3.0 Affected Environment

This chapter provides information on the physical, biological, chemical, social, and infrastructure characteristics of the environment that could be affected by the proposed action and alternatives discussed in this EIS. This information is necessary to evaluate individual and interactive impacts that could result from the activities described in Chapter 2.0. Impacts are discussed in Chapter 4.0.

For the purposes of this EIS, the affected environment encompasses the Moab site, the three alternative off-site disposal locations (Klondike Flats, Crescent Junction, and White Mesa Mill), the transportation (rail and truck) and slurry pipeline corridors leading to the off-site disposal locations, and the borrow areas that may provide borrow materials for the proposed action. Where appropriate, a specific region of influence has been defined. The region of influence is the area that could be affected by activities associated with each alternative; this region varies depending upon the aspect being assessed. Section 3.1 describes the affected environment of the Moab site. Sections 3.2 through 3.4 describe the affected environment of the three alternative off-site disposal locations.

Although both the Klondike Flats and Crescent Junction sites are located north of the Moab site, some environmental, cultural, and social aspects at these alternative sites have important differences; these differences are discussed for each site. When resources and aspects are the same as or similar to those discussed under the Moab site description, the appropriate section under the Moab site is referenced when the resources are first discussed, or a brief summary of the resources is provided at the beginning of the section on alternative disposal sites.

The slurry pipeline route is discussed in the appropriate major section. For example, the pipeline route segments north of the Moab site are described in Section 3.2, Klondike Flats site, or Section 3.3, Crescent Junction site. The pipeline route segments south of the Moab site are discussed in Section 3.4, White Mesa Mill site.

Borrow areas are described in Section 3.5. Many borrow areas are within or near the boundary of a proposed disposal site; because of this proximity, either the general resources present at the borrow area are summarized, or a specific resource section is referenced. More detailed site-specific information could be researched and evaluated once specific borrow sources were selected.

3.1 Moab Site

The Moab millsite lies in eastern Utah in an area characterized by low precipitation, high summer temperatures, and moderate winter temperatures. Unique desert scenery in this area has attracted increasing numbers of tourists and new residents who like the moderate climate and variety of outdoor activities readily available. The focal point for the area is the city of Moab, which is about 3 miles southeast of the millsite on the opposite side of the Colorado River. Much of the surrounding area is open country administered by federal agencies, primarily BLM and NPS.

3.1.1 Geology

The Moab site is at the northwest end of Moab-Spanish Valley along the axis of the Moab Valley salt-cored anticline (Figure 3–1). The northwest part of the valley is Moab Valley; the site is located at the mouth of Moab Canyon. The steep slope southwest of the site flanking Moab Valley rises 1,200 to 1,400 ft to the top of sandstone-capped Poison Spider Mesa. Just north of the site, north of US-191, and at the north end of Moab Valley is a steep slope rising approximately 600 ft that is composed of highly fractured and faulted sandstones.

3.1.1.1 Stratigraphy

Rocks exposed and in subcrop in the area range in age from Middle Pennsylvanian to Middle Jurassic. These bedrock formations and their ranges of thickness are shown in Figure 3–2. This section briefly describes the geologic formations in relation to the site. More detailed geologic descriptions are provided by Doelling et al. (2002) and are summarized in the SOWP (DOE 2003).

Bedrock Formations

The Paradox Formation was deposited in a periodically restricted part of the Paradox Basin. However, no outcrops of Paradox Formation are present in the immediate site area. No boreholes are known to have penetrated the Paradox Formation beneath the site.

The Honaker Trail Formation crops out as ledges on a steep slope west and south of the tailings pile. Up to 600 ft of Cutler Formation is exposed south and west of the site.

The Moenkopi Formation, also west of the tailings pile, consists of mostly red interbedded siltstone, fine-grained sandstone, and mudstone.

Outcrops of the Chinle Formation are located south of the tailings pile.

The Wingate Sandstone forms a prominent gray-pink to red-brown smooth cliff south and west of the tailings pile and forms a wall along the northeast side of Moab Valley and at the mouth of Courthouse Wash. The Wingate is faulted and highly fractured near the Moab anticlinal axis as it plunges southeastward into Moab Valley.

The Kayenta Formation caps Poison Spider Mesa to the south; north of the site, the formation crops out along the edge of Moab Valley near the mouth of Courthouse Wash.

Exposed at the site north of US-191, the Navajo Sandstone forms the northwest end of Moab Valley and dips moderately (about 50 degrees) southwest along the southwest flank of the Moab anticline.

One member of the Carmel Formation and one member of the Entrada Sandstone are present in the northwest end of the site area in the subsurface just north of the Moab Fault (Figure 3–3) in the lower end of Moab Canyon. The Dewey Bridge Member of the Carmel Formation overlies the Navajo Sandstone. The Slick Rock Member, which is the only member of the Entrada Sandstone in the vicinity of the site, is well-fractured in the subsurface along the Moab Fault zone.

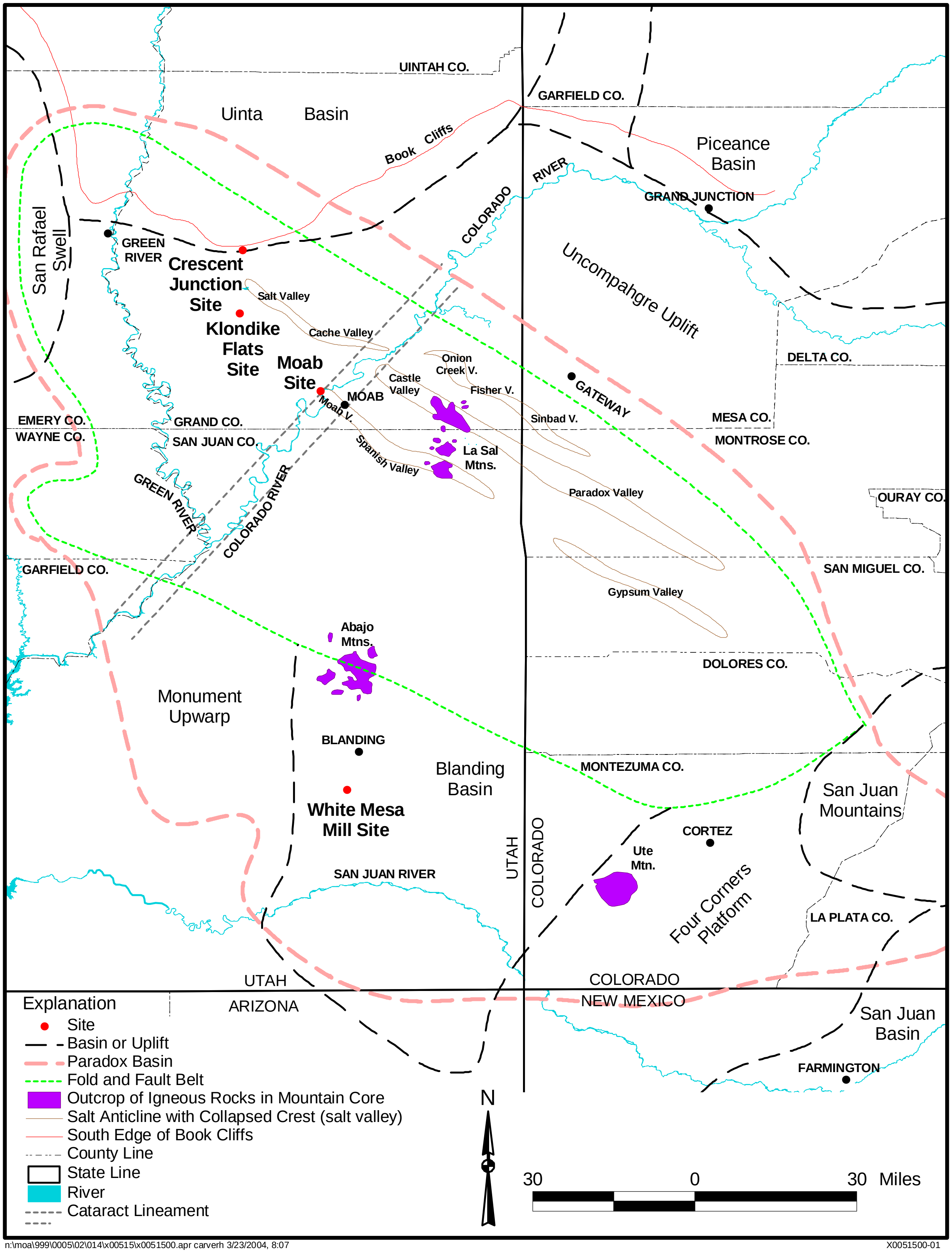


Figure 3–1. Physiographic and Structural Features in the Moab and Alternative Site Areas

Age	Deposit Type
Quaternary	Fill and Disturbed Deposits
	Modern Alluvium
	Older Alluvium
	Eolian Sand Deposits
	Talus
	Alluvial Fan Deposits
	Alluvial Terrace Deposits

Age	Group	Formation and Members	Thickness (ft)
Jurassic	San Rafael	**Entrada Sandstone, Slick Rock Member**	**At least 250**
		Carmel Formation, Dewey Bridge Member	**90–110**
	Glen Canyon	**Navajo Sandstone**	**300–700**
		Kayenta Formation	**250–400**
		Wingate Sandstone	**250–400**
Triassic		**Chinle Formation**	**100–700**
		Moenkopi Formation	**0–750**
Permian		**Cutler Formation**	**0–5,000**
Pennsylvanian	Hermosa	**Honaker Trail Formation**	**0–2,700**
		Paradox Formation	**300–9,000**

Modified from Doelling et al. (2002)

Figure 3–2. Stratigraphic Column of Geologic Formations in the Moab Area

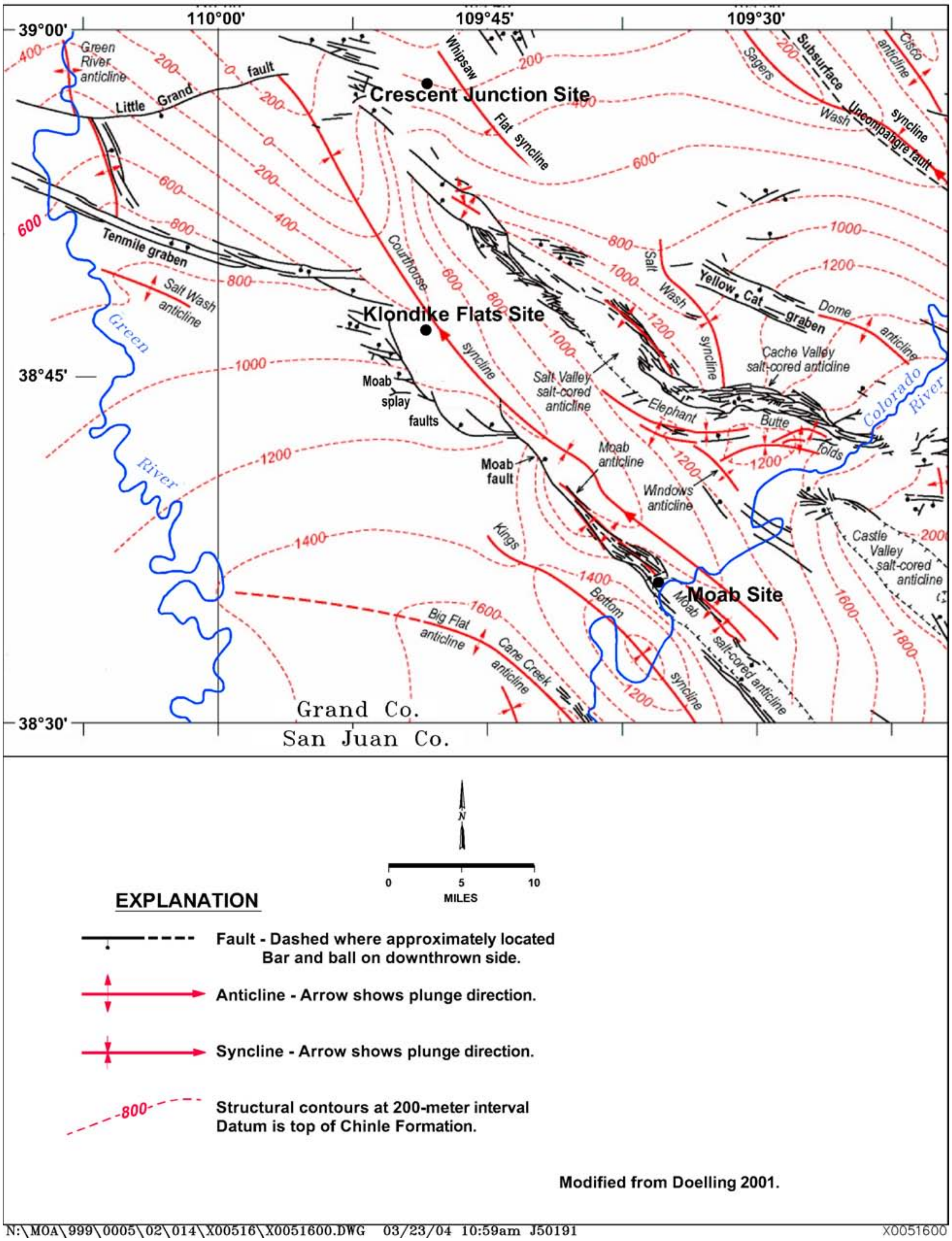


Figure 3–3. Geologic Structures in the Area from Moab Site to Crescent Junction Site

Quaternary Deposits

Except for the alluvial deposits, most Quaternary deposits are relatively thin. Because of the subsidence caused by removal of salt from the underlying Moab Valley salt-cored anticline, alluvium deposited mainly from the ancestral Colorado River has accumulated to a thickness of 450 to 500 ft beneath the site in Moab Valley. The subsiding Moab Valley has acted as a sump to catch Colorado River alluvium for much of Pleistocene time since erosion has begun "opening up" the Moab Valley salt-cored anticline and exposing the salt to dissolution by ground and surface waters.

The thick valley-fill alluvial deposits consist mainly of coarse gravelly sand, with minor silt and clay. Boulders as large as 1 to 2 ft in diameter, composed of resistant igneous and metamorphic rock types representing the upper Colorado River drainage, are common in the alluvium. At the mouth of Moab Canyon, the Colorado River alluvial deposits are mixed with and interlayered with generally fine-grained alluvium and detritus that has traveled down Moab Wash. Overlying the coarse alluvial deposits in the immediate site area in Moab Valley adjacent to the Colorado River is finer-grained alluvium of Holocene age composed mainly of sand, silt, clay, and minor lenses of gravel; this modern alluvium of the Colorado River covers much of the site area outside the tailings pile and is approximately 20 ft thick.

