within 20 km of an occupied site, measured from the outer edge of that contiguous habitat site (BLM 2007b). The nearest known location of sand dune lizard habitat is approximately 2 miles east of the project area. **Figure 3.8-2** displays the sand dune lizard protected habitat closest to the project area and Caprock pipelines. Based on the species' known distribution, the potential for this species to occur within the project area is considered moderate.

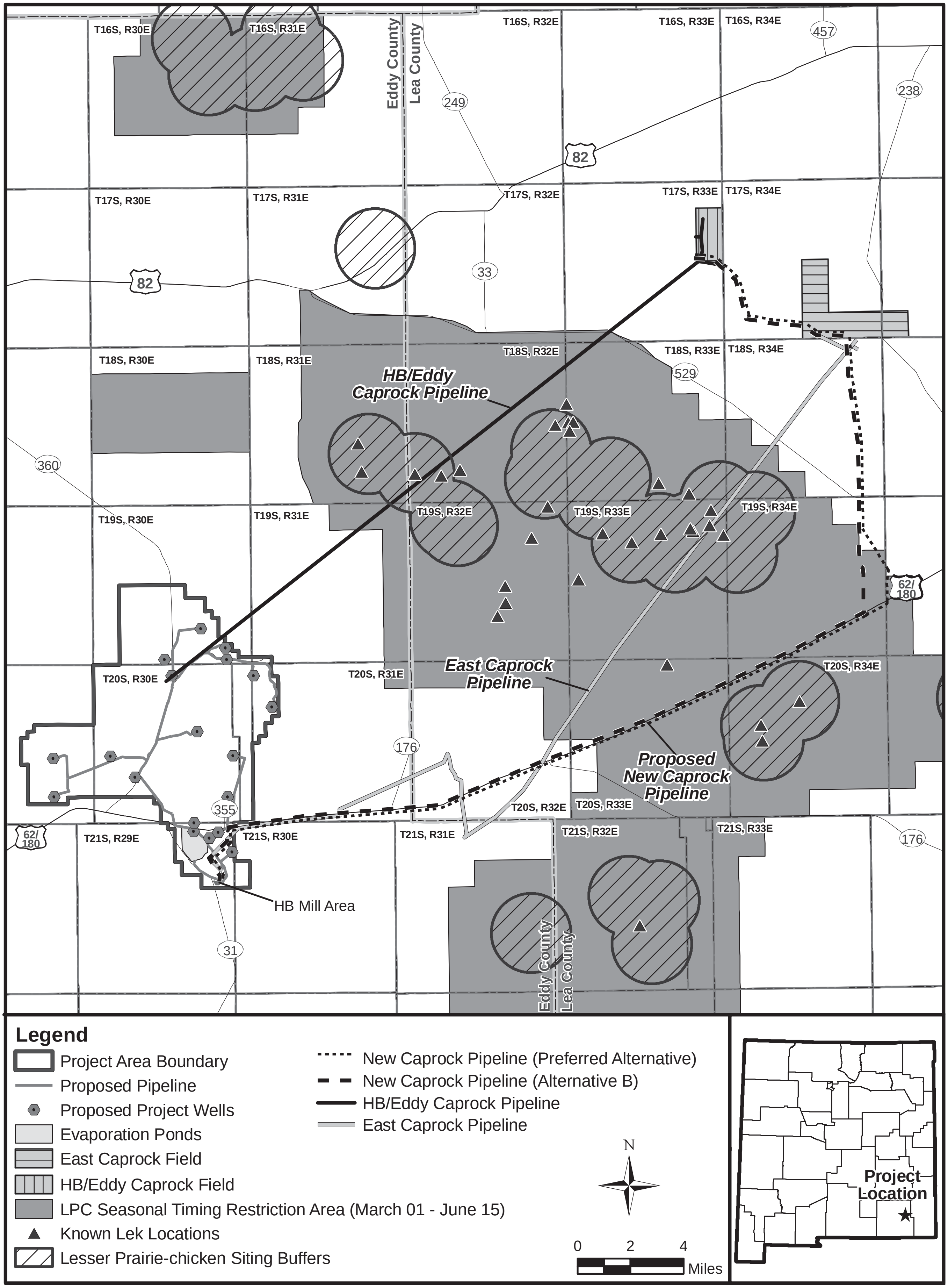


Figure 3.8-1 Lesser Prairie-chicken Habitat near Caprock Pipelines

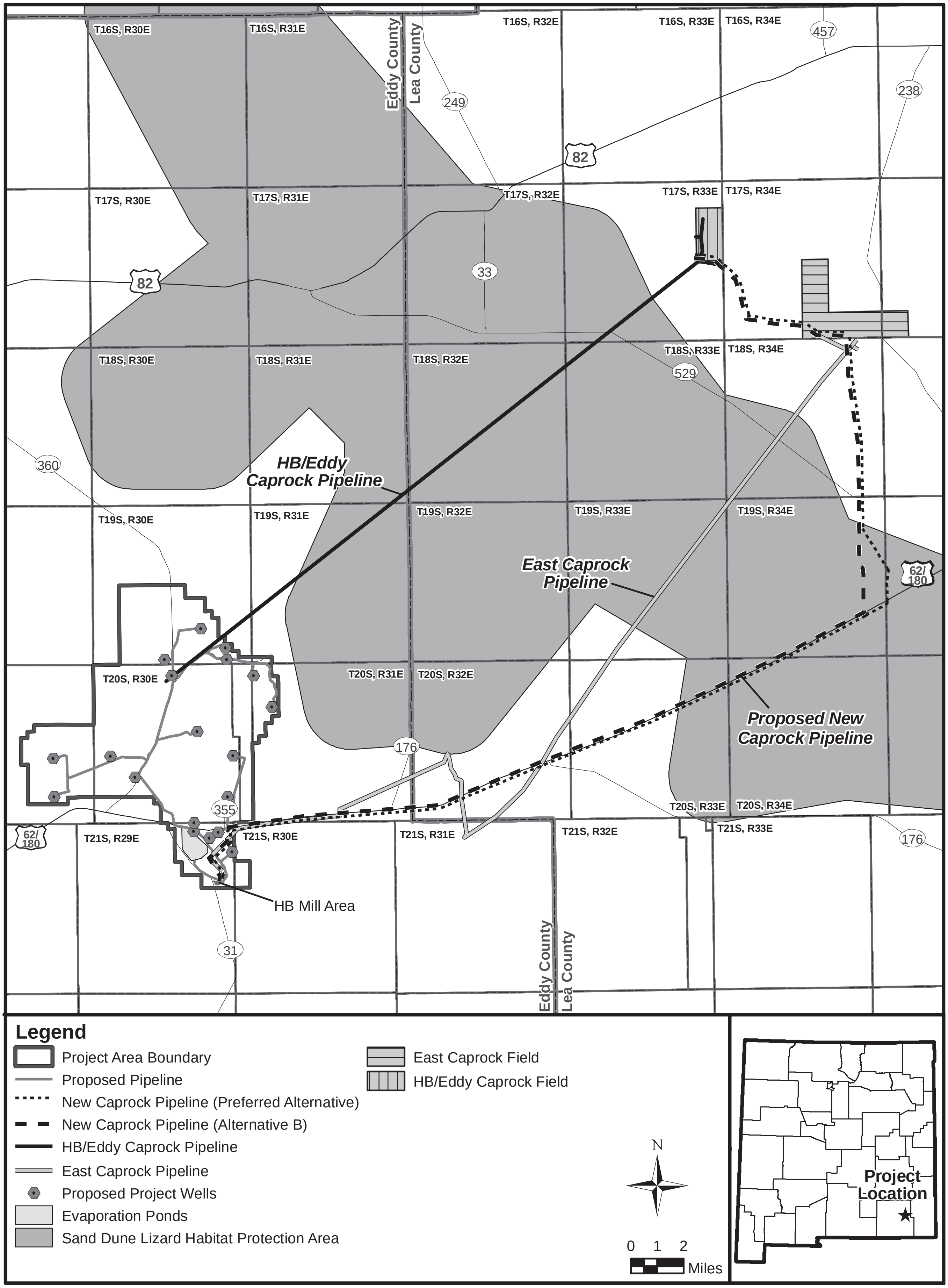


Figure 3.8-2 Sand Dune Lizard Habitat near Caprock Pipelines

Fish

Pecos Pupfish (NM-T, USFWS). The Pecos pupfish is found in a variety of habitats in the region from saline springs and gypsum sinkholes to desert streams with highly fluctuating conditions (BLM 1997). Pecos pupfish populations are most dense in the gypsum sinkholes on Bitter Lake National Wildlife Refuge, northeast of Roswell, New Mexico. Pecos Pupfish occasionally occupies the Pecos River, but is uncommon (BLM 1997). Potential habitat occurs within the project area; however, no known populations have been documented. Based on the species' known distribution, the potential for this species to occur within the project area is considered low.

3.9 Rangelands/Livestock Grazing

The following section presents range management activities for the project area. The study area for range resources is defined as the project area. There are five grazing allotments that occur in the project area, all of which are cattle allotments; while two allotments also show saddle horses on the permit (Clayton Basin and Twin Wells North). **Table 3.9-1** summarizes each grazing allotment within the project area, including acreage calculations, current stocking rates, and permitted uses. Land ownership is predominantly public with a small portion of each allotment encompassing private land. The allotments are grazed using a deferred rotational grazing scheme, where the grazed pastures are rotated each year. This allows each pasture to recover ungrazed during a growing season. The allotments within the project area and along the existing and proposed pipeline routes are granted as Section 3 permits under the Taylor Grazing Act.

Table 3.9-1 Grazing Allotments in the Project Area

Grazing Allotment Name	Total Allotment Active AUMs	Allotment Acreage within the Project	Projected Active AUMs within Project	Livestock		Season of Use	% of Public Land
				Type	Number		
Clayton Basin	10,200	6,771	1,369	Cattle/ Horses	992	Yearlong	85
Fenton Draw	811	887	106	Cattle	69	Yearlong	98
Maroon Cliffs	1,972	2,738	332	Cattle	208	Yearlong	79
Mimosa	2,765	447	55	Cattle	256	Yearlong	90
Twin Wells North	11,664	27,490	2,662	Cattle/ Horses	1,195	Yearlong	81

Note: The number and class of livestock, active AUMs, and stocking rates come from the full grazing permit numbers. Due to market conditions, rainfall, and amount of forage produced each year, actual numbers of livestock grazed and AUMs used are lower than the values above. Grazing permittees have the option to take non-use as conditions warrant.

Tables 3.9-2 and **3.9-3** summarize each grazing allotment along the existing and proposed pipeline routes. In the northeast portions of the pipelines routes, the remainder occurs on state and federal lands. All the allotments are grazed year round. **Figure 3.9-1** illustrates the five grazing allotments found within the project area.