3.1.1.2 Structure

The Moab site is in the northern part of the ancestral Paradox Basin (see Figure 3–1). The salts deposited in this basin flowed toward northwest-striking faults in the basin floor, where they became thicker and formed northwest-striking elongate salt diapirs. Basins, called rim synclines, formed between the salt diapirs. Regional compression in Late Cretaceous to early Tertiary time formed broad northwest-striking anticlines and synclines, resulting in the Moab Valley salt-cored anticline (where the Moab site is located), the Courthouse syncline to the northeast of the site, and the Kings Bottom syncline to the southwest (see Figure 3–3). The northwest-striking Moab Fault (Figure 3–3) formed near the crest of the Moab Valley salt-cored anticline in mid-Tertiary time during a period of extensional faulting after regional compression.

Late Tertiary erosion allowed ground water to locally reach the upper parts of the salt diapirs through fractures and joints in the anticlinal folds. The resulting dissolution during late Tertiary and Quaternary time (and to the present) caused local areas of collapse, tilting, faulting, and subsidence of the overlying strata along the salt-cored anticlines. The degree of breaching (or opening up) of the salt-cored anticlines in this part of the Colorado Plateau largely reflects the amount of ground water that has been available for dissolution of the underlying salt and subsequent collapse. Ground water dissolves the salt and carries it away, leaving the insoluble part of the Paradox Formation as residue, called cap rock, on top of the leached salt diapirs.

3.1.1.3 Geologic Resources

In the site area, potash- and magnesium-bearing sylvite and carnallite are probably present in the salt wall, estimated to be at least 9,000 ft high and composed of the Paradox Formation in Moab Valley and adjacent Spanish Valley (Doelling et al. 2002). Similar deposits about 8 miles southeast of the site on the Cane Creek anticline (Figure 3–3) have been commercially extracted. Information is not sufficient to assess the extractability or value of the saline deposits.

Brine has also been produced from salt beds in the Paradox Formation about 2.5 miles southeast of the site. No oil or gas resources are known to exist beneath the site on the basis of oil and gas test holes drilled within 1 mile of the site.

The modern and older alluvium along the Colorado River, covering much of the site outside the tailings pile, contains sand and gravel suitable for highway and other construction. The considerable thickness of alluvial basin fill (up to 500 ft) beneath the site may also contain significant sand and gravel resources. A sand and gravel pit adjacent to the west edge of the site near the junction of US-191 and SR-279 was used by UDOT for highway construction and maintenance. This pit, UDOT 19076 (McDonald 1999) appears to be inactive.

Uranium and vanadium prospects occur south of SR-279 along the lower slopes of Poison Spider Mesa. No significant uranium-vanadium deposits are known to occur on the site; however, uranium and copper deposits have been identified in the lowermost part of the Chinle Formation about 8 miles northwest of the site.

3.1.1.4 Geologic Hazards

Swelling clay (montmorillonite) is present in the Moenkopi and Chinle Formations along the west edge of the site. These bentonite-derived clays are capable of absorbing large amounts of water, accounting for the shrinking and swelling character of the formations and their derived soils.

Piping and rapid erosion may occur in fine-grained soils and unconsolidated fine-grained sediments at the site along the ephemeral stream channel of Moab Wash. The piping can occur when water from storms flows into permeable, noncohesive layers, removes fine sediments, and exits where the layer reaches the surface (Doelling et al. 2002). The void space created is a “pipe” that promotes accelerated erosion.

Active rock-fall areas are along the top of the slope of Poison Spider Mesa, which have the potential to reach the southwest border of the site.

Seismic and salt dissolution hazards associated with the Moab Fault were evaluated by Woodward-Clyde Federal Services (1996a). These hazards consist of the capability of the fault to rupture the surface of the site, the potential for salt dissolution and collapse at the site, and the potential of a microearthquake trend along the Colorado River.

In the vicinity of the site, the Moab Fault consists of two branches—the main Moab Fault and the west branch of the Moab Fault, which is exposed in places west and southwest of the site on the slopes of Poison Spider Mesa. The inferred trace of the main fault before salt dissolution passes through the site approximately across the northeast corner of the tailings pile (Doelling et al. 2002). No historical macroseismicity has been noted along the Moab Fault, and microseismicity studies have not revealed any earthquakes associated with the fault. The site area is in Uniform Building Code 1, indicating lowest potential for earthquake damage (Doelling et al. 2002). A concentration of seismicity was evaluated in a probabilistic seismic hazard analysis by Woodward-Clyde Federal Services (1996b). On the basis of that analysis, the recommended design-peak horizontal acceleration was 0.18g. For a 10,000-year return period for a strong earthquake, this value provides the level of protection equivalent to the extent practicable as specified in 10 CFR 100, “Reactor Site Criteria.” For these geologic and geophysical reasons, the

Moab Fault system is not a capable fault and does not pose a significant earthquake or surface-rupture threat to the present tailings pile.

Vertical subsidence rates in the northwest end of Moab Valley in the site area provide an estimate of the amount of collapse that could be expected from continued salt dissolution beneath the site. Rates of subsidence evaluated by Woodward-Clyde Federal Services (1996b) yield maximum estimates of 1 to 3 ft over 1,000 years. This deformation is expected to occur as a process of slow incremental displacements over time.

Radiocarbon dating of a wood fragment found deep in Colorado River alluvial deposits on the Moab millsite during monitor well drilling in summer 2002 provides another estimate of subsidence for the site. The carbonized wood fragment was in core from alluvial deposits at a depth of 116.5 ft in the boring for well MOA-435. The fragment was 89.5 ft below the top of gravel deposited by the Colorado River. A radiocarbon date of 45,340 years was determined for this wood fragment. Details of this wood occurrence and its radiocarbon dating are in the SOWP, Appendix D (DOE 2003). On the basis of this radiocarbon dating, a subsidence rate of approximately 2 ft per 1,000 years is indicated for the site; this rate is in the middle of the range (1 to 3 ft per 1,000 years) estimated by Woodward-Clyde Federal Services (1996b).

The rate of incision (downcutting) of the Colorado River where it has cut through sandstone bedrock upstream and downstream from the Moab site is much less than the estimated subsidence rate for the Moab Valley. The incision rate for this area has been estimated as 0.6 ft per 1,000 years by Willis (1992), using a dated volcanic ash bed preserved in a terrace at a known vertical elevation above the Colorado River. These subsidence and incision rates indicate that the tailings pile would become approximately 1.4 ft lower during the next 1,000 years in relation to the Colorado River.

Subsidence refers to the geologic process that is lowering the elevation of the entire tailings pile and the Earth's surface at the Moab site because ground water is dissolving the Paradox Formation salt deposits underlying the Moab-Spanish Valley. The rate of subsidence of the Moab-Spanish Valley is approximately 2 ft per 1,000 years. This gradual downward sinking of the tailings pile is partially offset by the gradual regional uplift of the Colorado Plateau.

River incision refers to the geologic process by which the Colorado River cuts down through the bedrock sandstone outcroppings located upstream and downstream of the Moab site. The rate of river incision in this area has been estimated as 0.6 ft per 1,000 years, much less than the estimated subsidence rate for the Moab Valley.

Over geologic time, the combined processes of subsidence and river incision will change the position of the tailings pile in relation to the underlying ground water and the Colorado River. As for ground water, these processes will eventually cause the bottom of the tailings pile to converge with the underlying ground water at an estimated rate of approximately 1.4 ft per 1,000 years. At this rate, DOE estimates that the tailings in the disposal cell would come into permanent contact with ground water in approximately 7,000 to 10,000 years, assuming the minimum depth to ground water ranges from 5 to 7 ft. As for the Colorado River, these processes will eventually lower the disposal cell by approximately 1.4 ft in relation to the river over the 1,000-year regulatory design period. This would place the 100-year floodplain of the river about 1.4 ft higher on the east toe of the cell, creating a higher probability for flooding over time. This potential impact would be very long term, and the potential hazard would be reduced by the proposed buried riprap diversion wall.

3.1.2 Soils

Surface soils in disturbed areas of the site are predominantly sands mixed with clays, silts, and gravels and are saturated within 16 ft of the surface most of the year (NRC 1999). Remaining native soils surrounding the site are predominantly sands mixed with clays, silts, and gravels and are classified as Nakai fine sandy loams (Table 3–1). Soils include sandy loams to loamy fine sands. Soils are generally deep (depths greater than 36 inches), are well-drained, and have a minimal water-erosion potential, a moderate hazard of blowing potential, and an estimated erosion rate of 3 tons per acre per year. Additional information is available in the *Soil Survey of Grand County, Utah, Central Part* (SCS 1989).

Table 3–1. Properties of the Nakai Soil Type

Soil Name	Taxonomy	Depth (inches)	pH	Salinity (mmho/cm)
Nakai	Coarse-loamy, mixed, mesic Typic Calciorthids	40–>60	7.4–8.4	< 2
Permeability (inches/hour)	**Available Water (percent)**	**Textural Class**	**Clay (percent)**	**Erodibility Factors[a]**
2.0–6.0	10–16	Fine sandy loam to loamy fine sand	10–18	K = 0.28 T = 3 Wind = 3

[a]Erodibility factors: "K," used in the Universal Soil Loss Equation, is an indicator of the susceptibility of a soil to sheet and rill erosion by water. Values range from 0.02 to 0.69; the higher the value, the more susceptible the soil is to sheet and rill erosion. "T" is an estimate of the maximum average annual rate of water or wind erosion in tons per acre per year. Wind erosion factors range from 1 to 8; the lower the value, the more susceptible the soil is to wind erosion.
mmho/cm = millimhos per centimeter.
Source: SCS 1989.

3.1.3 Description of Contaminated Materials at the Moab Site

3.1.3.1 Millsite Contamination

In 2001, DOE began radiometric characterization of soils on the millsite. To date, the area north and northeast of the tailings pile have been assessed. Most of the site has soil contamination exceeding EPA standards for radium-226 except for small areas north of the tailings pile and one larger area northwest of the pile where a borrow pit was excavated and soils were used for pile surcharge (i.e., weight on the pile to squeeze out moisture) and for the interim cover. Shallow contamination was also identified north of US-191 on DOE property extending to the property line with Arches National Park.

Depths of contamination range from 6 to 120 inches. The area outside the tailings pile (i.e., the area of windblown contamination) is estimated to contain 71,000 yd^3 of contaminated soils. Measuring the depth of contamination with surface scanning and downhole logging instruments has inherent uncertainties; experience at other UMTRCA sites suggests that the final volume could exceed the volume characterized by a range of 50 to 100 percent.

Additional data collected also suggest that contamination occurs elsewhere on the site. Preliminary surface scans by DOE show contamination between the railroad and SR-279 and also near the abandoned ore-loading station adjacent to the rail tracks. Preliminary scans also show elevated gamma levels southeast of the tailings pile in the tamarisk. However, statistical sampling performed to minimize cutting of the tamarisk between the property fence and the Colorado River indicates that radium-226 concentrations in the area may not exceed EPA standards. A 1980 survey performed for Atlas Corporation (Ford, Bacon & Davis 1979) suggests that contamination does not extend across SR-279 to the southwest and up the steep hillside. A 1982 aerial survey performed by a DOE contractor (EG&G) did not provide any additional data on millsite contamination.

On the basis of site knowledge and past UMTRCA site experience, DOE estimates that 11.9 million tons (8.9 million yd^3) of contaminated materials exist at the Moab site and vicinity properties. However, on the basis of recent surveys that were not available at the time the draft EIS was developed, DOE has slightly increased its estimate of the volume of contaminated off-pile soil that would be disposed of with the tailings. The increase is less than 1 percent of the total estimated volume of contaminated site material. The revised total estimates remain approximate and could increase again after more detailed site characterization is complete. The estimated volumes presented in the draft EIS represented DOE's best estimate based on information available when the draft EIS was developed. Due to the small cumulative change, the draft EIS estimates have been retained as a constant in the EIS for purposes of assessing and comparing the impacts of each alternative. DOE would use the most current and reliable estimates of the volumes of all contaminated site material in developing the remedial action plan.

Table 3–2 presents a summary of the contaminated materials and quantities present at the Moab site and nearby vicinity properties. On the basis of sampling results, Table 3–3 shows the percentages of tailings by type believed to be present in the Moab tailings pile. Additional investigations confirmed that most of the slimes are located in the center of the pile and are surrounded by sandy tailings.

Table 3–2. Contaminated Material Quantities

Source Material	Volume (yd^3)	Weight (dry short tons)
Uranium mill tailings	7,800,000	10,500,000
Pile surcharge	445,000	600,000
Subpile soil	420,000	566,000
Off-pile contaminated site soils	173,000	234,000
Vicinity property material	29,400	39,700
Total	**8,867,400**	**11,939,700**

Table 3–3. Percent of Tailing Types in the Moab Impoundment

Material	% Passing No. 200 Sieve	Percentage of Total Tailings
Sand	Less than 30	7
Slimey-sands	Greater than 30; less than 50	20
Sandy-slimes	Greater than 50; less than 70	23
Slimes	Greater than 70	49

The tailings pile at the site contains the waste residuals from the milling operation. Milling involved both acid and carbonate processing methods (i.e., circuits). Lime was added to the tailings to neutralize the acid-milled tailings. Chemicals used in the processing, including acids, ammonia, and solvents, are incorporated with the silicate grains. Many other minerals, including sulfates and sulfides, are also present in lesser amounts. It is difficult to determine the residence time of the contaminants, although there is evidence that some exist as siliceous mixtures, and others may exist as sulfides, selenides, molybdates, and uranium minerals. Contaminants are also likely to be adsorbed to minerals, especially iron oxyhydroxides.

Bulk chemical analysis of the tailings solids indicates that high concentrations of ammonia, uranium, and radium-226 are present. The mean radium-226, ammonia (as N), and uranium concentrations for the tailings are 516 pCi/g, 423 milligrams per kilogram (mg/kg), and 84 mg/kg, respectively. The finer grained (slimes and silt) fractions have more radium-226 and uranium but less ammonia as (N) than the sand fraction. Other constituents, including iron, manganese, copper, lead, molybdenum, and vanadium, are present in lesser amounts. The pH values of the tailings are near neutral but have zones of pH values as low as 2.5 and as high as 10. The tailings have a small amount of acid-generating capacity in the form of sulfide minerals. The oxidation-reduction potential is not well defined by existing data, and conditions may vary spatially from relatively oxidizing to relatively reducing.