Table 3.9-2 Grazing Allotments in the Existing Pipeline ROWs (HB/Eddy and Caprock East)

Grazing Allotment Name	Total Allotment Active AUMs	Allotment Acreage along the Pipeline	Projected Active AUMs within Project	Livestock		Season of Use	% of Public Land
				Type	Number		
Buckeye North	48	38	<1	Cattle	4	Yearlong	100
Buckeye South	No Data	33	No Data				
Clayton Basin	10,200	72	13	Cattle/ Horses	992	Yearlong	85
Halfway	3,576 cattle/ 40 horses	15	3	Cattle/ Horses	359 cattle/ 4 horses	Yearlong	83
Laguna Tonto	11,641	21	10	Cattle/ Horse	Varies	Yearlong	Varies
Laguna Totson	840	9	2	Cattle	70	Yearlong	100
Little Lake	691	4	<1	Cattle	80	Yearlong	72
Maljamar II	24	26	2	Cattle	178	Yearlong	68
Maljamar South	1,452	34	3	Cattle	2	Yearlong	100
Maroon Cliffs	1,972	25	2	Cattle	208	Yearlong	79
Querecho Plains	1,339	9	1	Cattle	115	Yearlong	97
Salt Lake	No Data	34	No Data				
Twin Wells North	11,664	32	3	Cattle/ Horses	1,195	Yearlong	81
West Bilbrey	1,176	15	2	Cattle	121	Yearlong	81

Note: The number and class of livestock, active AUMs, and stocking rates come from the full grazing permit numbers. Due to market conditions, rainfall, and amount of forage produced each year, actual numbers of livestock grazed and AUMs used are lower than the values above. Grazing permittees have the option to take non-use as conditions warrant.

Source: BLM 2010c.

Table 3.9-3 Grazing Allotments in the Proposed Caprock Pipeline ROW

Grazing Allotment Name	Total Allotment Active AUMs (ac.)	Allotment Acreage along the Pipeline	Projected Active AUMs within Project	Livestock		Season of Use	% of Public Land
				Type	Number		
Buckeye North	48	30	<1	Cattle	4	Yearlong	100
Buckeye South	No Data	24	No Data	No Data	No Data	No Data	No Data
Clayton Basin	10,200	29	5	Cattle/ Horses	992	Yearlong	85
Halfway	3,576 cattle/ 40 horses	16	4	Cattle/ Horse	359 cattle/ 4 horses	Yearlong	83
Hart Ranch	379	38	1	Cattle	117	Yearlong	27
Laguna Tonto	11,641	21	11	Cattle/ Horse	Varies	Yearlong	Varies
Laguna Totson	840	13	4	Cattle	70	Yearlong	100
Maljamar II	24	1	<1	Cattle	178	Yearlong	68
Salt Lake	No Data	18	No Data	No Data			
Twin Wells North	11,664	24	2	Cattle/ Horses	1,195	Yearlong	81

Note: The number and class of livestock, active AUMs, and stocking rates come from the full grazing permit numbers. Due to market conditions, rainfall, and amount of forage produced each year, actual numbers of livestock grazed and AUMs used are lower than the values above. Grazing permittees have the option to take non-use as conditions warrant.

Source: BLM 2010c.

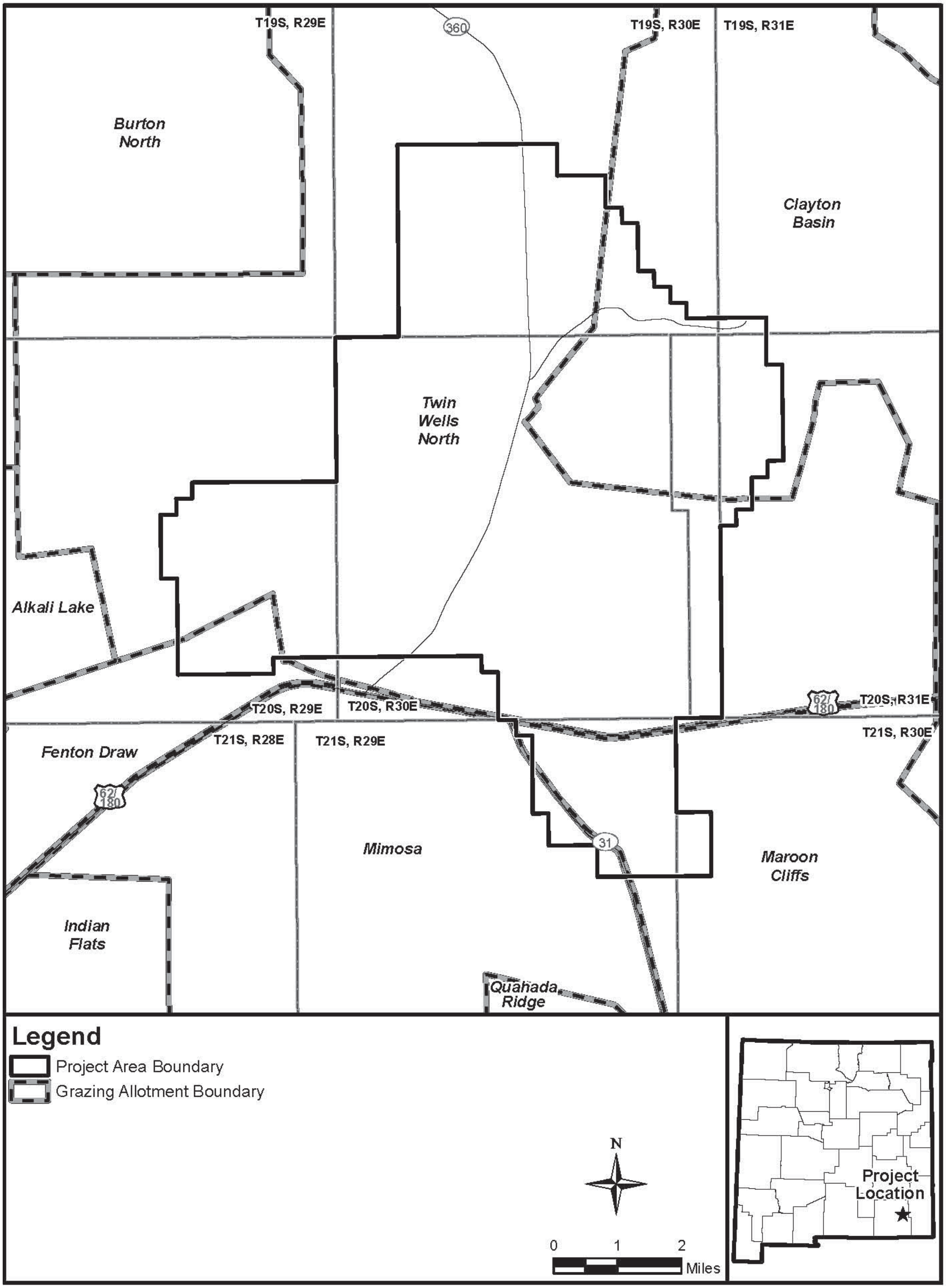


Figure 3.9-1. Grazing Allotments in the Project Area

The grazing allotments are categorized into one of three management categories: Improve (I), Maintain (M), or Custodial (C). These categories are based on present conditions, potential for improvement, other resource conflicts, and opportunities for positive economic return on public investments. An allotment can be reassigned to a different management category if resource conditions in the allotment change, or new and/or better data becomes available. The highest priority for management are allotments assigned to the I category. The second priority is allotments in the M category. Issues that arise on allotments in the C category are addressed when conflicts arise. Management goals for the allotments in the I category are geared towards improving resource conditions, while for allotments in the M category, management goals are to maintain current resource conditions. For allotments in the C category, custodial management works to prevent resource deterioration. In the project area, the allotments assigned to the M category include Clayton Basin, Mimosa, and Maroon Cliffs. Only Twin Wells North allotment is assigned to the I category. Fenton Draw is the only allotment in the C category. Management activities generally include vegetation treatments to improve rangeland health and forage availability. See Section 3.7, Vegetation, for more discussion of the vegetative treatments in the project area.

Water sources for livestock include intermittent and ephemeral streams, lakes, and stock ponds. Water related range improvements in the project area include base water sources, water wells and water storage, troughs, and wells (**Table 3.9-4).** The only water resource range improvements within the proposed and existing pipeline routes are two troughs in Buckeye South and one trough in Halfway allotments.

Table 3.9-4 Water Related Range Improvements within the Project Area

Grazing Allotment Name	Base Water	Trough	Water Well & Storage	Well
Clayton Basin	1	—	1	—
Twin Wells North	4	17	—	1
Total	**5**	**17**	**1**	**1**

3.10 Lands and Realty

Land use is currently comprised of livestock grazing; recreation, oil and gas leases with well sites and associated infrastructure, and potash mining with associated infrastructure. Due to the nature of the existing land uses, portions of the project area are highly disturbed. There are no areas with wilderness characteristics within or near the project area. Recreational activities are an additional land use, which takes place within the project area. Hunting, off-highway vehicle (OHV) use, camping, and picnicking are common recreational activities. Recreational activities are discussed in Section 3.11. The project area lies within the SPA.

3.10.1 Land Ownership

As noted in **Table 3.10-1**, the federal government, administered by the BLM, is the predominant land owner. State lands, private land owned by Intrepid, and other fee lands make up the remainder of the landowners within the project area boundary.

Table 3.10-1 Land Ownership

Ownership	Project Area		New Caprock Pipeline[1]		East-HB/Eddy Caprock Pipelines[1]	
	% Ownership	Acres	% Ownership	Acres	% Ownership	Acres
Federal Lands	82	31,439	45	119	61	237
State Lands	13	4,954	40	105	22	87
Private	5	2,060	15	38	17	64
Total	100	38,453	100	262	100	388

[1] Analysis does not include acreage within the project area.

3.10.2 Transportation

The project area is transected by one U.S. highway, two state highways, and numerous BLM maintained gravel roads and unimproved access roads. U.S. Highway 62 crosses the southern portion of the project area in an east-west direction. Northeast of the project area, U.S. 62 connects Carlsbad with Hobbs. State Highway 31 crosses the southern portion of the project area, terminating at U.S. 62, while NM 380 initiates at U.S. 62 and runs north through the project area. Additionally, CR 222/Shugart Road, initiates from within the project area and runs northwest, terminating at U.S. 82. NM 529 runs southwest from U.S. 82 to U.S. 62 in the vicinity of the proposed Caprock pipeline. Most of the roads within the project area are BLM-maintained access roads, but there are a number of secondary non-maintained user-created two-track roads.

3.10.3 Rights-of-Way

There are two common types of ROWs within the Carlsbad Field Office area—ROW grant authorizations and sundry ROWs. Sundry ROWs may include pipelines, roads, and power lines within oil and gas leases. Five ROW corridors have been designated within the field office jurisdiction, totaling 185 miles in length. There are no designated utility corridors in or adjacent to the project area. The nearest designated utility corridor is approximately 15 miles northwest of the project area.

ROWs for oil and gas pipelines, water pipelines, roads, fiber optic cable, electric power lines, and telephone lines are permitted in and near the project area. Several utilities within the project area that may be affected by the proposed project include three overhead power lines owned by Xcel, two buried New Mexico Gas pipelines, and one AT&T fiber optic line. Additionally, two short-line railroad tracks associated with the Burlington Northern Santa Fe Railroad transect the project area (Burlington Northern Santa Fe 2010). These lines are used to store rail cars and to serve nearby mines (Cranston 2009). **Table 3.10-2** summarizes the number of BLM- and State of New Mexico-permitted ROWs within the project area. See **Appendix C** for detailed descriptions of the ROWs.

Table 3.10-2 Rights-of-Way within Project Area

ROW Use	Total Within Project Area (no. BLM/no. NM[2])	Active (no. BLM/no. NM)	Inactive (no. BLM/no. NM)
Oil Pipeline[1]	11/1	6/1	5/0
Gas Pipeline	56/13	42/13	14/0
Road	60/2	52/2	8/0
Railroad	3/3	3/3	0/0
Power line	51/15	43/15	8/0
Water	14/0	11/0	3/0
Telephone	10/3	7/9	2/0
Fiber Optic	4/1	4/1	0/0
Total	209/38	169/38	40/0

[1] A total of 5 ROWs are listed as both oil and gas pipelines. In this table they have been included under Oil Pipeline to avoid double-counting.