Mean tailings pore water concentrations for radium-226 and uranium are 61.1 picocuries per liter (pCi/L) and 15.1 mg/L, respectively. The average tailings pore water concentration for ammonia (as N) is 1,100 mg/L. Pore water is a mixture of residual milling fluids and water that infiltrated later into the tailings. The pore water appears to be relatively oxidized, although few data are available to assess oxidation-reduction potential. The pH value of the pore water is near neutral, and the mean TDS concentration is 23,500 mg/L. Values of pH, oxidation state, and availability of soluble minerals in the tailings are the main parameters that affect the composition of pore water. Concentrations of organic constituents used in the mill processing circuit are negligible in the pore water. Concentrations of all constituents are much higher in samples of water collected in a shallow-depth sump fed by pore water extracted from the tailings through wick drains than in any of the pore water samples collected from deeper SRK (2000) wells. Analysis of samples collected from the sump indicate the presence of a salt layer in the upper portion of the pile (DOE 2003).

Two underground septic tanks (size unknown) that supported past operations but are no longer used are located inside the radioactively contaminated portion of the site northeast of the historical warehouse. It is unknown if there are buried leach fields associated with these tanks. Organic contamination in soil and ground water samples was not detected by DOE in an analysis performed as part of the site characterization for the SOWP (DOE 2003).

3.1.4 Air Quality

EPA has established National Ambient Air Water Quality Standards (NAAQS) for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter (particles less than 10 micrometers [µm] in aerodynamic diameter, designated PM_{10}) small enough to move easily into the lower respiratory tract. NAAQS are expressed as concentrations of particular pollutants that are not to be exceeded in the ambient or outdoor air to which the general public has access (40 CFR 50.1[e]). Primary NAAQS are designated to protect human health; secondary NAAQS are designated to protect human welfare by safeguarding environmental resources (such as soils, water, plants, and animals) (Table 3–4). Utah has adopted NAAQS as the air quality standards for the state.

Table 3–4. Air Quality Standards

Pollutant	Averaging Period	National and State Ambient Air Quality Standard (µg/m³)[a]		Allowable Increment for Prevention of Significant Deterioration (PSD)[a] (µg/m³)	
		Primary	Secondary	Class I	Class II
Sulfur dioxide	Annual	80	–	2	20
	24-hour[b]	365	–	5	91
	3-hour[b]	–	1,300	25	512
Nitrogen dioxide	Annual	100	100	2.5	2.5
Carbon monoxide	8-hour[b]	10,000	–	–	–
	1-hour[b]	40,000	–	–	–
Ozone	1-hour[b]	235	235	–	–
PM_{10}[c]	Annual	50	50	4	17
	24-hour[b]	150	150	8	30
Lead	3-month[d]	1.5	1.5	–	–

[a]µg/m³ = micrograms per cubic meter; where no value is listed, there is no corresponding standard.
[b]Not to be exceeded more than once per year (for ozone and PM_{10}, on more than 1 day per year on the average over 3 years).
[c]Particulate matter less than 10 µm in diameter.
[d]Calendar quarter.

The air quality in the Moab area is generally good. The current median visual range for the Moab region is about 81 miles (Trijonis 1990). Grand and San Juan Counties are designated as being in attainment with NAAQS for sulfur dioxide, nitrogen dioxide, carbon monoxide, and ozone (40 CFR 81.345). Not enough data are available to support a classification for PM_{10}, so a designation of "unclassifiable" is given for that pollutant (40 CFR 81.345). The PM_{10} data for the Moab region (Table 3–5) show one exceedance during the 4-year period of 1991–1994; an average of one exceedance per year over a 3-year period is allowed. No designation (attainment, nonattainment, or unclassifiable) is published for Utah for lead, although data from Utah metropolitan areas indicate that levels of lead are less than 10 percent of NAAQS (Table 3–4 and Table 3–5). Lead concentrations in the atmosphere have decreased markedly in recent years, largely because of the substitution of unleaded gasoline for leaded gasoline. Monitoring locations in Table 3–5 are those that are closest to the Moab site, including those in Colorado.

Table 3–5. Air Quality in the Moab Region

Pollutant	Monitor location[a]	Year	Averaging period	Maximum ($\mu g/m^3$)[b]	Annual mean ($\mu g/m^3$)
Sulfur dioxide	Mesa County, Colorado	1991	3 hours	28	4
	Mesa County, Colorado	1992	3 hours	13	4
	Salt Lake City[c]	1993	3 hours	776	34
	Salt Lake City	1994	3 hours	509	29
	Mesa County, Colorado	1991	24 hours	9	4
	Mesa County, Colorado	1992	24 hours	12	4
	Salt Lake City[c]	1993	24 hours	176	34
Nitrogen dioxide	Salt Lake City	1991	Annual		55
	Salt Lake City	1992	Annual		49
	Provo[c]	1993	Annual		49
	Provo[c]	1994	Annual		45
Carbon monoxide	Grand Junction, Colorado	1991	1 hour	14,375	
	Grand Junction, Colorado	1992	1 hour	13,685	
	Grand Junction, Colorado	1993	1 hour	13,800	
	Grand Junction, Colorado	1994	1 hour	13,340	
	Grand Junction, Colorado	1991	8 hours	8,970	
	Grand Junction, Colorado	1992	8 hours	7,705	
	Grand Junction, Colorado	1993	8 hours	7,935	
	Grand Junction, Colorado	1994	8 hours	8,625	
Ozone	Arches National Park	1991	1 hour	141	
	Arches National Park	1992	1 hour	135	
	Canyonlands National Park[c]	1993	1 hour	147	
	Canyonlands National Park[c]	1994	1 hour	143	
PM_{10}	Moab	1991	24 hours	181[d]	34
	Moab	1992	24 hours	65	33
	Grand Junction, Colorado[c]	1993	24 hours	67	25
	Grand Junction, Colorado[c]	1994	24 hours	63	24
Lead	Salt Lake City	1991	3 months[e]	0.09	
	Salt Lake City	1992	3 months[e]	0.05	
	Salt Lake City	1993	3 months[e]	0.05	
	Salt Lake City	1994	3 months[e]	0.05	

[a] With the exception of PM_{10}, few site-specific data are available for Moab. The following monitor locations provide the closest available data.
[b] $\mu g/m^3$ = micrograms per cubic meter. Values reported are from the nearest monitoring station.
[c] A different station was used for 1993 because reporting at the previous nearest station had been discontinued. For sulfur dioxide, the 1991 and 1992 values are believed to be more representative of current conditions at Moab than are the more recent values at the more distant station.
[d] One exceedance per year is allowed; the second highest value during 1991 was 111 $\mu g/m^3$, which is below the 24-hour standard.
[e] Calendar quarter.

In addition to ambient air quality standards, which represent an upper bound for allowable pollutant concentrations, there are standards to prevent the significant deterioration of air quality. The prevention of significant deterioration (PSD) standards differ from the NAAQS in that the NAAQS provide maximum allowable *concentrations* of pollutants, and PSD requirements provide maximum allowable *increases in concentrations* of pollutants for areas in compliance with the NAAQS. PSD standards are, therefore, expressed as allowable *increments* in the atmospheric concentrations of specific pollutants. Allowable PSD increments currently exist for nitrogen dioxide, sulfur dioxide, and PM_{10}. PSD increments are particularly relevant when a major proposed action (involving a new source or a major modification to an existing source) may degrade air quality without exceeding the NAAQS (as would be the case, for example, in an area where the ambient air is very clean). One set of allowable increments exists for Class II areas, which cover most of the United States, and a much more stringent set of allowable increments exists for Class I areas, which are specifically designated areas where the degradation of ambient air quality is severely restricted. Class I areas include certain national parks and monuments, wilderness areas, and other areas as described in 40 CFR 51.166 and 40 CFR 81.400–437. Maximum allowable PSD increments for Class I and Class II areas are given in Table 3–4. The PSD Class I area nearest the Moab site is Arches National Park, immediately to the north of the Moab site and about 1,000 ft from the north edge of the tailings pile. Arches National Park has been designated as a mandatory Class I federal area where visibility is an important value (40 CFR 81.430).

3.1.4.1 Conformity Review

Section 176(c)(1) of the Clean Air Act requires that federal actions conform to applicable state implementation plans for achieving and maintaining the NAAQS for the criteria air pollutants. In 1993, EPA promulgated a rule titled “Determining Conformity of General Federal Actions to State or Federal Implementation Plans,” codified at 40 CFR Parts 6, 51, and 93. The rule is intended to ensure that criteria air pollutant emissions and their precursors (e.g., volatile organic compounds and nitrogen oxide) are specifically identified and accounted for in the attainment or maintenance demonstration contained in a state implementation plan. For there to be a conformity, a federal action must not contribute to new violations of air quality standards, increase the frequency or severity of existing violations, or delay timely attainment of standards in the area of concern.

The conformity rule applies to proposed federal actions that would cause emissions of criteria air pollutants above certain levels to occur in locations designated as nonattainment or maintenance areas for the emitted pollutants. Under the rule, an agency must engage in a conformity review process and, depending on the outcome of that review, conduct a conformity determination.

DOE conducted the required conformity review and determined that all the proposed alternative actions would result in emissions of one or more criteria air pollutants. These emissions are described further in the air quality sections of Chapter 4.0. However, because none of the proposed action alternatives (on-site or off-site disposal) would occur in or potentially affect a nonattainment or maintenance area, further conformity determination under the conformity rule is not required.

3.1.5 Climate and Meteorology

The desert climate of Moab is characterized by hot summers and mild to cold winters. Weather data summarized by the Utah Climate Center for the town of Moab are presented in the following discussion (Pope and Brough 1996). January and July are the coldest and hottest months, with their respective average temperatures of about 30 °F and 81 °F. The average annual temperature is about 56 °F. Temperature extremes have ranged from –24 °F in January 1930 to 114 °F in July 1989. Temperatures of 32 °F or lower occur about 130 days a year; approximately 90 percent of those occur during November through March. Temperatures of 90 °F or higher occur about 95 days a year; approximately 25 of those days have temperatures of 100 °F or higher. The effects of temperatures higher than 90 °F on human comfort are somewhat moderated by the low relative humidity, which is typically less than 20 percent during daytime.

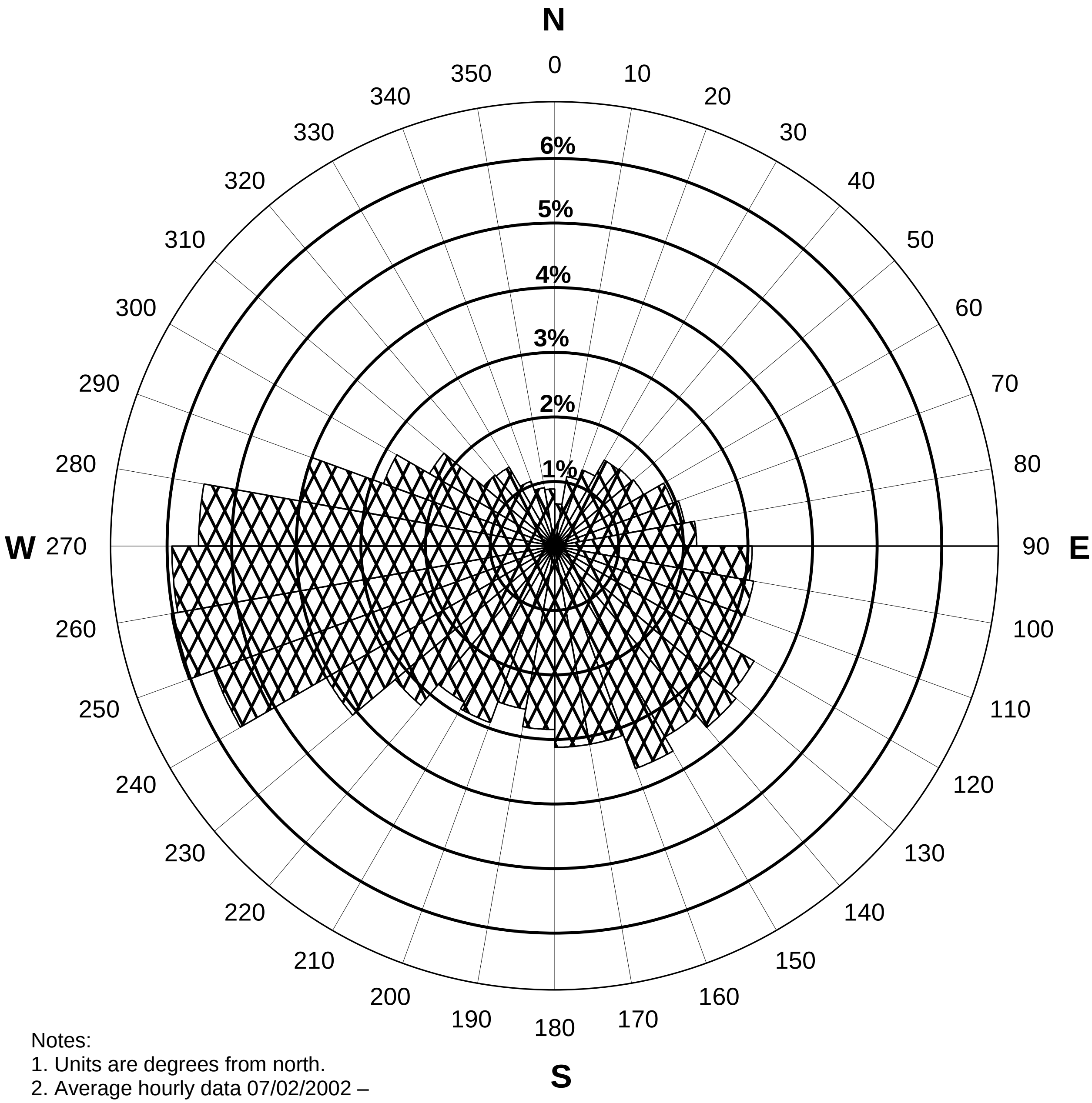
Average annual precipitation at Moab is 9 inches. The driest months are February and June, which have average precipitation slightly less than 0.5 inch; the wettest months are October and April, which have average precipitation of about 1.15 and 1.00 inch, respectively. Annual precipitation is greatly exceeded by potential evapotranspiration (about 50 inches annually), potential or pan evaporation (about 60 inches annually), and lake evaporation (about 38 inches annually).