[2] NM refers to state ROWs.

3.11 Recreation

Recreation in the project area is currently comprised of OHV activities as well as hunting, camping, and picnicking. All public lands in the BLM Carlsbad Field Office Area are designated as limited, open, or closed to OHV activities. All of the BLM-administered land in the project area is designated as open to OHV use.

A portion of the Hackberry Lake Special Recreation Management Area (SRMA) covers the northeastern part of the project area (see **Figure 3.11-1**). This recreation area totals 55,800 acres, and is open for intensive use of motorcycles, sand dune buggies, and other OHVs, getting frequent use year-round. The Desert Rough Riders hold a Special Recreation Use Permit in the Hackberry Lake OHV Area to hold a 2-day motocross and all terrain vehicle race each October. There is a parking area to the north that is used as a starting point for the race (Younger 2009).

Approximately, 16,178 acres or 29 percent of the OHV area lies within the project area boundary. The recreation area overlaps approximately 40 percent of the project area. Trails within the recreation area typically consist of many turns and steep hill climbs. Camping is allowed in the Hackberry Lake SRMA and facilities include picnic tables, shelters, fire rings, vault toilets, and parking areas at two different locations (trails on the east side and dune complex on the west side of the SRMA).

Hunting is another recreational activity that may take place within the project area. A variety of species, from big game to varmints and upland birds, may be hunted in the project area (Younger 2009).

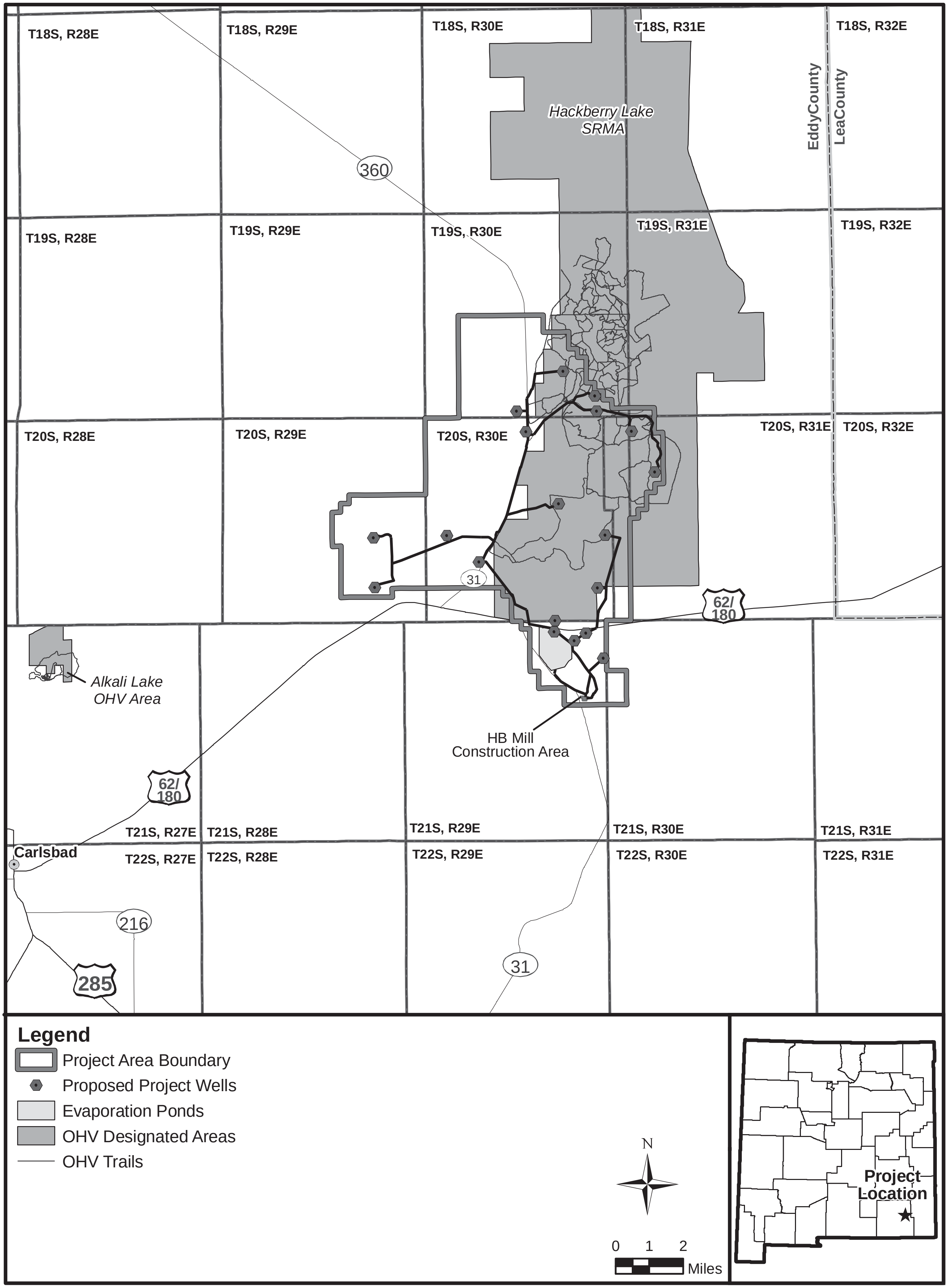


Figure 3.11-1 Hackberry Lake SRMA within the Project Area

3.12 Visual Resources

The project area is roughly bounded by Fade-A-Way Ridge to the northwest, Quahada Ridge to the southwest, Maroon Cliffs to the southeast, and Nimenim Ridge to the northeast. The affected environment is characterized by little variety or contrast in vegetation, a variety in colors and contrast of the soil, rock, and vegetation, scattered pools of water that do not dominate the landscape, and as well as current oil and gas operations, and current and abandoned potash mining facilities. The project area is sparsely populated.

In a January, 2011, the BLM conducted a scenic quality rating for the project area. Scenic quality is the relative worth of a landscape from a visual perception point of view. Key observation points were established along NM Highway 62/180 (Hobbs Highway), NM Highway 360 (Bluestem Road), Buckeye Road, and the outlying areas of Shugart Road. The scenic quality rating provides a score for the following scenic elements: landform, vegetation, water, color, influence of adjacent scenery, scarcity, and cultural modifications. The scores and descriptions determined in the inventory of the project area are listed below, using a rating system of 1 (low), 3 (medium), 5 (high) on the first six elements and a score of -4 (low), 0 (medium) and 2 (high) on the last element of cultural modification.

- Landform = 1: Terrain in the proposed project area is dominated by low rolling hills or flat valley bottoms with few interesting natural features.
- Vegetation = 1: Little variety or contrast in vegetation is noted in the proposed project area. Salt cedar, mesquite, shinnery oak, yucca, and warm season grasses dominate the landscape.
- Water = 5: Dominant factor in the landscape (primarily from Hackberry SRMA key observation point and Shugart Road.
- Color = 1: Subtle color variations, contrast, or interest; generally mute tones.
- Adjacent Scenery = 0: Adjacent scenery has little or no positive influence on overall visual quality. Current and abandoned potash mining facilities, vegetative damage from old mining activities, and current oil and gas operations are highly visible. Maroon Cliffs Archaeological District is a positive scenic element and a VRM III classification.
- Scarcity = 1: Area is interesting within its setting but fairly common throughout the region. The area contains two developed recreation areas that are highly used.
- Cultural Modifications = -4: Modifications add variety but are very discordant and promote strong disharmony. Abandoned potash mining facilities, environmental damage from past practices, caliche mining, and increasing oil and gas development is having a negative cumulative impact on visual scenic quality in this area.

The score for each elements is then added to provide a Scenic Quality Classification of A (19 or more), B (12 to 18) or C (11 or less). As a result of the rating, it was determined that all portions of the project area on BLM-administered land were had a Scenic Quality Classification as C. A Scenic Quality Classification of C reflects the lowest relative worth of a landscape from a visual perception point of view.

The BLM is responsible for managing the public lands for multiple uses, while ensuring that the scenic values of public lands are considered before allowing uses that may have adverse visual impacts. The BLM accomplishes this by classifying areas according to its Visual Resource Management (VRM) system. Each VRM class describes the degree of modification to the basic elements of the landscape allowed. The following are the minimum management objectives for each class, based on BLM Handbook H-8410-1, Visual Resource Inventory.

- Class I: Natural ecological changes and very limited management activity are allowed. Any contrast created within the characteristic landscape must not attract attention. This classification is applied to Visual Areas of Critical Environmental Concern, wilderness areas, wild and scenic rivers, and other relatively undisturbed landscapes.

- Class II: Changes in any of the basic elements (form, line, color, texture) caused by a management activity should not be evident in the landscape. A contrast may be seen but should not attract attention.
- Class III: Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape. Contrasts to the basic elements caused by a management activity may be evident and begin to attract attention in the landscape. The changes, however, should remain subordinate in the existing landscape.
- Class IV: Contrasts may attract attention and be a dominant feature in the landscape in terms of scale. However, the changes should repeat the basic elements of the landscape.

With the exception of 13 acres located near the southeast project boundary between the Hobbs highway and the railroad track, the proposed project is located on public lands managed as VRM Class IV in which the level of change of the characteristic landscape can be high. Management activities may dominate the view and be the primary focus of viewer attention. However, every attempt should be made to minimize the impact of activities through careful location of facilities, minimal disturbance, and repetition of the basic landscape elements of color, form, line, and texture.

3.13 Cultural Resources

Cultural resources are definite locations of human activity, occupation, or use identifiable through field inventory (survey), historical documentation, or oral evidence. The term includes archaeological, historic, or architectural sites, structures, or places with important public and scientific uses, and may include definite locations (sites or places) of traditional, cultural, or religious importance to specified social and/or cultural groups. Cultural resources are concrete, material places and things that are located, classified, ranked, and managed through the BLM's Land Use Planning system of identifying, protecting, and utilizing for public benefit.

The analysis area for cultural resources is the area of potential effect (APE). Under Section 106 of the NHPA, the APE is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking" (36 CFR 800.16[d]). The APE should include:

- All alternative locations for all elements of the proposed project.
- All locations where the proposed project may result in ground disturbance such as tailings piles.
- All locations from which elements of the proposed project (e.g., a facility or land disturbance) may be visible or audible.
- All locations where the proposed project may result in changes in traffic patterns, land use, public access, etc.
- All areas where there may be direct or indirect effects.

The APE for the proposed project encompasses the project area. Only those cultural resources located in the APE were reviewed to determine if they would be subject to impacts that could affect their eligibility for the National Register of Historic Places (NRHP) based on NRHP criteria for evaluation.

3.13.1 Regulatory Framework

Federal historic preservation legislation provides a legal environment for documentation, evaluation, and protection of prehistoric and historic sites that might be affected by federal undertakings, including private undertakings that operate under federal license or on federally managed lands. The NHPA of 1966, as amended, established the Advisory Council on Historic Preservation (ACHP) and the NRHP. The NHPA mandates that federal agencies consider the effect of an undertaking on cultural resources that are listed or are eligible for listing on the NRHP. Section 106 of the NHPA and its implementing regulations (36 CFR 800) establishes a four-step review process by which such resources are considered. The four steps are as follows:

1. Initiate the Section 106 process by establishing the undertaking, defining the APE, and consulting with the appropriate agencies.
2. Identify NRHP-eligible sites, through inventory and evaluation.
3. Apply the criteria to determine adverse effects.
4. If adverse effects will occur, then take appropriate steps to avoid or mitigate those effects.