The greatest precipitation amount reported at Moab in a single day was 3.99 inches on September 23, 1896, and the most precipitation in a single month was 6.63 inches in July 1918. In a 7-day period in late August and early September 1969, Moab received 6.25 inches of precipitation (Pope and Brough 1996). These large precipitation amounts are examples of high rainfall that sometimes occur in association with the late summer-early fall southwest monsoon period. For shorter-term precipitation events, the greatest expected 30-minute precipitation in 100 years is about 1.3 inches, and the greatest expected 1-hour precipitation in 100 years is about 1.6 inches (Hershfield 1961).

Snowfall is light and averages only about 10 inches per year, occurring mostly from December through February. The greatest amount of snow recorded in a single day was 33 inches on December 31, 1915; that month also had the highest single-month snowfall of 46 inches (Pope and Brough 1996). These snowfalls are highly unusual; a single snowfall of greater than 6 inches is rare and occurs only about once every 3 years.

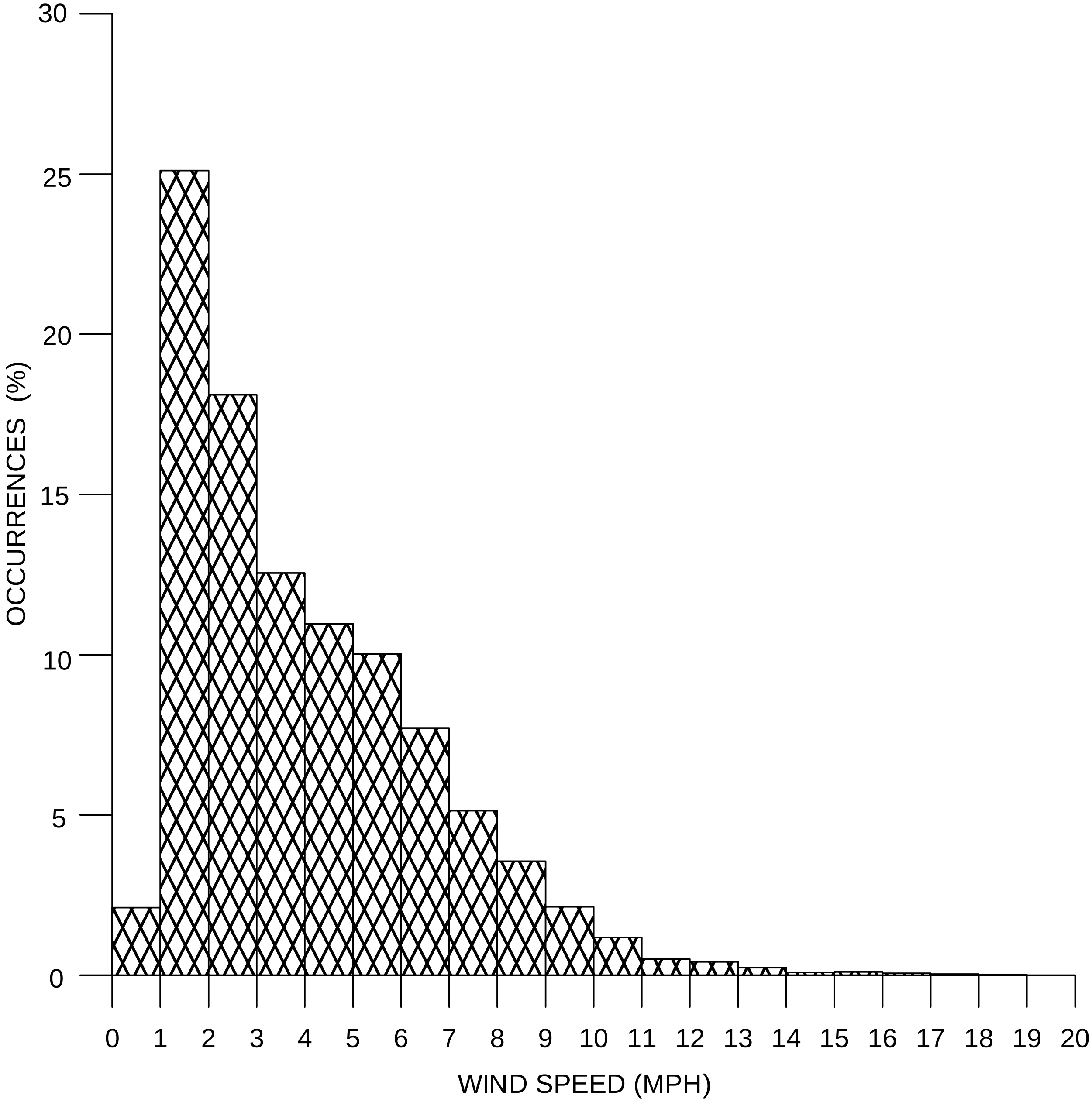
Low humidity in the region limits fog occurrences (visibility less than 0.3 mile) to fewer than 10 days per year. Thunderstorms occur about 40 days per year. Hail occurs about 3 days per year.

Prevailing winds in the Moab area are from the west-southwest (Figure 3–4). Wind speeds are less than 1 mile per hour (mph) 75 percent of the time; wind speeds are 1 to 7 mph 95 percent of the time (Figure 3–5). The highest wind speed recorded at Moab was 80 mph (Pope and Brough 1996). One tornado with wind speeds of at least 100 mph would be expected once in about 100,000 years (ANS 1983). Cold air drainage at the Moab site can occur from the northwest under stable conditions, creating a temperature inversion. These inversions typically occur in the winter months of December and January at times when snow covers the valley floor and can persist for several weeks.



Notes:
1. Units are degrees from north.
2. Average hourly data 07/02/2002 – 07/02/2003 (wind blowing from direction shown) (Ref. Moab Site Meteorological Station).
3. Percent shown indicates frequency of occurrence.

Figure 3–4. Prevailing Wind Direction at the Moab Site



Note:
Average hourly data 07/02/2002 – 7/02/2003
(Ref. Moab Site Meteorological Station).

Figure 3–5. Wind Velocity in the Moab Area

3.1.6 Ground Water

3.1.6.1 Hydrostratigraphy

Rush et al. (1982), Weir, Maxfield, and Hart (1983), and Weir, Maxfield, and Zimmerman (1983) grouped the aquifers in the northern part of the Paradox Basin into lower and upper hydrologic systems. The upper ground water system consists of unconsolidated and bedrock formations above the impermeable salt beds of the Paradox Formation. Confining salt beds of the Paradox Formation underlie most of the site and locally contribute to high levels of salinity in the overlying unconsolidated basin-fill aquifer. The lower ground water system includes all the stratigraphic units below the Paradox Formation. Site-related ground water contamination occurs in the unconsolidated basin-fill aquifer in the upper hydrologic system. Water-bearing characteristics of major stratigraphic units from the Paradox Formation and above are presented in Figure 3–6.

3.1.6.2 Ground Water Occurrence

Ground water occurs in the bedrock formations and unconsolidated Quaternary material deposited on the floor of Moab and Spanish Valleys. The Navajo Sandstone, Kayenta Formation, and Wingate Sandstone of the Glen Canyon Group contain the principal bedrock aquifer in the region and locally are present only upgradient at the northern boundary of the site. The Navajo Sandstone of the Glen Canyon aquifer ranges in thickness from 300 to 700 ft (Doelling et al. 2002) and is the shallowest and most permeable formation in the Glen Canyon Group. Wells located 7 to 8 miles southeast of the site produce in excess of 1,000 gpm of high-quality water from the Navajo Sandstone for the city of Moab water supply.

Estimated transmissivity for the Navajo Sandstone ranges from near 0 to 700 ft^2/day, and estimated hydraulic conductivity ranges from 0.4 to 1 ft/day (Blanchard 1990). Specific capacities of two water-supply wells at the entrance to Arches National Park, completed in the Navajo Sandstone, were 1.7 and 14.5 gpm per foot (Blanchard 1990). Average saturated thickness of the gravelly sand that constitutes the unconsolidated basin-fill aquifer is approximately 70 ft (Sumsion 1971). This basin fill material may be as much as 450 to 500 ft thick in Moab Valley.

Most of the fresh water in the basin-fill aquifer enters the site from Moab Wash and along geologic contacts between the alluvium and the Glen Canyon Group bedrock present at the north boundary of the site. The bedrock in this area is highly fractured and faulted from incipient collapse of the Moab anticline caused by dissolution of the underlying Paradox Formation salt core of the anticline.

Ground water elevation of the fresh water in the basin fill alluvium is shown in Figure 3–7. West of the Colorado River, these shallow water-table contours are based on average water elevations measured in 2001 and 2002. Contours east of the Colorado River in the Matheson Wetlands Preserve are based on March 2003 water elevation measurements and indicate ground water flow toward the river. The elevation contours indicate that fresh water entering the site at the northern boundary flows south toward the river over the top of a deeper natural brine zone.

	Symbol	Explanation
Quaternary	Qa	Quaternary alluvial deposits Surficial and basin-fill deposits. Mostly sand, silt, gravel and minor amounts of clay deposited by the Colorado River. Overlain in places by finer-grained overbank deposits of sand, silt, and clay. Contains fan alluvium and some eolian interbeds. Secondary aquifer used mostly for irrigation and some domestic water supply in Spanish Valley where the water quality is fresh to slightly saline. Yields very saline to briny water in Moab Valley near the Colorado River where the underlying Paradox salt-beds subcrop.
Jurassic	Jctm	Curtis Formation Moab Member Fine-to medium-grained, massive, quartzose sandstone. Recharge unit to Entrada aquifer especially where highly fractured.
	Jes	Entrada Sandstone Slick Rock Member Massive, fine-grained, eolian sandstone. Highly jointed in outcrop. Entrada aquifer. Yields fresh water near outcrop areas in Moab and Spanish Valley.
	Jcd	Carmel Formation Dewey Bridge Member Muddy to silty, mostly fine- to medium-grained sandstone. Low permeablity unit and commonly acts as a confining layer. Not known to yield water in this area.
	Jn	Navajo Sandstone Fine-grained, well sorted, subrounded to very well rounded, eolian quartz sandstone. Navajo aquifer. Principal drinking water aquifer in Spanish Valley. Very permeable and yields fresh water to wells at relatively shallow depths.
	Jk	Kayenta Formation Very fine to medium-grained fluvial sandstone, siltstone, interbedded with mudstones. Generally a confining layer; however, the unit is sandy and more permeable in Spanish Valley. Not known to yield water to wells in the area.
	Jw	Wingate Formation Very fine to fine-grained, massive, eolian sandstone. Moderately low permeability. Wingate aquifer. Yields moderate quantities of fresh water where the formation is intensely fractured.
Triassic	TRc	Chinle Formation Interbedded fluvial sandstone, mudstone, siltstone, and conglomerate. Generally considered a confining unit. Some permeable layers yield very saline water.
	TRm	Moenkopi Formation Interbedded siltstone, fine-grained sandstone, and mudstone. Generally considered a confining unit. Some permeable layers yield very saline water.
Permian	Pc	Cutler Formation Fluvial arkosic sandstone and conglomerates interbedded with eolian sandstones. Not known to yield water to wells in the area.
Pennsylvanian	IPh	Honaker Trail Formation Interbedded sandstone, fossiliferous limestone, and siltstone. Not known to yield water to wells in the area.
	IPp	Paradox Formation Principal confining unit consisting of 70 to 80 percent halite and some associated potash salts that are practically impervious to fluid flow. Interbedded with black shale, dolomite, and anhydrite. Yields briny water from dissolution of interbeds that forms cap rocks probably along contact zones rather than through the section.

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Figure 3–6. Water-Bearing Characteristics of Major Stratigraphic Units

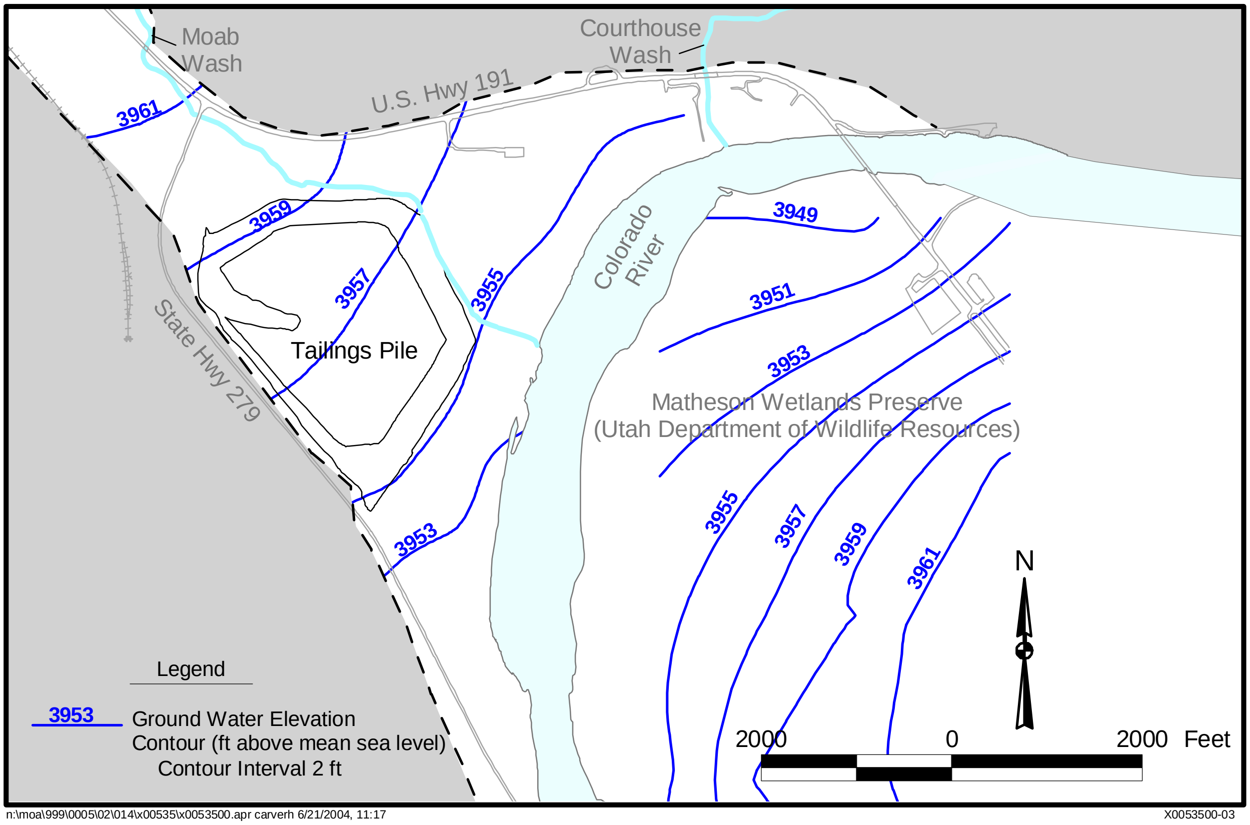

Figure 3–7. Ground Water Elevation Contours on the Upper Freshwater Surface

The deeper brine water results mostly from dissolution of the underlying salt beds of the Paradox Formation present beneath most of the site. Figure 3–8 presents a conceptual model of the subsurface hydrogeology along a representative streamline showing the interface between the deeper saltwater system and the overlying freshwater system. The saltwater interface is defined at the 35,000-mg/L TDS boundary. The transition from the saltwater to the freshwater system occurs over a short vertical distance and is, therefore, referred to as being "sharp." The vertical position of the interface is in equilibrium because the buoyant force exerted by the brine is balanced by the weight of the overlying fresh water. In natural systems, little, if any, fresh water penetrates salt water at the interface. The fresh water can be thought of as a liquid that "floats" upon a buoyant saltwater liquid. At the Moab site, the interface extends across the site in a wedge shape, in which the deepest part of the interface is near the northwest boundary, and the shallowest depth is near the river. The position of the interface near the river is in dynamic equilibrium and probably shifts laterally and vertically in response to evapotranspiration by the tamarisk plant communities and the stage of the Colorado River. The interface may also shift vertically upward as a result of pumping from the shallow fresh water (e.g., during a pump-and-treat remediation) and cause the salt water to rise to a higher elevation and intrude the fresh water. Saltwater intrusion would result in degradation of the overlying fresh water, which could adversely affect the tamarisk plant communities that are providing some beneficial phytoremediation at the site.