Cultural resources that are listed or eligible for listing on the NRHP are referred to as historic properties.

The National Programmatic Agreement (NPA) among the BLM, ACHP, and National Conference of State Historic Preservation Offices regarding the manner in which the BLM will meet its responsibilities under the NHPA is the National BLM authority for meeting requirements of the NHPA. Day-to-day operations are based on the protocols developed by the local BLM offices in each state. In New Mexico, the Protocol Agreement (2004) between the BLM and New Mexico SHPO defines how the BLM and SHPO will interact and cooperate under the NPA, and provides direction for implementing the NHPA.

3.13.2 Eligibility Criteria for Listing Cultural Resources on the NRHP

The NRHP, maintained by the NPS on behalf of the Secretary of the Interior, is the nation's inventory of significant cultural resources. The NPS has established three main standards that a resource must meet to qualify for listing on the NRHP: age, integrity, and significance. To meet the age criteria, a resource generally must be at least 50 years old. To meet the integrity criteria, a resource must "possess integrity of location, design, setting, materials, workmanship, feeling, and association" (36 CFR 60.4). Finally, a resource must be significant according to one or more of the following criteria:

- Criterion A: be associated with events that have made a significant contribution to the broad patterns of our history.
- Criterion B: be associated with the lives of persons significant in our past.
- Criterion C: embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction.
- Criterion D: have yielded, or may be likely to yield, information important in prehistory or history.

3.13.3 Culture History

The proposed project falls within the Southeastern New Mexico Archaeological Region. This region contains the following cultural/temporal periods: Paleoindian (ca. 12,000 – 6,200 B.C.), Archaic (ca. 6,200 B.C. – A.D. 500), Ceramic (ca. A.D. 500 – 1540), Protohistoric and Spanish Colonial (ca. A.D. 1400 – 1821), and Mexican and American Historical (ca. A.D. 1822 to early 20th Century). For a full discussion of the cultural/temporal periods, the reader is referred to Living on the Land: 11,000 Years of Human Adaptation in Southeastern New Mexico, An Overview of Cultural Resources in the Roswell District (Sebastian and Larralde 1989).

3.13.4 Cultural Resources Investigations

To date, 12 Class III cultural resources inventories associated with the proposed project have been conducted within proposed disturbance areas. In addition to the inventories, a treatment plan was developed for three NRHP-eligible sites located during inventory of the proposed evaporation ponds. Of the 12 cultural resources inventories, 7 encountered archaeological sites. The following are brief summaries of the seven inventories in which archaeological sites were encountered.

In August 2007, a Class III cultural resources inventory of two proposed solution wells (IP-017 and IP-018) and associated access roads was conducted for the proposed project (Walker and Dello-Russo 2007). Site LA157681, a prehistoric lithic scatter of unknown cultural affiliation, was documented during the inventory. The site was recommended as ineligible for the NRHP; no additional investigation of the site is necessary.

Between October 2007 and March 2008, three proposed monitor wells (IP-015, IP-016, and IP-019) and associated access roads were inventoried at the Class III level for cultural resources (Walker and Dello-Russo 2008a). During the Class III inventory, one newly recorded segment of a railroad spur along the Atchison, Topeka, & Santa Fe Railroad was located within the access road associated with IP-015, as well as a previously recorded prehistoric lithic scatter (LA36561). The abandoned railroad spur (LA158191) was recommended as ineligible for the NRHP and the prehistoric lithic scatter was recommended as eligible under Criterion D. Subsequent to the inventory, the proposed access road was dropped from consideration and an existing dirt road was chosen as access to the well. Consequently, the NRHP-eligible prehistoric lithic scatter would be avoided by project construction. No additional investigation of the site is recommended.

From October 2007 to March 2008, a Class III cultural resources inventory of three proposed monitor wells (IP-020, IP-022, and IP-030) and associated access roads was completed for the proposed project (Walker and Dello-Russo 2008b). Two newly recorded historic sites and two previously recorded prehistoric sites were located during the inventory. The newly recorded historic sites include a possible camp with several features (LA159881) and an artifact scatter (LA159882). Both sites were recommended as not eligible for the NRHP; no additional investigation of these sites is necessary. The two previously recorded prehistoric sites include an NRHP-eligible lithic, ceramic, and groundstone scatter (LA110823) and an ineligible lithic scatter (LA137355). Due to the presence of the NRHP-eligible prehistoric site within a proposed well location, the orientation of the well pad was realigned to provide maximum distance between construction activities and the site. No additional investigation of the site is necessary; however, an archaeological monitor is recommended during construction of the well.

Between February and May 2008, a Class III cultural resources inventory of the proposed evaporation ponds was conducted for the proposed project (Walker and Dello-Russo 2008c). The inventory located nine newly recorded sites and eight previously recorded sites. Eight of the seventeen sites were recommended as eligible for the NRHP. However, seven of the eight eligible sites are located outside of proposed disturbance associated with construction of the ponds and therefore would not be impacted by project construction. The remaining eligible site (LA109920) and sites LA159599 and LA159601, both of which have undetermined eligibility, are located within proposed disturbance areas and would be adversely affected by construction activities. Site LA109920 is a previously recorded prehistoric lithic and ceramic scatter eligible for the NRHP under Criterion D. Sites LA159599 and LA159601 are newly recorded prehistoric artifact scatters that require test excavations to determine their eligibility to the NRHP. In a letter to the New Mexico State Historic Preservation Officer (SHPO), the BLM recommended additional archaeological work for sites LA109920, LA159599, and LA159601 to mitigate the adverse effects of the proposed project .The New Mexico SHPO subsequently concurred with the BLM recommendations (Nelson 2008).

In January 2009, a treatment plan for sites LA109920, LA159599, and LA159601 was prepared and submitted to the BLM (Lone Mountain 2009a). The treatment plan outlines the procedures for conducting evaluative testing at the three sites and subsequent data recovery, if necessary. The plan also includes a summary of findings to date, description of the general theoretical perspective guiding the work, regional research problems, testable research questions, relevant data needs, field techniques, laboratory and analytical techniques, and curation arrangements.

Evaluative testing at sites LA109920, LA159599, and LA159601 was completed in late fall 2009. Laboratory analysis of the data collected during testing currently is underway. Results of the testing and laboratory analysis will be included in a report and submitted to the BLM and SHPO for review. Recommendations for additional archaeological work (i.e., data recovery) will be determined based on BLM and SHPO review.

In October 2008, a proposed core hole location (IP-40) was inventoried at the Class III level for cultural resources (Walker and Dello-Russo 2008d). As a result of the inventory, one previously recorded site was located outside of the proposed disturbance area. The site (LA30766) was identified as a prehistoric lithic, groundstone, and ceramic scatter, and recommended as eligible for the NRHP under Criterion D. Since the site is located outside of proposed disturbance associated with construction of the core hole, no additional investigation of the site is recommended.

From March to May 2009, a Class III inventory of two proposed monitor wells (IP-024 and IP-025) and associated access roads was conducted for the proposed project (Walker and Dello-Russo 2009). During the inventory, three newly recorded sites were documented and one previously recorded site was updated. The newly recorded sites include a prehistoric lithic scatter (LA163309), multi-component site with a prehistoric lithic, ceramic, and groundstone scatter and historic artifact scatter (LA163310), and historic railroad (LA163311). Site LA163309 (prehistoric lithic scatter) and the prehistoric component of LA163310 were recommended as eligible for the NRHP under Criterion D. Site LA163311 (historic railroad) and the historic component of LA163310 were recommended as ineligible for the NRHP. The one previously recorded site (LA121535) contains a prehistoric lithic and ceramic scatter and is recommended as eligible for the NRHP under Criterion D. NRHP-eligible sites LA163309 and LA121535, and the NRHP-eligible prehistoric component of site LA163310 would be avoided by proposed disturbance; therefore, no additional investigation of these sites is recommended.

Between June and July 2009, a Class III inventory of 153 acres in and around the proposed project area was conducted for a proposed subsidence monitoring program by Intrepid Potash (Lone Mountain 2009b). The monitoring program involves placing metal rods below the surface at designated drill points to measure future ground elevation (subsidence) in and around the proposed project area. One previously recorded site (LA70119), one newly recorded site, and seven isolated occurrences were located during the Class III inventory. Previously recorded site LA70119 is a large prehistoric lithic scatter determined eligible for the NRHP under Criterion D by the New Mexico SHPO in 1998. The newly recorded site (LA163291) is a prehistoric lithic scatter and is recommended as eligible for the NRHP under Criterion D. Both of the NRHP-eligible sites were avoided by placement of the metal rods; no further work is recommended. Isolated occurrences are by definition not eligible for the NRHP; therefore, no further investigation of these isolated finds is recommended.

At this time, no Class III inventories have been conducted for the proposed locations of the mill processing facilities, water pipelines, and utility conveyances associated with the proposed project; all other proposed project components have been inventoried. Inventories of proposed project components not yet inventoried would be completed by a BLM-approved archaeologist prior to project construction. The results of the inventories would be documented in a technical report, which would include the results of the literature search and field survey, a cultural background of the area, descriptions of each site, a historic context to evaluate each site for NRHP eligibility, and management recommendations. The report would be submitted to the BLM for review, and the BLM would consult with the New Mexico SHPO according to the terms of the Protocol Agreement.

3.13.5 Native American Traditional Values

Ethnographic resources are associated with the cultural practices, beliefs, and traditional history of a community. Examples of ethnographic resources include places in oral histories or myths, such as particular rock formations, the confluence of two rivers, or a rock cairn; large areas, such as landscapes and viewscapes; sacred sites and places used for religious practices; social or traditional gathering areas, such as dance areas; natural resources, such as plant materials or clay deposits used for arts, crafts, or ceremonies; and places and natural resources traditionally used for non-ceremonial uses, such as trails or camping locations.

3.13.5.1 Regulatory Framework

Federal law and agency guidance require the BLM to consult with Native American tribes concerning the identification of cultural values, religious beliefs, and traditional practices of Native American people that may be affected by BLM undertakings. This consultation includes the identification of places (i.e., physical locations) of traditional cultural importance to Native American tribes. Places that may be of traditional cultural importance to Native American people include, but are not limited to, locations associated with the traditional beliefs concerning tribal origins, cultural history, or the nature of the world; locations where religious practitioners go, either in the past or the present, to perform ceremonial activities based on traditional cultural rules or practice; ancestral habitation sites; trails; burial sites; and places from which plants, animals, minerals, and waters possessing healing powers or used for other subsistence purposes, may be taken. Some of these locations may be considered sacred to particular Native American individuals or tribes.

In 1992, the NHPA was amended to explicitly allow that "properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization may be determined to be eligible for inclusion on the NRHP." If a resource has been identified as having importance in traditional cultural practices and the continuing cultural identity of a community, it may be considered a Traditional Cultural Property (TCP). The term "traditional cultural property" first came into use within the federal legal framework for historic preservation and cultural resource management in an attempt to categorize historic properties containing traditional cultural significance. National Register Bulletin 38: Guidelines for Evaluating and Documenting Traditional Cultural Properties (Parker and King 1998) defines a TCP as "one that is eligible for inclusion on the NRHP because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community." To qualify for nomination to the NRHP, a TCP must be more than 50 years old, must be a place with definable boundaries, must retain integrity, and must meet certain criteria as outlined for cultural resources in National Register Bulletin 15 (NPS 1995).

In addition to NRHP eligibility, some places of cultural and religious importance to the tribes also must be evaluated to determine if they should be considered under other federal laws. These include, but are not limited to, the NAGPRA, American Indian Religious Freedom Act (AIRFA) of 1978, Archaeological Resources Protection Act (ARPA) of 1979, and EO 13007 (Sacred Sites) of 1996.

3.13.5.2 Native American Consultation

The BLM conducts Native American consultation regarding TCPs and sacred sites during land use planning and its associated environmental impact review. In addition, during the oil and gas lease sale process, Native American consultation is conducted to identify TCPs and sacred sites whose management, preservation, or use would be incompatible with oil and gas or other land use authorizations. With regard to TCPs, the BLM has very little knowledge of tribal sacred or traditional use sites, and these sites may not be apparent to archaeologists performing surveys in advance of drilling. However, to date, no TCPs or sacred sites have been identified in the vicinity of the proposed project area.

In January 2009, the BLM submitted a copy of the above-described treatment plan to the Mescalero Apache Tribe, Apache Tribe of Oklahoma, Comanche Indian Tribe, Pueblo of Isleta, Kiowa Tribe of Oklahoma, Ysleta del Sur Pueblo, and Hopi Tribal Council for review. To date, only the Hopi Tribe and Pueblo of Isleta have responded. In a letter dated February 23, 2009, the Hopi Tribe stated their appreciation for the continued opportunity to provide input on the proposed project, and requested if prehistoric human remains are inadvertently discovered during project construction that the Tribe be notified prior to any proposed excavation (Kuwanwisiwma 2009). In addition, the Tribe requested copies of the cultural resources report for review and comment. In a letter dated February 19, 2009, the Pueblo of Isleta stated that the proposed project would not impact religious or cultural sites; however, in the event of unanticipated discoveries during project construction, the pueblo would appreciate being advised of such findings (Benavides 2009).

On February 1, 2010, the BLM sent a letter to the Ysleta del Sur Pueblo, which described the proposal from Intrepid Potash, Inc. to transform their existing HB Mine into a Solution Mining operation (Stovall 2010). Attached to the letter were a detailed description of the proposed project and a map of the project area. In addition, the BLM included a discussion of previous archaeological investigations in the project area and requested information regarding tribally significant religious or cultural properties that may be located in or near the project area in order to identify and address tribal concerns. On March 24, 2010, the BLM received a response letter from the Ysleta del Sur Pueblo (Loera 2010). The Pueblo is not opposed to the proposed project and believes the project would not adversely affect traditional, religious, or culturally significant sites of their Pueblo; however, they would like to be consulted if any human remains or artifacts that fall under the NAGPRA are unearthed during the project.

In December 2010, all tribes with a known interest in the area were invited to become cooperating agencies for this EIS.

3.14 Health and Safety; Hazardous Materials

3.14.1 Introduction

The affected environment for hazardous materials, health, and safety includes air, water, soil, and biological resources that potentially could be affected by an accidental release of hazardous materials during storage and use at the mine. The study area for direct and indirect impacts for hazardous materials and solid waste encompasses the proposed project operations boundary.

3.14.1.1 Regulatory Definitions of Hazardous Materials

“Hazardous materials,” which are defined in various ways under a number of regulatory programs, can represent potential risks to both human health and the environment when not properly managed. The term hazardous materials includes the following materials that may be utilized or disposed of in conjunction with mining operations:

- Substances covered under OSHA and Mine Safety and Health Administration (MSHA) Hazard Communication Standards (29 CFR 1910.1200 and 30 CFR 42): The types of materials that may be used in mining activities and that would be subject to these regulations would include almost all of the materials identified above.
- “Hazardous materials” as defined under USDOT regulations at 49 CFR, Parts 170-177: The types of materials that may be used in mining activities and that would be subject to these regulations would include sodium cyanide, explosives, cement, fuels, some paints and coatings, and other chemical products.
- “Hazardous substances” as defined by Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and listed in 40 CFR §302.4, Table 302.4: The types of materials that may contain hazardous substances that are used in mining activities and that would be subject to these requirements would include sodium cyanide, solvents, solvent containing materials (e.g., paints, coatings, degreasers), acids, and other chemical products.
- “Hazardous wastes” as defined in the RCRA: Procedures in 40 CFR 262 are used to determine whether a waste is a hazardous waste. The types of materials used in mining activities and that could be subject to these requirements could include liquid waste materials with a flash point of less than 140°F, spent solvent containing wastes, corrosive liquids, and lab assay wastes. Hazardous wastes are regulated under Subtitle C of RCRA.

- Any “hazardous substances” and “extremely hazardous substances” as well as petroleum products such as gasoline, diesel, or propane, that are subject to reporting requirements if volumes on-hand exceed threshold planning quantities under Sections 311 and 312 of Superfund Amendments and Reauthorization Act (SARA): The types of materials that may be used in mining activities and that could be subject to these requirements would include fuels, coolants, acids, and solvent-containing products such as paints and coatings.
- Petroleum products defined as “oil” in the Oil Pollution Act of 1990: The types of materials used in mining activities and that would be subject to these requirements include fuels, lubricants, hydraulic oil, and transmission fluids.

In conjunction with the definitions noted above, the following provides information regarding management requirements during storage and use of particular hazardous chemicals, substances, or materials:

- The SARA Title III List of Lists or the Consolidated List of Chemicals Subject to Emergency Planning and Community Right-to-Know Act (EPCRA) and Section 112(r) of the CAA.
- Certain types of materials, while they may contain potentially hazardous constituents, are specifically exempt from regulation as hazardous wastes. Used oil, for example, may contain toxic metals, but would not be considered a hazardous waste unless it meets certain criteria. Other wastes that might otherwise be classified as hazardous are managed as “universal wastes” and are exempted from hazardous waste regulation as long as those materials are handled in ways specifically defined by regulation. An example of a material that could be managed as a universal waste is lead-acid batteries. As long as lead-acid batteries are recycled appropriately, requirements for hazardous waste do not apply.
- Pursuant to regulations promulgated under CERCLA, as amended by SARA, release of a reportable quantity of a hazardous substance to the environment must be reported within 24 hours to the National Response Center (40 CFR Part 302). The New Mexico Environment Department also requires immediate reporting of a release of a hazardous substance as soon as possible, but not later than 24 hours after the event, to the New Mexico Environment Department (NMED 2010a). Intrepid has Spill Prevention, Controls, and Countermeasures (SPCC) plans in place to prevent and contain a hazardous material spill (Intrepid Potash, Inc. 2010d). The storage of hazardous materials is regulated by the Hazardous Waste Bureau (NMAC 20.4.1) under the NMED (2010b).

3.14.1.2 Project-related Hazardous Materials

The types of hazardous materials to be used in the proposed mining operations are briefly summarized below:

- Diesel fuel, gasoline, oils, greases, anti-freeze, and solvents used for equipment operation and maintenance
- Butric acid, hydrochloric acid, clay blinder, hexanol, flocculants, lime, and guar
- Wastes classified as hazardous waste

3.14.1.3 Regulatory Definition of Solid Waste

Solid waste consists of a broad range of materials that include garbage, refuse, wastewater treatment plant sludge, non-hazardous industrial waste, and other materials (solid, liquid, or contained gaseous substances) resulting from industrial, commercial, mining, agricultural, and community activities (USEPA 2006). Solid wastes are regulated under different subtitles of RCRA and include hazardous waste (discussed in the previous section) and non-hazardous waste. Non-hazardous wastes are regulated under RCRA Subtitle D. In New Mexico, solid waste rules are found in the NMAC. Disposal of solid waste is regulated under NMAC 20.9.2.0 to 20.9.2.22; disposal of hazardous waste is regulated under NMAC 20.9.8.

3.14.1.4 Solid Wastes Generated from Mining Operations

The solid wastes at the proposed mine would include hazardous waste, solid non-hazardous waste, and sanitary waste. The facility generates hazardous waste in amounts to be considered a Conditionally Exempt Small Quantity Generator under the RCRA waste generator rules (less than 200 pounds per month) (USEPA 2010c). Hazardous waste would consist of “universal wastes,” which include florescent bulbs, aerosol paint can residue and filters, and batteries. Solid non-hazardous materials (for example, construction debris and trash) would be disposed at an off-site licensed facility. Appropriate materials (used oil, lead acid batteries, and antifreeze) would be recycled. Sanitary wastes would be dealt with by construction of a new septic system, which would be installed to service the proposed mill. Solid wastes that are expected to be generated include hazardous waste from the aerosol can aspirator and used oil.

3.14.1.5 Health and Safety

Mining operations often have a controlled entrance to the mine site. Additionally, mining operations are usually fenced to limit access and promote onsite security. Mine employees are often required to take multiple forms of safety training and adhere to safety regulations. Public uses for the area include hunting, camping, OHV use, and picnicking. The project area is also utilized by grazing lessees, oil and gas operations, as well as motorists traveling on local roads and state and U.S. highways. Potash mining activities in the past have resulted in areas of subsidence across portions of the project area.

3.15 Socioeconomics and Environmental Justice

3.15.1 Analysis Area

Eddy County and Carlsbad comprise the primary study area for socioeconomic effects of the Proposed Action and alternatives. Eddy County provides most public services to the project area and the majority of the project’s construction and expanded operations work forces are likely to live in Carlsbad, based on the distribution of Intrepid’s current work force (**Table 3.15-1**).

Table 3.15-1 Residency Distribution of Intrepid's Current Work Force, October 2009

	Carlsbad	Loving	Hobbs	Elsewhere in New Mexico	Out of State
Number of Workers	550	36	22	13	8
Percent of Total	87.4%	5.7%	3.5%	2.1%	1.3%

Source: Intrepid Potash, November 2009.

The Eddy County community of Artesia is over 30 miles from the project area. Less than 1 percent of Intrepid’s current work force lives in Artesia and it is unlikely to be substantially affected by construction and operation of the Proposed Action or alternatives.

The Village of Loving has no motels, recreational vehicle (RV) parks, or mobile home parks and is therefore also unlikely to host construction workers or experience substantial socioeconomic impacts from implementation of the HB In-Situ Solution Mine Project.

A small percentage (22 workers) of Intrepid’s present work force live in Hobbs (2008 population 30,746), located about 35 miles east of the project area in neighboring Lea County. More than 15 motels and several large RV parks are located in Hobbs, nearby Eunice (2008 population 2,771) and the surrounding area. These accommodations serve tourists, the region's natural resource industry, and the nonlocal construction work force for the Louisiana Energy Service's National Enrichment Facility (NEF) (New Mexico Business Weekly 2008). As construction on the NEF nears completion in late 2010/early 2011, the construction work force will be scaled back from about 700 to 350 to 400 workers. As the scale back occurs, contractors and workers currently working at the NEF may become available and commute to the proposed project. Others may seek permanent jobs at the NEF, which will begin ramping up to about 350 operations workers (Brooks 2010). Because these workers already live in the community, the proposed project would generate few if any incremental socioeconomic impacts in Hobbs.

The potential for effects on other sectors of the local economy (e.g., oil and gas, ranching and grazing, and outdoor recreation) and the linkages to the regional economy are also considered in this assessment.