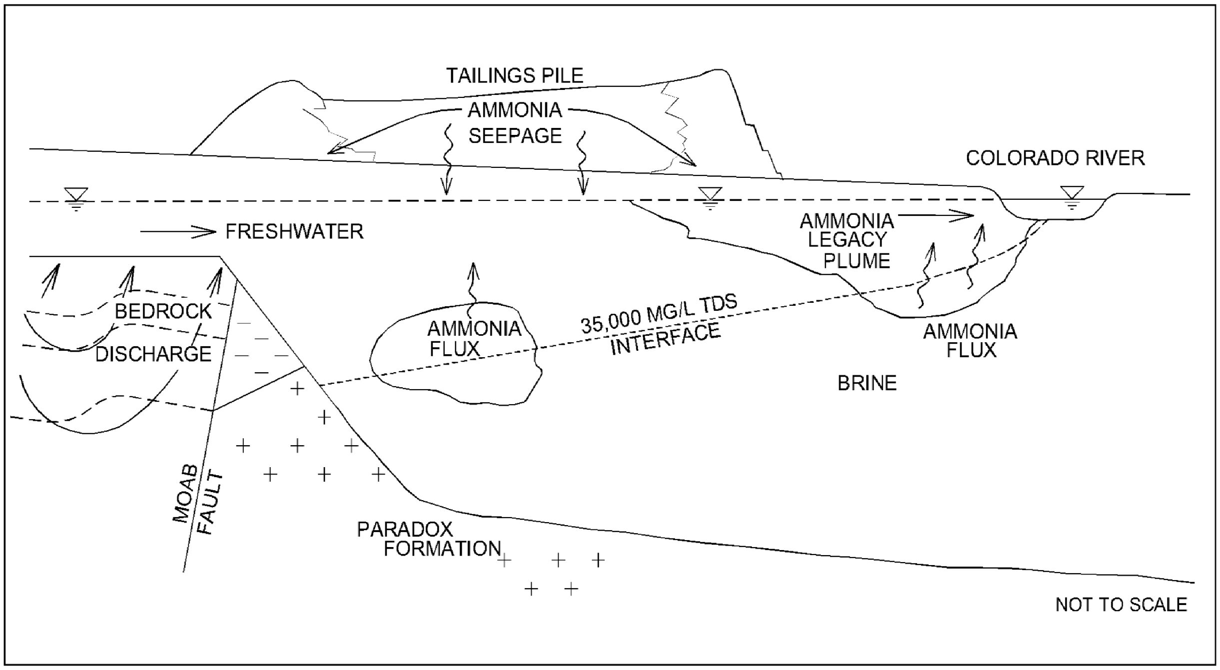

Figure 3–8. Conceptual Model, Saltwater/Freshwater Interface

Rising salt water may also bring higher ammonia and salt concentrations to the surface and cause added contamination flux to the river. Low pumping rates and proper extraction well construction and pump location may prevent saltwater intrusion. Additional information on the hydrogeology of the site is presented in the SOWP (DOE 2003).

Additional recharge to the site occurs through precipitation. The Paradox Formation is believed to be an impermeable boundary (bedrock aquitard) and does not contribute to the site water budget. An estimate of the annual steady-state water budget for each hydrologic component of the system is presented in Table 3–6. Short-term transient effects such as the small positive contribution to bank storage by recharge from the Colorado River during periods of high flow are not included. The estimates are represented with a large range of individual values, and the ranges of the total inflow and total outflow do not overlap, reflecting the uncertainty of the values and suggesting that the true water budget might lie between the two ranges. The SOWP (DOE 2003) provides additional discussion of the ground water hydrology and water budget of the site.

Table 3–6. Estimated Annual Water Budget for the Moab Site

Flow Component	Inflow (gpm)	Outflow (gpm)
Areal Precipitation	16–65	N/A
Moab Wash	0.5–33	N/A
Glen Canyon Group	28–280	N/A
Tailings Pile	20	N/A
Evapotranspiration	N/A	200–500
Colorado River	N/A	300–600
Total	**65–400**	**500–1,100 (rounded)**

N/A = not applicable.

3.1.6.3 Ground Water Quality

The basin-fill aquifer underlying the site is divided into three hydrochemical facies: (1) an upper fresh to moderately saline facies (fresh Quaternary alluvium [Qal]) that has concentrations of TDS up to 10,000 mg/L, (2) an intermediate facies of very saline water (saline Qal), having TDS concentrations between 10,000 and 35,000 mg/L, and (3) a lower briny facies (brine Qal) that has TDS concentrations greater than 35,000 mg/L. All three facies existed beneath the site prior to milling activities. The SOWP (DOE 2003) provides additional discussion of ground water geochemistry and water quality at the site.

A cross-sectional view of contoured TDS concentrations beginning at Moab Wash and extending southeast to the Colorado River is shown in Figure 3–9. The interface between the upper fresh water with the deeper saline water is shown by the 35,000-mg/L contour line. Sixty percent of the alluvial aquifer is contained in the lower briny facies. More than 80 percent of the basin-fill aquifer contains TDS concentrations that are greater than 10,000 mg/L. The upper hydrochemical facies contains limited fresh water with less than 3,000 mg/L TDS that could provide potable water (Figure 3–9). The volume of ground water containing 3,000 mg/L or less TDS represents less than 3 percent of the total volume in the basin-fill aquifer beneath the site. All the fresh water with TDS concentrations less than 3,000 mg/L that could provide potable water occurs upgradient of the tailings pile near Moab Wash. Though some of the TDS in the freshwater system is from recent contamination, the percentage of the aquifer that would return to TDS concentrations of less than 3,000 after remediation would be minimal.

The fresh water quickly becomes mixed with more saline water in the basin-fill aquifer as it enters the site from Moab Wash and flows toward the Colorado River. Salinity naturally increases with depth and distance from the freshwater source contribution from Moab Wash. Mixing of the two background water types (fresh upgradient water with the deeper depth saline water) influences the background water quality at the site. The result is a background water quality in the basin-fill aquifer that is highly variable both vertically and horizontally across the site.

Background conditions in the upper fresh Qal facies are characterized by low concentrations of uranium and other trace metals that are all below the EPA standards in 40 CFR 192 (Table 3–7). TDS concentrations range from 677 to 7,820 mg/L, which classifies the water quality as fresh to slightly saline. Background alkalinity as calcium carbonate ranges from 137 to 189 mg/L. There is no EPA standard for ammonia in 40 CFR 192. Ammonia–N concentrations are less than 1 mg/L. Sulfate concentrations range from 180 to 1,140 mg/L. Calcium concentrations range from 47 to 294 mg/L. Magnesium concentrations range from 31 to 188 mg/L. On average, the pH value of the upper fresh Qal facies is near neutral (7.7), and the redox condition is slightly oxidizing (oxidation-reduction potential is 186 millivolts [mV]).

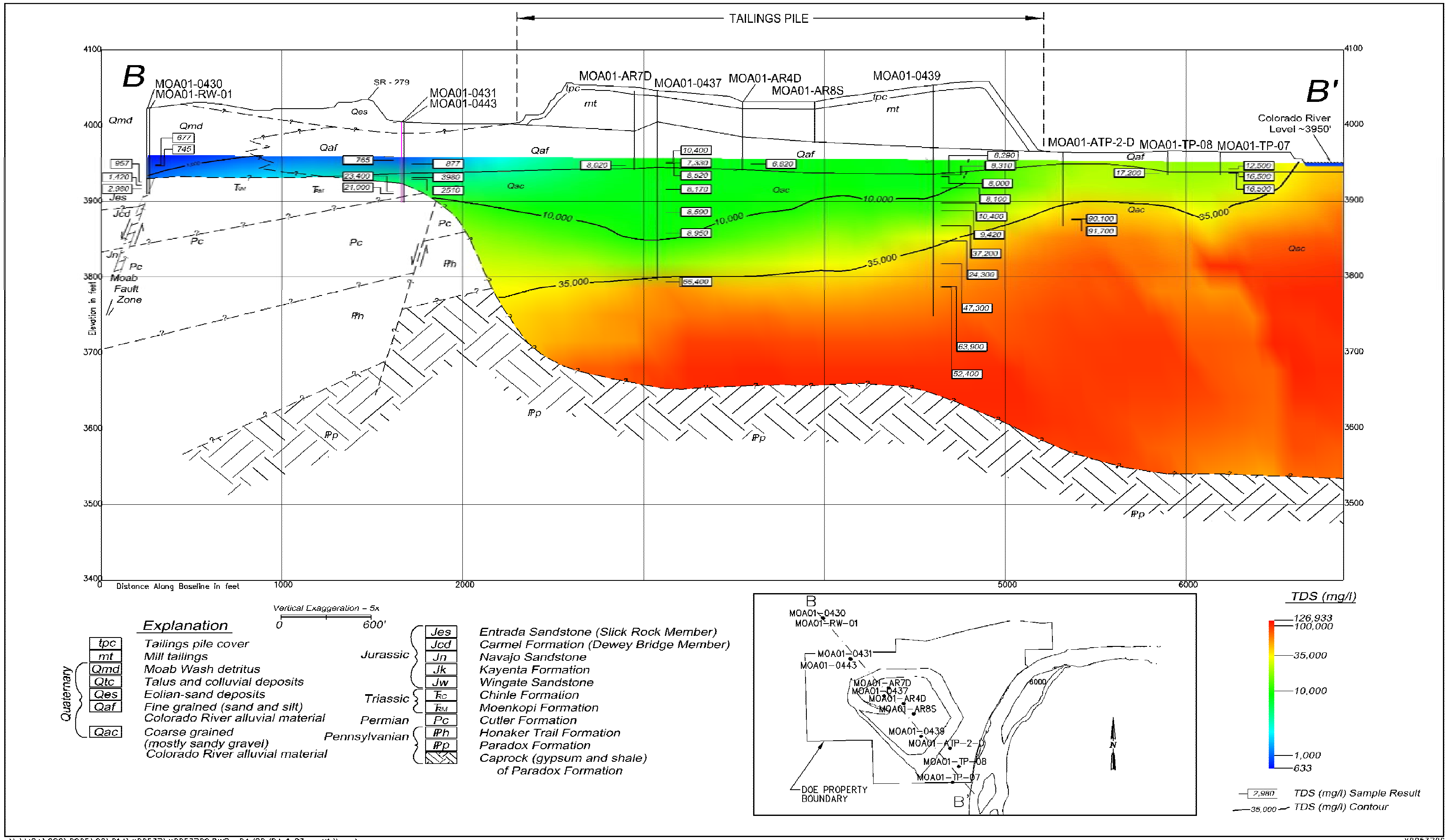

Figure 3–9. Cross-Sectional View of TDS Concentrations in Moab Wash and the Basin-Fill Aquifer Beginning at Moab Wash and Extending Southeast to the Colorado River

Table 3–7. Standards for Inorganic Constituents in Ground Water at UMTRCA Sites

Constituent	Standards[a]		Background[a]	
	EPA (40 CFR 192)[b]	SDWA[c]	Fresh Qal Facies Range	Brine Qal Facies Range
Arsenic	0.05	0.01	0.00018–0.0015	0.00015–0.11
Barium	1.0	2.0	0.0222–0.033	0.031–0.121
Cadmium	0.01	0.005	<0.0001–<0.0017	<0.0001–0.014
Chromium	0.05	0.1	<0.0005–<0.011	<0.003–<0.01
Lead	0.05	N/A	<0.0001–<0.0055	0.00054–0.184
Mercury	0.002	0.002	<0.0001–<0.0002	<0.0002–<0.0002
Molybdenum	0.1	N/A	<0.0018–0.01	<0.004–<0.009
Nitrate (as N)	10[d]	10[d]	1.22–15.9	<0.02–0.075
Selenium	0.01	0.05	0.0091–0.0266	<0.0001–0.009
Silver	0.05	N/A	<0.0001–<0.0055	<0.0001–<0.004
Radium (combined radium-226 and radium-228)	5 pCi/L	5 pCi/L	N/A	N/A
Radium-226	N/A	N/A	0.07–0.16 pCi/L	<0.29–9.26 pCi/L
Radium-228	N/A	N/A	<0.5–1 pCi/L	2.6–6.09 pCi/L
Uranium (combined uranium-234 and uranium-238)	0.044[e]	0.03	0.0042–0.0259	0.0007–0.0269
Gross alpha-particle activity (excluding radon and uranium)	15 pCi/L	15 pCi/L	<6.73–<73.92 pCi/L	<356.33–<473.08 pCi/L

[a]Concentrations reported in milligrams per liter (mg/L) unless noted otherwise; pCi/L = picocuries per liter.
[b]Maximum concentration limits, 40 CFR 192, Table 1, Subpart A.
[c]Maximum contaminant levels, Safe Drinking Water Act, 40 CFR 141.23 and 141.62.
[d]Equivalent to 44 mg/L nitrate as NO_3.
[e]Equivalent to 30 pCi/L, assuming secular equilibrium of uranium-234 and uranium-238.
N/A = not applicable

Background conditions in the lower brine Qal facies are characterized by a poor water quality resulting from the dissolution of gypsum and salt beds in the underlying bedrock formations. The water is a sodium-chloride type with TDS concentrations up to 97,000 mg/L, which classifies the water quality as briny. Maximum detected concentrations of arsenic (0.11 mg/L), cadmium (0.014 mg/L), and lead (0.184 mg/L) are all slightly higher than EPA standards in 40 CFR 192. Maximum concentrations of uranium (0.027 mg/L) are less than the EPA standard. Ammonia background concentrations range from 0.03 to 3.0 mg/L. Safe Drinking Water Act secondardy standards are exceeded for sulfate (250 mg/L), chloride (250 mg/L), manganese (0.05 mg/L), and iron (0.3 mg/L), demonstrating the poor quality of the brine Qal background ground water. Secondary standards are unenforceable.