3.15.2 Socioeconomic Setting

Settlement of southeastern New Mexico by people of European descent began in the late 1800s, following passage of the Homestead Act. Eddy County, formed in 1889, was initially settled by ranchers and later by farmers as irrigation projects were developed. A railroad line linking El Paso, Texas, with Roswell, New Mexico, was constructed in the 1890s, passing through the Town of Eddy, which later became Carlsbad.

In addition to farming and ranching, the county's economic base includes tourism and recreation, initiated by discovery of Carlsbad Caverns, which became a national park in 1930; oil and natural gas, which began with the 1909 discovery of oil near Artesia; and potash, discovered east of Carlsbad in 1925 (Eddy County 2007). Two major federal government employers include WIPP, and the Federal Law Enforcement Training Center (FLETC). WIPP, located about 30 miles east of Carlsbad, began operations as the first transuranic waste storage facility in the nation in 1999. FLETC, located near Artesia, provides law enforcement training for local, state, federal, and international agencies. At any one time, the center trains about 1,000 men and women who are instructed and supported by 300 to 400 staff who live in nearby communities (Eddy County 2008; Carlsbad 2009).

The City of Carlsbad (2008 population 25,629) is located near the center of Eddy County on the Pecos River, about 275 highway miles southeast of Albuquerque. Carlsbad is the governmental and commercial center of Eddy County. The city also hosts service companies for the potash and oil and gas industries and serves as a service center for tourists visiting Carlsbad Caverns National Park and other destinations in the region. Carlsbad also is developing as a retirement community because of climate and area recreation attractions such as golf courses (City of Carlsbad 2009).

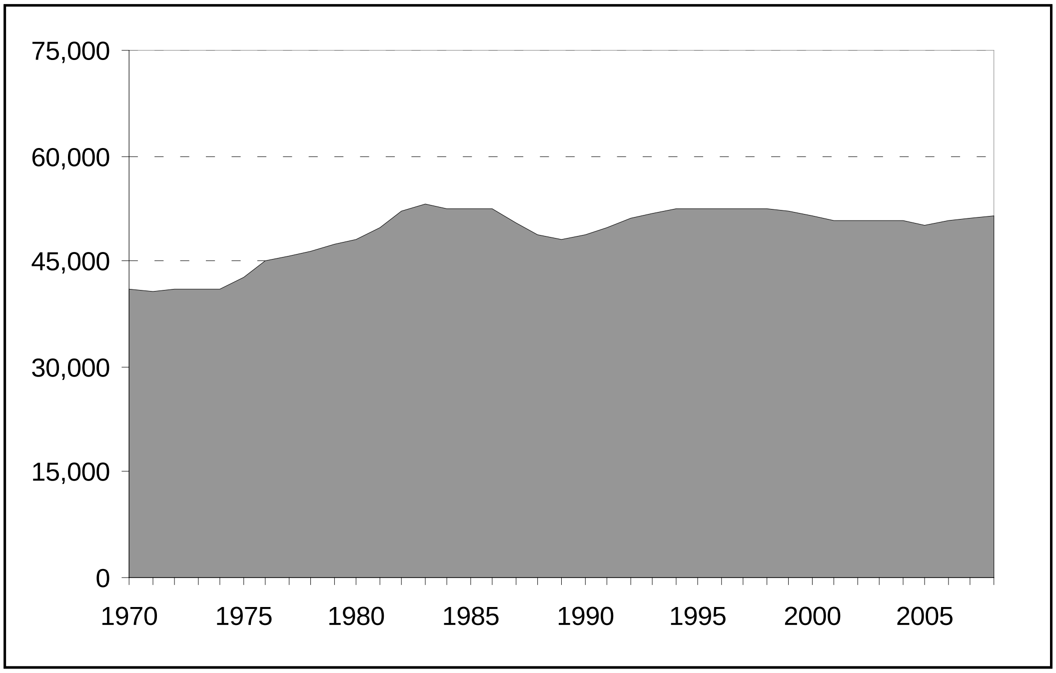
3.15.3 Population and Demographics

Eddy County experienced a near-decade long period of population growth spanning the late 1970s and early 1980s (**Figure 3.15-1**). Oil and gas development was the major driver of this growth as the potash industry had matured and actually experienced declines in production. Resident population peaked at 53,266 in 1983, followed by a brief period of contraction when the county lost about 5,000 residents. Several years of renewed population growth occurred in the early 1990s, but the county's population has since trended slightly downward. Between 2000 and 2008, the U.S. Census Bureau estimates a net loss of 298 residents in Eddy County.

Settlement patterns within Eddy County have remained relatively unchanged in recent years. Approximately half of the population resides in Carlsbad and another 20 percent in Artesia. Approximately 1,300 residents live in Loving, with the remainder in unincorporated areas of the county, as shown in **Table 3.15.2**.

Despite the strong economic gains in recent years, net out-migration from the community has been the dominant trend affecting local population levels. Between 2000 and 2008, net out-migration of nearly

1,900 residents more than offset the net natural increase of approximately 1,600 residents Natural increase, defined as the net difference between the number of births and deaths among residents.



Source: U.S. Bureau of Economic Analysis 2009; U.S. Census Bureau 2009a.

Figure 3.15-1 Eddy County Population, 1970 to 2008

Table 3.15-2 Population Settlement within Eddy County, 2000 to 2008

Area	2000	2004	2008	Change
Eddy County	51,658	50,803	51,360	-298
Carlsbad	25,625	25,309	25,629	4
Artesia	10,692	10,646	10,994	302
Loving	1,326	1,337	1,340	14
Remainder of the County	14,015	13,511	13,397	-618

Source: U.S. Census Bureau 2009a,b.

The median age of Eddy County residents is 37.0 years, with 13.9 percent of all residents aged 65 and over; both values are slightly higher than the comparative statistics for the state. However, Eddy County has a larger share of youthful residents under the age of 18 (**Table 3.15-3**).

Table 3.15-3 Age Distribution and Median Age of the Resident Population 2008

Location	Under 18 (%)	18 to 64 (%)	64 and Over (%)	Median Age
New Mexico	25.5	61.7	12.8	35.8
Eddy County	26.1	60.0	13.9	37.0

Source: U.S. Census Bureau 2009c.

The local population has a higher percentage share of whites and lower percentage shares of minorities and residents who are Hispanic or Latino than does the statewide population (**Table 3.15-4**). The establishment of large ranches, introduction of rail service, the subsequent promotion of the area's climate to outsiders, and discovery of oil and gas, all promoted immigration of whites to the area, the influences of which continue to the present. Another factor contributing to the differences is that there are no Indian reservations in Eddy County, unlike in many parts of New Mexico.

Table 3.15-4 Racial and Ethnic Population Composition, 2000

Location	Percent of the Total Population			
	White and not Hispanic or Latino	American Indian and Alaska Native and not Hispanic or Latino	Other Races, Two or More Races, and not Hispanic or Latino	Hispanic or Latino Ethnicity
New Mexico	41.9	8.7	4.9	44.5
Eddy County	53.7	0.3	3.9	42.1

Source: U.S. Census Bureau 2000.

Long-term population forecasts for Eddy County, released in 2008, anticipated a 2010 population of 54,145, climbing to 60,764 by 2030 (University of New Mexico Bureau of Business and Economic Research [UNM-BBER] 2008). Those projections likely reflect a continuation of pre-recession natural resource development trends. Thus, it would be reasonable to expect that the recent economic downturn could manifest itself in lower growth in the future.

3.15.4 Employment, Labor Force, and Economic Structure

Changes in local labor market conditions over time portray the economic growth that occurred more so than do the changes in population described above. From 2000 to 2009, the local labor force expanded by more than 5,600 workers (24.3 percent) and the number of employed persons climbed by 25 percent. Between 2003 and 2008, the number of unemployed declined by nearly half. Since that time, the global recession, mortgage-lending crisis, and curtailment in local energy development activity contributed to a doubling of unemployment. Unemployment continued to climb through 2009, reaching 6.0 percent by year's end.

The economic growth that occurred in Eddy County for several years preceding the current economic recession was associated with increases in energy resource development, the region's tourism and recreation economy, residential construction, lifestyle migration, and the opening of the FLETC in Artesia. **Table 3.15-5** shows the increases in mining and construction jobs that were two key drivers of the growth. Mining and construction also are key sectors in nearby Lea County economy, with nearly 5,400 mining jobs and 2,340 construction jobs reported in June 2009. Many of the latter are associated with the NEF, which is anticipating reductions in its construction work force in late 2010/early 2011.

Table 3.15-5 Trends in Eddy County Mining and Construction Employment, 2003 to 2009

Industry	2003	2004	2005	2006	2007	2008	2009 (June)
Mining	2,492	2,699	2,821	3,124	3,359	3,752	3,515
Construction	1,162	931	1,064	1,113	1,491	1,921	1,815
Total Covered Employment	19,677	19,743	20,234	21,051	22,030	23,207	23,557

Source: U.S. Bureau of Labor Statistics 2010.

Other key industries in the local economy include retail and wholesale trade, health care, and accommodation and food services. The latter reflects the role of tourism and recreation, much of which is tied to nearby Carlsbad Caverns National Park (400,000+ visitors per year), Guadalupe Mountains National Park (approximately 200,000 visitors per year), and two state parks (NPS 2010; Padilla 2010).

Farm employment accounted for only 3.1 percent of Eddy County employment in 2007; about 40 percent higher than the statewide average. Public sector employment, including public education, stood at 13 percent in 2007, substantially lower than the 18.8 percent of the comparable statewide level (**Table 3.15-6**). The opening and operations of the FLETC, which has expanded over time, now accounts for a substantial segment of all government jobs in the county.

Table 3.15-6 Eddy County Employment, by Major Category, 2007

Geographic Area	Farm	Non-farm Private	Government	Total	Farm	Non-farm Private	Government
New Mexico	24,508	881,017	210,152	1,115,677	2.2	79.0	18.8
Eddy County	911	24,754	3,828	29,493	3.1	83.9	13.0

Source: U.S. Bureau of Economic Analysis 2009.

Despite the high number of mining jobs, the area's agriculture, tourism, and federal government sectors provide Eddy County's economy a greater degree of economic diversity than rural economies that are heavily dependent on a single major industry. This diversity diminishes the regional economy's susceptibility to severe economic distress and enhances its economic resilience.

Natural resource development, ushered in by the discovery of oil in 1909 and discovery of potash in 1925, has long been a mainstay of the area economy. Such development provides jobs, and capital investment, spending, and production generates tax revenues to support state and local government and public education (Eddy County 2007). Indicators of the industry's importance include the following:

- In 2007, the local mining industry reported total employee earnings of $383 million, equivalent to 21 percent of the total personal income in Eddy County in that year.
- During the second quarter of 2009, 116 mining establishments were reported in Eddy County by the New Mexico Department of Labor: 38 active in oil and gas extraction, 8 in conventional mining, and 70 in support activities for mining. Each of the three segments had about 1,150 employees.
- For tax year 2008, the net taxable value on oil and gas and mineral production in Eddy County topped $1.4 billion, with another $286 million in net taxable value on oil and gas equipment.
- The $1.7 billion in taxable value on oil and gas and mineral production ranked Eddy County 3rd among New Mexico counties in terms of resource-related valuation; neighboring Lea County (oil and gas) was first, followed by San Juan County (coal and gas) (New Mexico Taxation & Revenue Department 2009).
- In 2007, local potash production had a market value of approximately $270 million. The market value of oil and gas production was not reported, but likely several times greater based on the reported production of 21.1 million barrels of oil and 262.5 million MCF (MCF = 1,000 cubic feet of gas) of gas.