Site-related constituents have contaminated the basin-fill aquifer beneath the tailings pile and beneath the former millsite. Ammonia, nitrate, sulfate, molybdenum, uranium, gross alpha, and gross beta are the site-related constituents most prevalent in the basin-fill aquifer. The relatively low distribution ratios (R_ds) measured for uranium and ammonia explain the higher prevalence of these site-related constituents, which are conserved in the ground water and are more easily dispersed from the source area. Similarly, molybdenum and nitrate are geochemically conservative and tend to be highly mobile in ground water under almost all conditions.

Concentrations of magnesium, cobalt, manganese, and strontium exceed the upper limit of the range in natural background for the fresh Qal facies in more than 50 percent of the samples but do not exceed the upper limit of natural background for the brine Qal facies in any of the samples. Similarly, cadmium and nickel concentrations exceed the upper limit of natural background for the fresh Qal facies in more than 50 percent of the samples but exceed the upper limit in natural background for the brine Qal facies in only 3 percent or less of the samples. This low frequency reflects the relatively high concentrations that occur naturally in the Paradox Formation brine.

Other site-related constituents are present at concentrations above the upper limit of natural background; however, concentrations exceed background less frequently. For example, arsenic concentrations exceed the upper limit in approximately 35 percent of the samples when compared to the fresh Qal background but in only 3 percent of the samples when compared to the brine Qal background. Selenium concentrations exceed the upper limit in approximately 29 percent of the samples when compared to the fresh Qal background and in 54 percent of the samples when compared to the brine Qal background. Vanadium concentrations exceed the upper limit in approximately 19 percent of the samples when compared to the fresh Qal background and in 10 percent of the samples when compared to the brine Qal background. Antimony, barium, chromium, lead, mercury, silver, and zinc concentrations exceed the upper limit of natural background for either the fresh or brine Qal facies in only 10 percent or less of the samples.

Ground water concentration limits for arsenic, barium, cadmium, chromium, lead, mercury, molybdenum, nitrate, selenium, silver, uranium (combined U-234 and U-238), gross alpha (excluding radon and uranium), and radium (combined radium-226 and radium-228) are regulated by EPA standards (see Table 3–7). Of these constituents, the maximum concentrations detected for arsenic, cadmium, uranium, radium, gross alpha, nitrate, selenium, and molybdenum exceed EPA standards. The remaining regulated constituents (barium, chromium, lead, mercury, and silver) are all present at relatively low concentrations below EPA standards.

The areal distribution of uranium concentrations greater than 0.044 mg/L, interpolated and contoured on the upper surface of the ground water, is presented in Figure 3–10. The highest uranium concentrations are in the shallow ground water in the former millsite area. Cross-sectional views of the uranium plume and additional isoconcentration maps of uranium as a function of depth are provided in the SOWP (DOE 2003). SMI (2001) suggested that the high uranium concentrations beneath the millsite are caused by waste leaking from the former wood chip disposal areas. Although the uranium plume is in an area where wood chip disposal was likely to have occurred, lithologic logs of borings installed in this area of the site do not indicate that they penetrated through the wood chip pits. Another possible source of the high uranium concentrations is the uranium ore stockpiles; however, samples collected from monitor wells nearest the largest known ore stockpiles have lower uranium concentrations. Whether the source of the high uranium concentrations in ground water samples is the wood chip pits, the ore stockpiles, or some other millsite-related release, it seems that some of the ground water contamination originates in the millsite area, independently of the tailings pile.

Although ammonia has no EPA standard in 40 CFR 192, it occurs at concentrations significantly greater than natural background, is one of the most prevalent contaminants in the ground water, and is the constituent of greatest ecological concern that is discharging to the Colorado River in backwater areas adjacent to the site. The areal distribution of ammonia concentrations greater than 50 mg/L, interpolated and contoured on the upper surface of the ground water, is presented in Figure 3–11. The highest concentrations in the shallow ground water, greater than 500 mg/L,

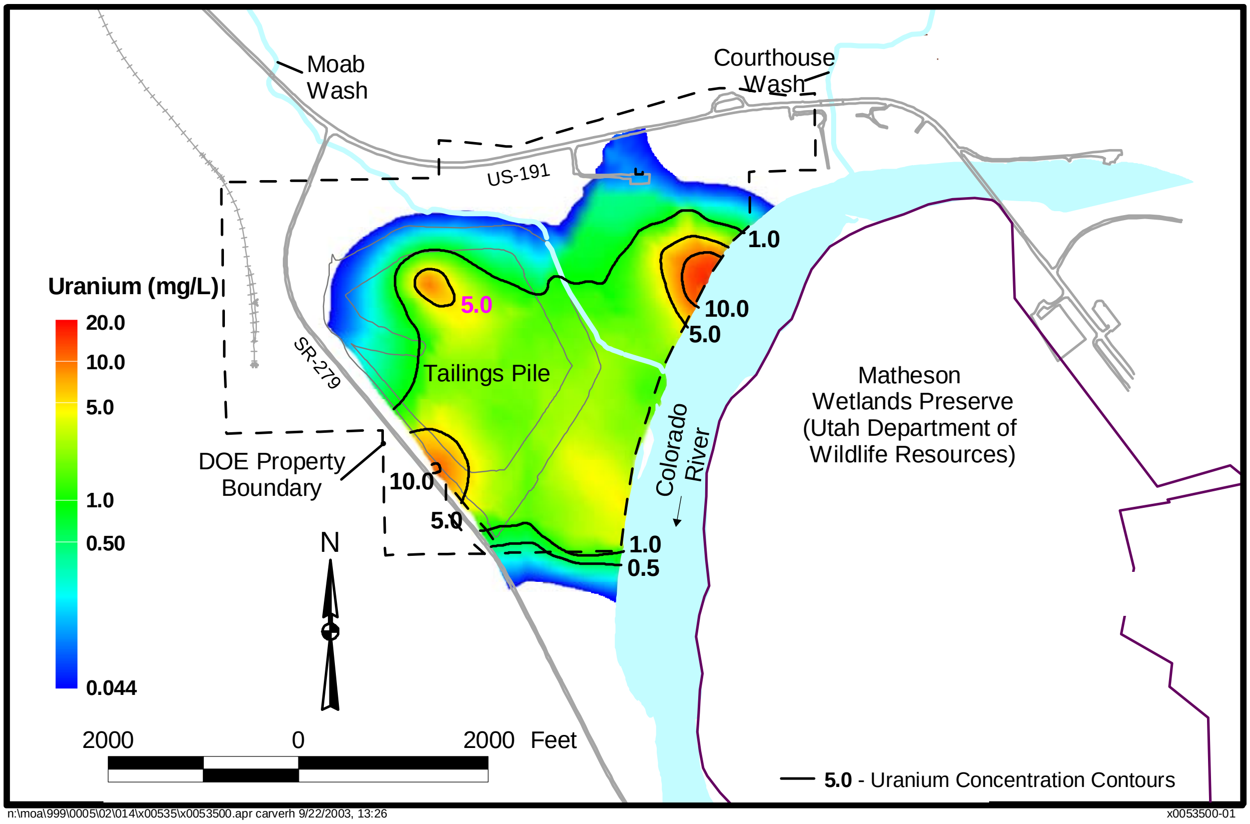

Figure 3–10. Uranium Concentrations Interpolated at the Ground Water Surface

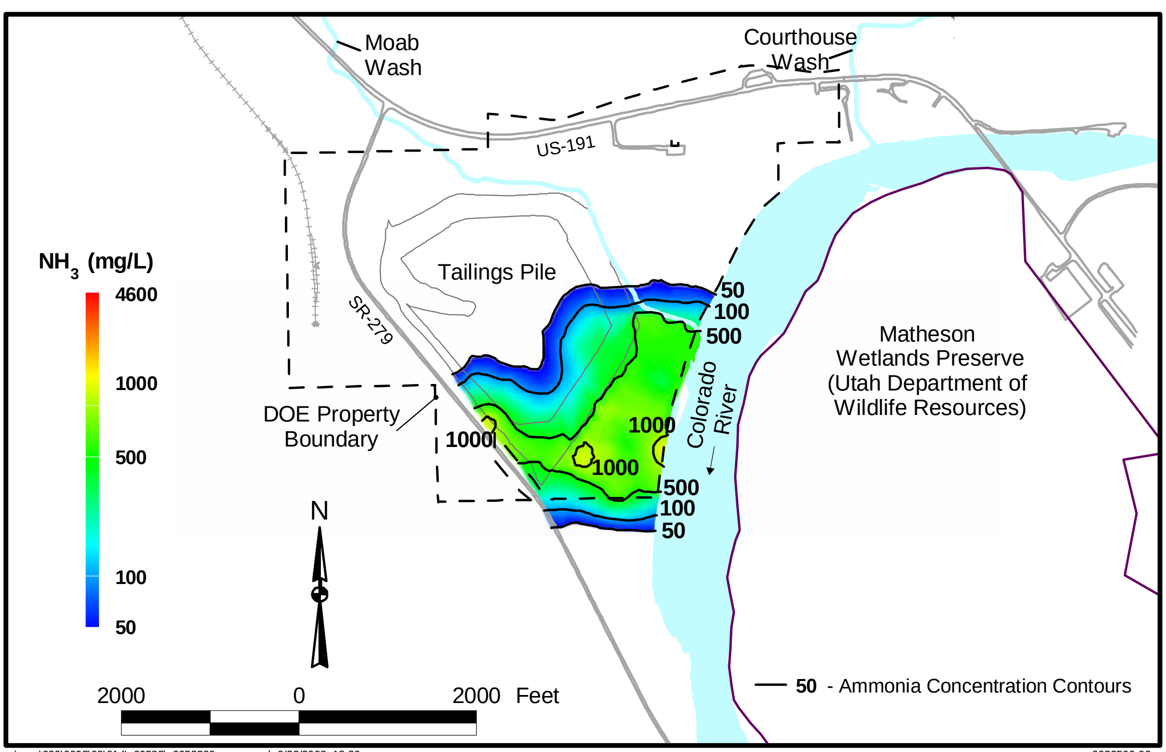

Figure 3–11. Ammonia Concentrations Interpolated at the Ground Water Surface (DOE 2003)

appear near the downgradient edge of the pile and extend to and discharge to the Colorado River. The highest ammonia concentrations in surface water samples are detected in samples collected closest to the riverbank adjacent to the tailings pile and immediately downstream of Moab Wash. A comparison of ground water data with surface water data shows that, with few exceptions, concentrations of site-related constituents are much lower in the surface water than in the ground water. Ammonia concentrations in the river are approximately 2 orders of magnitude lower than in the ground water. Available data (DOE 2005b) suggest that at least order-of-magnitude decreases in constituent concentrations can be expected as ground water discharges to the river. For further discussions see Section 2.3.1.2. Isolated pools or very shallow areas may be exceptions to this; however, those locations are temporary and are unlikely to represent important aquatic habitat.

Relatively high ammonia concentrations in ground water also occur at depth beneath the tailings pile (Figure 3–12). During milling operations, the tailings pond contained fluids with TDS concentrations ranging from 50,000 to 150,000 mg/L. Because these salinities exceed 35,000 mg/L, they had sufficient density to migrate vertically downward through the freshwater system and into the brine. This downward migration of the tailings pond fluids into the saltwater system is believed to have created a reservoir of ammonia that now resides below the saltwater interface. This ammonia plume below the interface probably came to rest at an elevation where it was buoyed by brine having a similar density. Under present conditions, the ammonia plume beneath the saltwater interface represents a potential long-term source of ammonia to the freshwater system. The conceptual model presented in Figure 3–8 illustrates the ammonia source at the saltwater interface (basal flux), the legacy plume, and seepage of ammonia from tailings pore fluids.

3.1.6.4 Ground Water Use

Historical records indicate that two water supply wells were present at the site before milling operations began in 1956 (DOE 2003). Both wells were located near the northwest area of the tailings pile. Records indicate that the first well, designated as well C, was installed to a depth of 67 ft by the U.S. Department of the Interior Grazing Service in 1940 and provided approximately 20 gpm from the basin-fill aquifer, presumably used for livestock watering. The second well, designated as well B, was installed to a depth of 114 ft by the U.S. Atomic Energy Commission in 1954 just prior to mill construction. The zone of completion for well B is unknown. This well produced approximately 11 gpm through a perforated casing and was presumably used to supply process water for the mill. In both cases, the quality of the water is unknown, and the wells have subsequently been decommissioned. No other water wells are known to have existed at the site prior to milling.

The Navajo Sandstone of the Glen Canyon aquifer, which ranges in thickness from 300 to 700 ft (Doelling et al. 2002), is the shallowest and most permeable formation in the Glen Canyon Group. Consequently, it is the primary target for most bedrock wells drilled in the area (Eisinger and Lowe 1999). The city of Moab derives most of its drinking water from a well field that is completed in the Glen Canyon aquifer near the northeast canyon wall of Spanish Valley (Blanchard 1990). Two water-supply wells located near the entrance to Arches National Park are completed in the Navajo Sandstone.

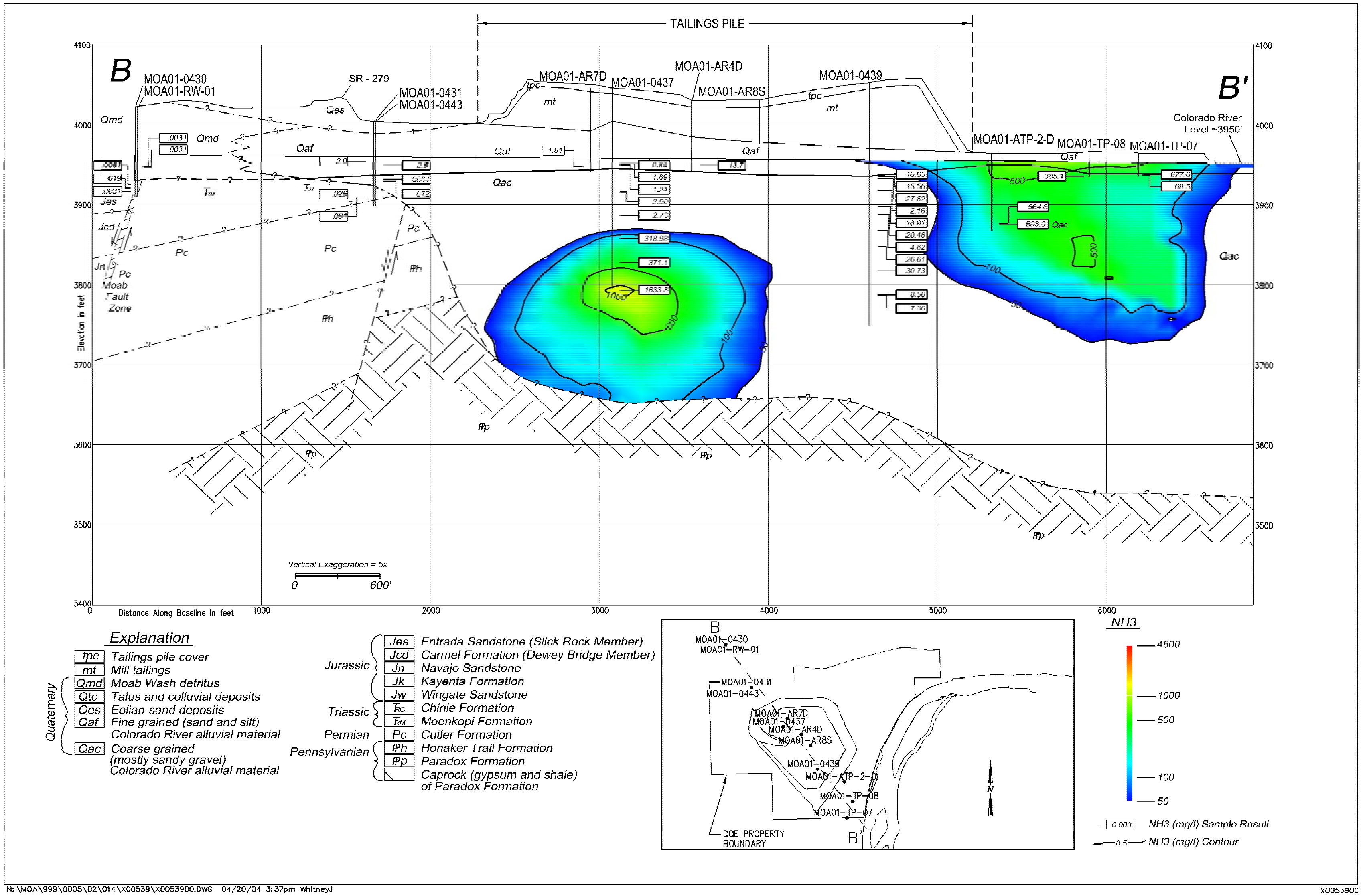

Figure 3–12. Cross-Sectional View of Ammonia Concentrations Beneath the Tailings Pile

Numerous springs flow from the Navajo Sandstone. Flux from these springs is limited to less than 10 gpm but is sufficient to provide water for a few cattle (Doelling et al. 2002). Other consolidated formations in the Spanish Valley, such as the Entrada Sandstone, are capable of transmitting and yielding small quantities of water but are not important as a water resource (Sumsion 1971).

Unconsolidated basin-fill deposits make up a secondary aquifer used mostly for irrigation and some domestic water supply in Spanish Valley (Steiger and Susong 1997). More than 200 wells completed in the unconsolidated material in the Moab-Spanish Valley area (Sumsion 1971) range in depth from 30 to 300 ft (Eisinger and Lowe 1999). Water in the unconsolidated aquifer is generally of poorer quality than that of the Glen Canyon and Entrada aquifers. Near the Colorado River, TDS and trace metals concentrations in the basin-fill aquifer increase as a result of dissolution of the underlying Paradox Formation salt beds (Cooper and Severn 1994).

3.1.7 Surface Water

3.1.7.1 Surface Water Resources

The Moab site is located within the Southeast Colorado Watershed Management Unit as designated by UDEQ's Division of Water Quality (UDEQ 2000). This watershed unit includes the Colorado River in the vicinity of the Moab site and all its tributaries and other water bodies between the Colorado River and the Colorado/Utah state line.

The principal surface water resource in the area, the Colorado River, lies 500 to 700 ft from the easternmost extent of the tailings pile, which is located on alluvial material deposited by the river. It flows south along the east edge of the site, and flows in deeply incised bedrock canyons cut by the river at the northeast and southwest borders of Moab Valley. The Colorado River flows south out of Moab Valley through The Portal, 1,000-ft sandstone cliffs flanking the entrance to the river canyon. The river drains one of the most arid sections of the North American continent. The rugged mountains, broad basins, and high plateaus in the Upper Colorado Basin (above Lees Ferry, Arizona) have been deeply entrenched and dissected (Price and Arnow 1974).

Courthouse Wash empties into the Colorado River 0.5 mile upstream from the tailings pile, and Moab Wash crosses the site along the north and east sides of the tailings pile. The channel of Moab Wash was rerouted east of the mill during operations to mitigate flooding potential during peak flows. Courthouse Wash drains 102 square miles, has an average discharge of 2.12 cfs, and produces peak flows reaching 12,300 cfs. Courthouse and Moab Washes are ephemeral and are dry much of the year. Courthouse Wash sustains flows for longer durations than Moab Wash, which drains an area of only 5 square miles (Smith Technology Corporation 1996). Moab Wash is an ungaged stream.

The Dolores River and the Green River empty into the Colorado River upstream and downstream, respectively, from Moab and the tailings pile. The Scott M. Matheson Wetlands Preserve (Matheson Wetlands Preserve), a shallow wetland open to the public and managed jointly by the Nature Conservancy and the Utah Division of Wildlife Resources (UDWR), is located across the river from the pile.

Natural streamflow of the Colorado River has been affected by many diversions and dams. The dams above the Moab area are not large in comparison to other dams in the Upper Colorado drainage system, such as the Flaming Gorge or Glen Canyon dams. The reservoirs along the Colorado River tributaries upstream of the Moab area store only about 10 percent of the total volume of water stored in Lake Powell (Van Steeter and Pitlick 1998), which is located 150 miles downstream from Moab. However, the presence of these dams has altered streamflow significantly by controlling the extreme high and low flows experienced prior to dam construction. These controlled flows have resulted in changes of river morphology and other characteristics such as sediment load (Van Steeter and Pitlick 1998).

The Cisco, Utah, gaging station (the closest station upstream of the site) is located 1 mile below the confluence of the Colorado and Dolores Rivers, and 31 miles upstream from the Moab site (NRC 1979). The drainage area above the gage is 24,100 square miles. The average discharge for 59 years of record (1911 to 1970) was 7,711 cfs, and maximum and minimum daily mean flows measured 73,200 cfs and 640 cfs, respectively. The complete period of record for the Cisco gaging station extends from January 1895 through 2003. The first 15 years consist of calendar-year rather than water-year discharge statistics. The maximum discharge for the complete period of record was 76,800 cfs.

3.1.7.2 Surface Water Quality

The Colorado River Basin Water Quality Control Project was established in 1960 (U.S. Department of Health, Education, and Welfare [HEW] 1961), and much of the early monitoring of the river was conducted in support of that project. A study conducted to determine the potential effects of the Moab site identified several constituents in the Colorado River in the study area that had concentrations above recommended limits, including sulfate, chloride, TDS, and manganese (HEW 1961). The presence of these constituents was attributed to natural causes. Highest levels of some analytes were detected in samples collected at the confluence of the Dolores River with the Colorado River. Studies of Colorado River water quality were undertaken in 1966 mainly to study the effects, if any, of uranium milling operations on the river. Radionuclides, particularly radium, were of main concern in these studies (HEW 1966).

In the 1970s, much of the focus on the Colorado River Basin concerned salinity control, pursuant to passage of the Colorado River Basin Salinity Control Act (Public Law 93-320). A major source of salinity load to the Colorado River, particularly in the Southeast Colorado Watershed Management Unit, is the Dolores River. As the Dolores River crosses the Paradox Valley in southwestern Colorado, highly saline ground water (brine) discharges to the river (Chafin 2003). The source of the brine is a collapsed salt anticline, similar to that in Moab Valley. Surface waters in the vicinity of the Moab site are influenced by discharge of ground water containing dissolved salts from the Paradox Formation that is found in the cores of salt anticlines characteristic of this region (DOE 2003). Highly saline ground water is known to occur beneath the Moab site as well as at the Matheson Wetlands Preserve across the river from the site. Near the confluence of the Dolores River and the Colorado River, the salinity of the Dolores River limits the use of river water for irrigation of some crops (UDEQ 2000). Onion Creek, another high-salinity tributary to the Colorado River, has been designated as an impaired water body because of elevated levels of TDS from both natural and agricultural sources (UDEQ 2000).

Several other water bodies in the Southeast Colorado Watershed Management Unit have been designated as impaired because of high TDS levels, including Mill Creek, which is a source of recharge to the alluvial aquifer across the Colorado River from the Moab site.

Selenium is also cause for regional concern. Although selenium levels have received greater attention in the Upper Colorado River Basin in Colorado, where concentrations have been detected up to 2 orders of magnitude above the National Ambient Water Quality Criteria of 0.005 mg/L (Spahr et al. 2000), concentrations in the vicinity of the Moab site are also relatively high. Concentrations of other constituents are known to be elevated in the Upper Colorado River Basin and the Southeast Colorado Watershed Management Unit as a result of the extractive industries; these effects tend to be more localized (Spahr et al. 2000; UDEQ 2000).

More recently, surface water monitoring of the Colorado River Basin, which includes the Moab site, has been conducted as required by the Clean Water Act. An intensive monitoring program took place between July 1997 and June 1998 to assess streams against state water quality standards and pollution indicators to determine if their designated beneficial uses were being met (UDEQ 2000).

Water quality of the Colorado River has declined over the years as human activities in the basin have expanded. Dams and water-diversion projects have greatly accelerated water loss through evaporation and consumption, resulting in higher salinities (i.e., higher TDS), altered temperature and flow regimes, and altered nutrient and suspended solids transport (NRC 1999). Industrial development (mining and milling in particular) and rapid urbanization have introduced wastewaters containing a variety of contaminants into the river, including suspended sediments, acid mine drainage, heavy metals, radionuclides, and organic wastes.

Despite the different factors that impair the surface water quality of the Colorado River, the portion of the river belonging to the Southeast Colorado Watershed Management Unit was assessed as fully supporting all its beneficial uses, according to results of the intensive monitoring conducted from July 1997 to June 1998. Therefore, the overall river water quality is considered to be good. Of the 981 stream miles within the Southeast Colorado Watershed Management Unit, 27 sampling sites were used in the assessment. Four of the 27 sampling sites were located on the Colorado River (UDEQ 2000).

3.1.7.3 Site-Related Surface Water Contamination

In addition to previous characterization, DOE conducted a baseline round of surface water sampling in the Colorado River near the site in summer 2002. Analytical results of samples collected adjacent to the site were compared to background concentrations and aquatic benchmarks to develop a list of contaminants of potential concern. The analytical results confirmed that ground water discharge from the Moab site has caused localized degradation of surface water quality. As a result of that evaluation, ammonia, copper, manganese, sulfate, and uranium are considered contaminants of concern.

Additional sampling conducted in 2004 focused on understanding the effects of ground water discharge on surface water quality in backwater areas that may provide preferred habitat for endangered fish. The sampling results (DOE 2005a) confirmed both historical and the 2002 sampling results.

Concentrations of contaminants of potential concern in surface water samples vary widely, depending on sampling locations and river flow conditions. Concentrations are highest immediately adjacent to the riverbank in areas where water is shallow, slow moving, or pooled where it is cut off from the main channel of the river. Concentrations are most likely to be elevated during average to low river stages. The constituents with concentrations that are most consistently elevated in samples from the Colorado River are ammonia and uranium. The highest ammonia concentrations have been detected in samples from areas next to the riverbank immediately downstream of Moab Wash. DOE conducted field mapping of the most distinctive features in the river adjacent to the site in November 2001 (DOE 2003). Those mapped features are shown on Figure 3–13. The distribution of maximum uranium concentrations detected in the surface water samples since 2000 is shown in Figure 3–14. The distribution of maximum ammonia concentrations detected in surface water samples since 2000 is shown in Figure 3–15. However, samples collected in the main river channel show minimal or no impact to water quality. Sampling has shown that concentrations of contaminants decrease to natural background levels within 0.5 mile downstream of the Moab site.

Low river flows expose greater portions of the Moab Wash sandbar, creating increased backwater areas that allow for higher concentrations of ammonia in the surface water. However, a study completed in 2000 (SMI 2001) determined that during high flows, backwater areas are eliminated near the site, and ammonia concentrations near the shore are diluted to protective levels (within EPA's recommended total ammonia protection criteria), or loading is temporarily stopped by river water flowing into the aquifer because of the seasonally high river stage. This finding suggests that snowmelt runoff periods (May and June) may effectively reduce the ammonia concentration in the Colorado River.

Because ground water gradients on both sides flow toward the river, it is likely that the presence of the ground water brine affects surface water quality. However, because process fluids disposed of in the former tailings pond contained some of the same constituents that occur in natural brines, distinguishing between naturally occurring constituents and site-related constituents in surface water is not straightforward. Increases in sodium, chloride, or dissolved solids content of river water (among other constituents) in the vicinity of the site, compared to background concentrations, could be a result of discharge of either site-related contaminated ground water or natural brines.

3.1.7.4 Surface Water Use

The Colorado River Compact of 1922 established water allocations to the Upper and Lower Colorado River Basins, which encompass seven states (Chrisman et al. 1976). The 1944 Treaty with Mexico established a Colorado River water reserve that must cross the international boundary. Glen Canyon Dam defines the point of compliance for water allocations between the Upper and Lower Colorado River Basins. Numerous diversions occur for irrigation. Phoenix and Tucson, Arizona, as well as the Mexican border towns of Mexicali and Tijuana, obtain drinking water from the Colorado River. No discharge occurs into the Gulf of California because the Colorado River is completely diverted by the United States and Mexico.