The area of commercially viable potash is surrounded by existing oil and gas development and overlies commercially recoverable carbon-based reserves. The overlap of resources and management of the area under the 1986 Secretary's Potash Order has contributed to tensions between the two industries.

3.15.5 Farming and Ranching

The local agriculture industry is another element of the area's economic base. Data from the 2007 Census of Agriculture provides the following characteristics regarding farming and ranching in the area (USDA 2009).

- There were 543 farms and ranches in Eddy County, with a total associated land area of 1.11 million acres.
- In 2007 the farms and ranches produced $94.8 million in crop and livestock sales. The top commodities, in terms of market value, were milk and dairy products, hay and other forage, and cattle and calves.
- Dairy operations comprise an important element of the local agriculture sector with 12 dairy farms reporting a total of 12,742 dairy cattle in 2007. Those numbers compare to 175 non-dairy farms and ranches reporting a total of 17,781 beef cattle.
- About 46 percent of all farms and ranches were operated by individuals reporting agriculture as their primary occupation.
- About 43 percent of all farms and ranches reported no sales or less than $5,000 in sales of livestock or farm products in 2007, 24 percent having annual sales of $50,000 or more.
- Many farmers and ranchers in the area utilize grazing on public lands. Grazing on public lands allows ranchers to use available private irrigated lands to grow hay for use as winter feed or for sale as a cash crop. Approximately 4,500 AUMs of grazing occur within the project area.

3.15.6 Personal Income and Poverty

Personal income is an important measure of economic well-being for communities and individuals. Total annual personal income trends in the study area reflect the key economic and demographic conditions described above.

For the period of 2000 to 2007, Eddy County registered a 66 percent increase in total personal income, from $1.06 billion to $1.76 billion, 16 percentage points higher than the 50 percent growth registered statewide (USBEA 2009). General inflationary trends account for about 20 percent of the changes, but the majority of the increases reflect economic growth and rising income. The residual translates into real per capita income growth. In 2007, Eddy County accounted for nearly 3 percent of statewide personal income.

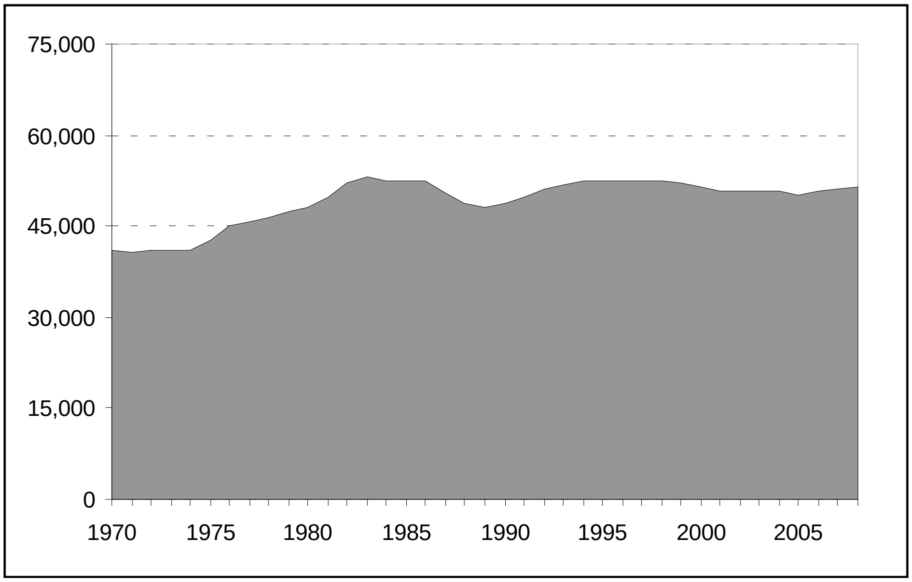
For many years, per capita income in Eddy County lagged the statewide average, both of which lag behind the national average. In recent years, local personal income growth in Eddy County outpaced that across the state such that per capita personal income in 2007 was nearly $4,000 per person higher in Eddy County, compared to the statewide average ($34,523 versus $30,706). Despite the growth in local income, per capita income in Eddy County continued to lag behind the national average, as shown in **Figure 3.15-2**. After adjusting for inflation, real per capita personal income increased by 40 percent in Eddy County from 2000 to 2007, compared to 16 percent across the state and 8 percent across the nation.

The trends in total and per capita personal income in Eddy County manifest themselves in modest reductions in the local incidence of poverty and higher median household incomes. In 2008, an estimated 15.3 percent of all residents of Eddy County had incomes below the established poverty level, with approximately 600 fewer residents in poverty, compared to 2004. The strong local income growth raised the median household income Eddy County above the statewide median (U.S. Census Bureau 2009d).

3.15.7 Housing

3.15.7.1 Eddy County

Eddy County housing stock has changed little since in recent years. The 2000 census reported just over 70 percent of all housing was single family. The U.S. Census Bureau reports 259 new units or just over 1 percent of total housing units between 2000 and by 2008. However, building permits for more than 700 new units were issued during that same period, suggesting much of the construction was for replacement demand. Virtually all of the permits were for new single family units (U.S. Census Bureau 2009e).



Source: USBEA 2009.

Figure 3.15-2 Trends in Per Capita Income, 2000 to 2007

Affordable work force housing is an issue for municipalities in Eddy County, resulting in some workers not being able to find affordable housing in the communities where they work (Eddy County 2008).

3.15.7.2 Carlsbad

The City of Carlsbad completed a Housing Analysis and Strategic Plan for the Greater Carlsbad Area (housing analysis) (Carlsbad 2009). Key findings of the housing analysis were that:

- Carlsbad is experiencing a housing shortage that affects the community's quality of life and hinders the expansion potential of the local economy.
- Young, working families and retirees comprise the primary market for housing. The greatest need is for multi-family rentals, particularly multi-bedroom units. A need also exists for single-family detached homes.
- Rehabilitation or replacement of older and poorly maintained housing is another identified need.
- There is an unmet demand for low-income and affordable housing.
- Constraints and impediments to the development of new housing in Carlsbad include the absence of utility (water, wastewater, and storm drainage) infrastructure in certain areas, and difficulty in obtaining financing in the current (early 2010) market. Nevertheless, some active residential subdivision activity is occurring in the community.

The housing analysis identified 12,501 housing units within the Greater Carlsbad area (the city and the planning area within a 5-mile radius of the city limits), of which 11,452 units were located within the city limits. Of the Greater Carlsbad total, 10.3 percent (1,398 units) were mobile homes and trailers and about 9 percent (1,082) units were in multi-family complexes of 3 to 50 or more units.

According to the housing analysis, the overall housing vacancy rate stood at over 12 percent. However, only 2 percent were vacant for rent and 6 percent were vacant for sale at the time of the census. The housing analysis indicated that a survey of apartment managers revealed a vacancy rate approaching zero; and all had waiting lists.

The housing analysis reported 120 housing units for sale during late 2008, representing less than 2 percent of the total housing stock. The housing market remains tight, as demonstrated by information from the National Association of Realtors indicating only 168 units listed for sale in Carlsbad, 32 of which are listed at or over $300,000 (National Association of Realtors 2009).

Regarding future housing needs, the housing analysis identified an existing need for up to 50 market-rate temporary housing units and future needs for 50 additional such units per year. Up to 240 market-rate ownership units are needed. In addition, need for approximately 1,600 units for low-income and cost burdened households was identified. The housing analysis also identified needs for transitional housing, rehabilitation of units currently in poor condition, and expanded supply of units for retirees.

Currently, there is substantial subdivided land within the city being developed on a lot by lot basis. Two single-family home subdivisions have been approved, one with about 200 units and the other with about 85 units. Some new home construction occurred in these subdivisions in recent years.

Two other subdivisions have received zoning approval; one zoned for about 200 apartment units and 100 single family homes, the other zoned for about 185 apartments. The subdivisions are intended to support market rate sales and rentals. At the time of this assessment (first quarter 2010) the developers of these subdivisions were still seeking development financing (Shumsky 2010).

Carlsbad has 10 major motels and 4 major RV parks. During the last surge in oil and gas development, these motels were used heavily by oil and gas field workers, which sometimes resulted in a lack of availability for tourism and recreation visitors (Burgess 2010).

3.15.8 Public Infrastructure, Services, and Local Government Fiscal Conditions

Public infrastructure and services within the socioeconomic study area are provided by Eddy County, the City of Carlsbad, and by a number of special districts and volunteer agencies.

3.15.8.1 Water

There are 30 public water systems within Eddy County. The City of Carlsbad’s water system serves the community likely to host most of the work force associated with the proposed HB In-Situ Solution Mine Project. A wellfield located 7 miles southwest of the city is the primary source of the city’s water supply. The remainder is provided by the Double Eagle well system located in northwestern Lea County, which draws water from the Ogallala aquifer. Carlsbad is currently implementing a $45.3 million capital improvement program for its water and wastewater systems (City of Carlsbad Undated).

3.15.8.2 Wastewater

The Carlsbad Sewage Collection System is operated by the Carlsbad Water Department. The system includes gravity-fed collection mains and 12 lift stations, all of which feed a single wastewater treatment plant. The plant treats an average of more than 2.5 million gallons of sewage per day, and is designed to treat up to 6 million gpd (City of Carlsbad 2003).

3.15.8.3 Solid Waste Disposal

Eddy County operates the Sandpoint Landfill, located approximately 12 miles east of Carlsbad on Highway 62/180. The City of Carlsbad provides solid waste collection services (Eddy County 2008; City of Carlsbad 2003).

3.15.8.4 Law Enforcement

There are 10 local law enforcement agencies operating in Eddy County. The Eddy County Sheriff's Department provides law enforcement services to the project area and along access routes to the area and also operates a dispatch center for the rural parts of the county. Eddy County also operates a detention center for adults and juveniles. Carlsbad maintains a municipal police department and has its own dispatch center (Eddy County 2008).

3.15.8.5 Emergency Response (Fire and Ambulance)

There are 12 volunteer fire departments (VFDs) in Eddy County. The La Huerta VFD serves the project area. Carlsbad maintains a staffed fire department that serves the city, but which also responds to structure fires near and within the project area and will respond to rangeland fires in that area if no volunteer agency responds. Emergency Medical Technicians from the Carlsbad Fire Department respond to injury accidents and health care emergencies within and near the project area, with back-up from the VFDs when available (Arnwine 2010; Burgess 2010)

3.15.8.6 Health Care

The Carlsbad Medical Center is the acute care hospital serving the community and surrounding region, both for routine health care and for emergency care. The Carlsbad Family Health Center and the Surgical Center of Carlsbad also provide routine health care services for residents of the community. Eddy County provides a variety of public health care and indigent health services.

3.15.8.7 Public Education

The Carlsbad Municipal School District operates 11 primary schools, 2 middle schools, and 1 high school. There is one private elementary school in Carlsbad. Fall enrollment for the 2009-2010 school year is 5,837 students (Eddy County 2008; New Mexico Public Education Department 2010).

3.15.9 Mining as it Relates to Public Sector Fiscal Conditions

Public sector fiscal conditions in the region are integrally linked to natural resource development and presence of public lands in the study area. State and many local entities derive substantial revenues from development activity. The major revenue sources include payments in lieu of taxes on federal lands, gross receipts taxes (GRTs) on the taxable value of commodities sold,(as well as on purchases by energy firms, their vendors and employees), mineral royalties and severance taxes, and ad valorem taxes on the value of production and mining equipment. Recent receipts from several of these sources are highlighted below in order to demonstrate their significance.

Payments in lieu of taxes (PILTs): PILTs are transfers from the federal government to counties with PILT-eligible property within their boundaries to help defray the costs of providing emergency services on those lands and offset some of the property tax revenue foregone due to the public ownership of lands and minerals. PILTs totaling $3.1 million were made to Eddy County in fiscal year 2009 (U.S. Mineral Management Service 2009).

Federal mineral royalties: federal mineral royalties are collected on mineral and oil and gas production from federal lands. Approximately one-half of the receipts are returned to the state in which the production occurred. The funds received by the state accrue primarily to the general fund, with subsequent disbursements to public education and other programs. In fiscal year 2009, federal mineral royalties, rents, and bonus bids on new leases totaled $765.1 million in New Mexico. The majority of the total was derived on the value of natural gas and oil produced. Approximately $388 million was disbursed to the state during the same period.

Oil and gas taxes: New Mexico imposes a severance tax, conservation tax, and an emergency school tax on sales value of oil and gas produced, regardless of ownership. The current combined tax rate is 7.09 percent. The total proceeds from oil and gas taxes are typically more than double the receipts from federal mineral royalties (New Mexico Energy, Minerals and Natural Resources Department 2009).

Gross receipts taxes: similar in some respects to a sales tax, the New Mexico GRT is levied on the sales and leases of most goods, property, and services. The rate varies between 5.375 percent and 8.6875 percent across the state, as counties and municipalities have the option to levy GRT as well. The rate in Eddy County ranges from 5.625 percent in unincorporated areas of the county to 7.3125 percent in Carlsbad (New Mexico Taxation and Revenue Department 2009). As shown in **Table 3.15-7**, GRTs levied on mining and oil and gas extraction generated $20.5 million in Eddy County in 2009. That total represents 14.6 percent of all GRTs in Eddy County, and also more than 17 percent of the statewide total of $118.3 million from mining and oil and gas extraction.

Table 3.15-7 Direct Contributions of Mining and Oil and Gas to Eddy County and Statewide Gross Receipts Taxes, 2009

	State of New Mexico			Eddy County		
	(millions)					
Industry	Gross Receipts	Taxable Gross	Gross Tax	Gross Receipts	Taxable Gross	Gross Tax
Mining and Oil and Gas Extraction Industries	$3,522.1	$1,899.9	$118.3	$772.4	$333.6	$20.5
Total – All industries	$95,490.4	$45,876.1	$3,086.1	$3,475.7	$2,150.5	$140.4
Mining and Oil and Gas % of Total	3.7	4.1	3.8	22.2	15.5	14.6

Source: New Mexico Taxation and Revenue Department 2009.

The contributions of mining and oil and gas extraction would be even greater if the indirect and induced effects associated with exploration, development, and production were included.

Eddy County and other local taxing authorities assess and collect ad valorem property taxes on mineral production and mining related equipment located within its taxing boundaries. For the 2008 tax year, the aggregate net taxable value assessed on such production and equipment in Eddy County exceeded $1.69 billion, approximately two-thirds of the county's total net taxable value. Eddy County collected more than $20.7 million in ad valorem/property taxes that same year. Taxable values are a function of both production and commodity prices and therefore subject to substantial year-to-year fluctuation (New Mexico Department of Finance and Administration 2009; New Mexico Taxation and Revenue Department 2009).

Public service demands associated with such activity also factor into public sector expenditures. However, because of the limited scale of the incremental demands associated with the proposed HB In-Situ Solution Mine Project, a full analysis of public sector conditions is outside the scope of this assessment.

3.15.10 Social Organization and Conditions

This section focuses on social conditions within Eddy County and within and near the project area. Information for this section was obtained from public scoping comments, newspaper articles, interviews with local officials and staff, and secondary sources as cited.

Residents of Eddy County are familiar with potash mining, other forms of natural resource development, and major construction projects. Many in Eddy County and Carlsbad welcome the economic boost associated with construction projects and resource development. Some enthusiasm toward natural resource development was tempered by the recent collapse of a brine well on the outskirts of Carlsbad. The collapse, along with collapses of two other brine wells in Eddy County heightened concern about subsidence associated with the injection of water into salt formations. Such concern was amplified by media coverage surrounding the collapse and efforts by the city, county, state, and an interagency and industry working group to address the issue.

Ranching, outdoor recreation, oil and gas production, and potash mining have coexisted as elements of the Eddy County social and economic fabric for over 80 years. Each of these activities is a vital element of the Eddy County economy and each provides a measure of economic diversity for the county. The potential for conflict arises when two or more of these economic activities occupy the same space, are in close proximity to each other, or have the potential to limit access to resources for development. In the case of the proposed project area, ranching, outdoor recreation, oil and gas production, and potash mining activities are all present within and near the project area.

3.15.10.1 Ranching and Grazing

Portions of five grazing allotments are contained within the project area. Ranching and grazing operator's concerns include the effects of aboveground pipelines on livestock and movement, the effects of subsidence on rangeland, range improvements and surface water resources, the effect of groundwater pumping and injection on surface water resources, reductions in forage associated with pipeline and power line ROWs, and the potential effects of construction activities and mine operations on the production of the forage adjacent to these activities.

3.15.10.2 Outdoor Recreation

The primary outdoor recreation activity occurring in and near the project area is OHV use, although some hunting and other dispersed recreation also occurs. Approximately one-fifth of the 55,000-acre Hackberry Lake OHV Area, managed by the BLM for intensive use of motorcycles, sand dune buggies, and other OHVs, lies within the project area. Camping occurs in association with these activities although there are no developed campground facilities and no developed source of drinking water in the area. There are private lands within the Hackberry Lake OHV Area where grazing, mining, oil and gas development, and communication and utility rights-of-way also are present. Although outdoor recreation users are accustomed to sharing the project area with other uses, a key concern is the potential for aboveground pipelines to alter the character of the OHV area landscape and pose a hazard for OHV users.

3.15.10.3 Oil and Gas

There are 23 producing oil wells, 29 producing gas wells, 1 water injection well, and 3 disposal wells in the project area, as well as 52 plugged and abandoned oil wells and 8 plugged and abandoned gas wells. A total of 60 unsuccessful wells (dry holes) have been drilled in the area. There also are gathering systems and other ancillary facilities such as tank batteries. Oil and gas exploration continues within the project area. At a basic level, the concerns of the oil and gas industry include the potential effects of the proposed mining project on existing oil and gas facilities and operations and the potential that the proposed project may constrain future oil and gas development within the project area. While oil and gas operators holding leases in the project area have some specific concerns related to proposed project, these concerns are set against tension between the oil and gas industry and potash mining interests dating back to the time when the two industries began operating in the area. In reality, however, there would be no change in how oil and gas leasing and development would be managed as a result of the proposed solution mining project.

3.15.10.4 Potash Mining

Four inactive mine workings are located within the project area. The concerns of the potash industry essentially mirror those of the oil and gas industry, seeking to ensure that existing and future oil and gas development does not limit the potash industries' ability to develop the potash resource. The tension between these two industries arises from competing economic interests for collocated resources and from concerns regarding potential safety and liability associated with concurrent development by both industries.

3.15.11 Environmental Justice

Environmental justice is defined as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (USEPA 1998). EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, tasks "each Federal agency [to] make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high adverse human health and environmental effects of its programs, policies, and activities on minority populations and low-income populations."

Implementation of EO 12898 for NEPA requires the following steps:

- Identification of the presence of minority and low-income populations and Indian Tribes in areas that may be affected by the action under consideration.
- Determination of whether the action under consideration would have human health, environmental, or other effects on any population.
- Determination of whether such environmental, human health, or other effects would be disproportionately high and adverse on minority or low-income populations or Indian Tribes.
- Provision of opportunities for effective community participation in the NEPA process, including identifying potential effects and mitigation measures in consultation with affected communities and improving the accessibility of public meetings, crucial documents, and notices (CEQ 1998).

The portion of Eddy County surrounding the project area has a very low population density. The closest Census Block, the basic unit of geography used to enumerate population in the decennial census, with more than 10 persons is at least 8 miles from the project area. There is a ranch within the project boundary and a residence approximately 2 miles to the south of the project boundary on Highway 31. Census Block Group 1 (CBG 1) of Census Tract 9, which surrounds the project area, covers 1,567 square miles and had a total population of 2,725 persons (or 1.7 persons per square mile) in 2000. Most of the population in CBG 1 is contained in areas surrounding the communities of Artesia, Riverside, and Loco Hills. The population density outside of these population centers averages less than 1 person per 3 square miles.

The City of Carlsbad is located about 20 miles west of the project area. The city's distance from the project area, its racial and ethnic composition, existence of substantial levels of intervening oil and gas development, lack of identified concerns during scoping, limited scale of incremental impacts, established operations of the mine, and effective land use buffer created by the Secretary's order, effectively dismiss Environmental Justice as an issue in the City of Carlsbad.

Table 3.15-8 presents 2000 Census information on the prevalence of minority populations in Eddy County, Carlsbad and the rural area surrounding the project area. As shown, the concentration of minority populations in each of these geographies is substantially lower than the New Mexico statewide average.

Table 3.15-8 Percentage of Minorities in Geographic Comparison Areas

Geographic Area	Percentage of Total Population				Variation in the Percentage of Minority Population to the Statewide Average
	White Alone and Non-Hispanic	Hispanic or Latino	Other Racial and Ethnic Minorities	Total Racial and Ethnic Minorities	
United States	69.1	12.5	18.3	30.9	n/a
New Mexico	44.7	42.1	13.2	55.3	n/a
Eddy County	57.7	38.8	3.6	42.3	-13.0
Census Tract 9	63.1	34.6	2.3	36.9	-18.4
Block Group 1, Census Tract 9	63.0	34.1	2.9	37.0	-18.3
Carlsbad	58.8	36.7	4.4	41.2	-14.1

Note: Racial minorities includes all persons identifying themselves in the census as a non-white race, including “Black or African American,” “American Indian and Alaska Native,” “Asian,” “Native Hawaiian and Other Pacific Islander,” “Some other race alone,” and “Two or more races.” Ethnic minorities include persons who identify themselves as Hispanic or Latino. Hispanic or Latino persons can identify themselves as part of any race.

Source: U.S. Census Bureau 2002a.

Table 3.15-9 identifies the prevalence of low-income populations in Eddy County, Carlsbad, and the rural area surrounding the project area. As with minority populations, the concentration of low-income populations in each of these geographies is lower than the New Mexico statewide average. In some cases the population below 150 percent of the poverty level is slightly, but not meaningfully, higher than the statewide average.

Based on the absence of human habitation within the project area, the very low population densities in areas surrounding the project area, and the comparatively low prevalence of minority and low-income populations in the area surrounding the project, the City of Carlsbad, and Eddy County in general, no Environmental Justice populations have been identified for this assessment.

Table 3.15-9 Percentage of Low-Income Population in Geographic Comparison Areas

Geographic Area	Percentage of Total Population Below 100% of Poverty Level	Percentage of Total Population Below 150% of Poverty Level	Percentage of Low-income Population Above/Below Statewide Average
United States	2.4	20.9	n/a
New Mexico	18.4	30.6	n/a
Eddy County	17.2	31.1	-1.2
Census Tract 9	17.2	33.1	-1.2
Block Group 1, Census Tract 9	13.9	26.5	-4.6
Carlsbad	16.5	30.5	-2.0

Source: U.S. Census Bureau 2002b.