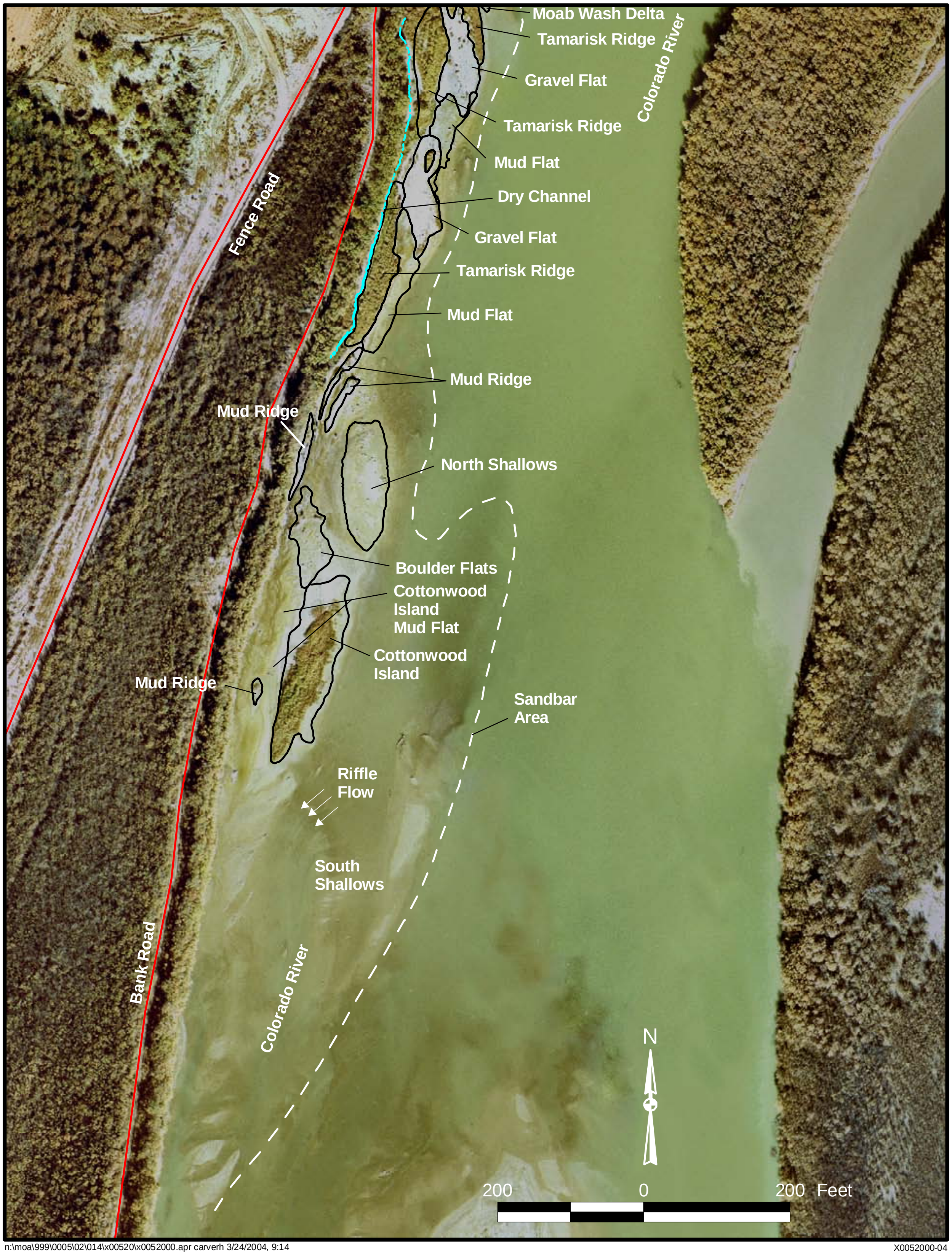

Figure 3–13. Mapped Colorado River Features Near the Moab Site

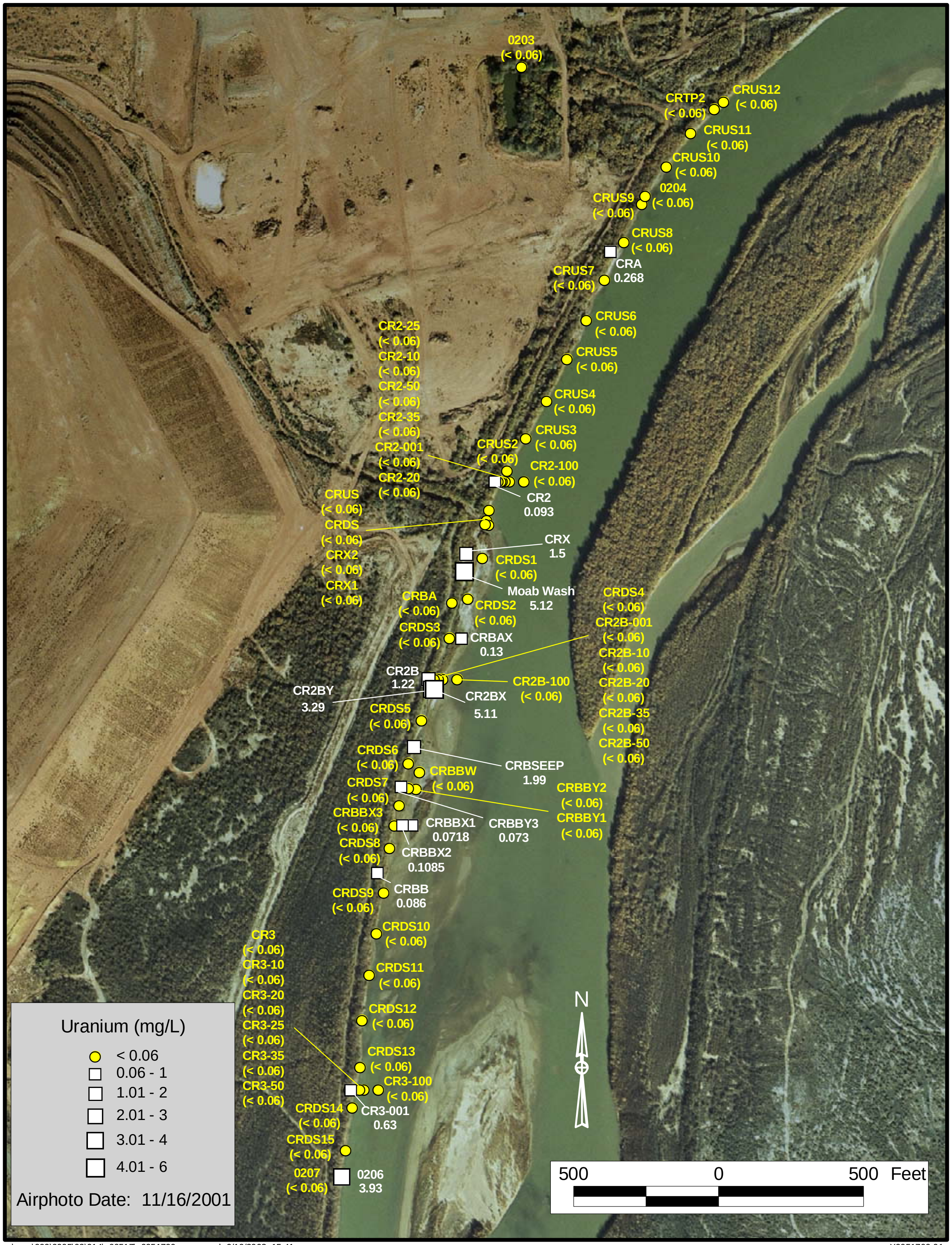

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Figure 3–14. Uranium Concentrations in Surface Water Samples Collected at the Moab Site

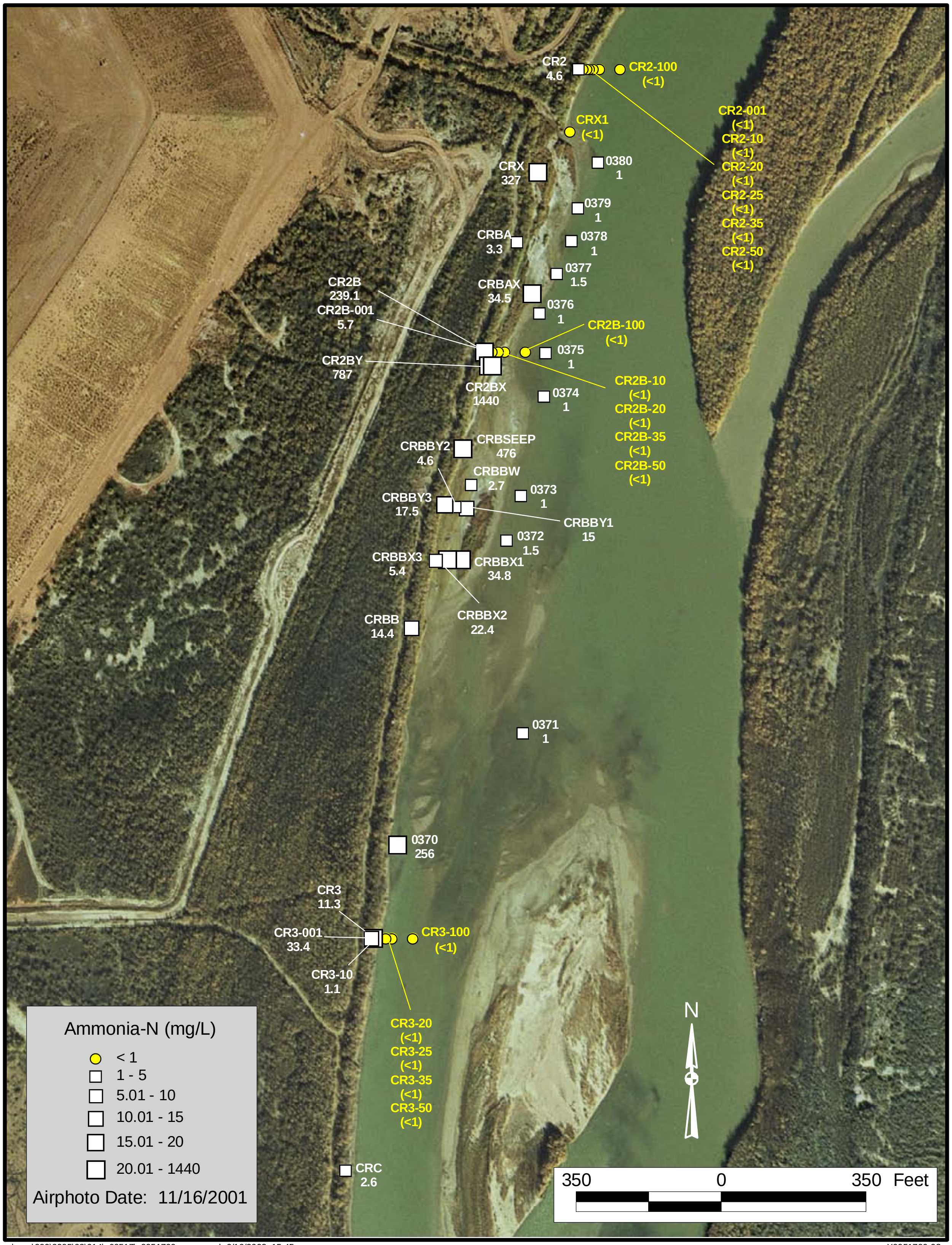


Figure 3–15. Ammonia Concentrations in Surface Water Samples Collected at the Moab Site

Surface water consumption from the Colorado River watershed is less than 25 million gallons per day (39 cfs) in Grand County, Utah. This water is used almost exclusively for agricultural irrigation. Industry, mining, and thermoelectric power plant cooling account for less than 10 percent of this consumption. DOE's water right (previously Atlas' water right) allows for 3 cfs consumptive and an additional 3 cfs nonconsumptive (6 cfs total). The Colorado River is not currently used as a drinking water supply for the city of Moab.

Water from the Colorado River was not diverted for use in Moab-Spanish Valley prior to 1971, other than for the Atlas mill (Sumsion 1971). Domestic and public drinking water supplies are obtained from ground water, streams, and springs. In Utah, use of Colorado River water for purposes other than recreation is limited. In Grand County downstream from Moab, water is withdrawn from the river for irrigation of about 100 to 150 acres of hay and small grains, and a water right for consumptive use of 3 cfs is held for operations at Potash. No additional water withdrawals are believed to occur in Utah, including Canyonlands National Park and Lake Powell (NRC 1999). The Colorado River in the vicinity of Moab is used for swimming, rafting, boating, and fishing as well as other forms of recreation and is a recognized scenic waterway. The stretch of the river adjacent to the site is within the area designated as critical habitat for four endangered species of fish. For further details, see Section 3.1.10, "Aquatic Ecology."

3.1.7.5 Surface Water Quality Criteria

Five contaminants of concern in the surface water have been identified, as described in Section 3.1.7.3 (Site-Related Surface Water Contamination) and Appendix A2. There are no EPA surface water standards in 40 CFR 192. However, UMTRCA requires DOE to determine applicable regulations in consultation with the State of Utah. Surface water quality criteria for the protection of aquatic species have been developed in Appendix A2 for these contaminants of concern. The criteria for ammonia and copper are consistent with the standards currently specified in the Utah Administrative Code R317-2. In the case of ammonia, the State of Utah is in the process of updating its standards to be consistent with the current Ambient Water Quality Criteria published by EPA. Suter and Tsao (1996) were used where state and federal standards were not available. There are no federal or State of Utah standards for uranium or sulfate. Suter and Tsao developed estimated lowest chronic uranium values for fish extrapolated from laboratory studies. The lowest chronic value is considered conservative in comparison to results of studies on swim-up fry and juvenile Colorado pikeminnow (*Ptychocheilus lucius*), razorback sucker (*Xyrauchen texanus*), and bonytail (*Gila elegans*) (Hamilton 1995). Sulfate was retained as a contaminant of concern because concentrations are elevated when levels of other contaminants of concern are also elevated. Table 3–8 summarizes the protective criteria for each contaminant of concern.

3.1.8 Floodplains

The 100-year floodplains for Moab Wash and the Colorado River and the 500-year floodplain of the Colorado River occupy more than one-third of the Moab site (Figure 3–16). The Colorado River floodplains extend the length of the eastern site boundary from the river's edge to distances ranging from 500 to 1,200 ft west and are approximately 10 ft above the average river level. The tailings impoundment is located within the 100- and 500-year floodplains of the Colorado River and within the floodplain of the PMF. Two dams upstream of the Moab site affect the flow of the Colorado River: Blue Mesa Dam on the Gunnison River and McPhee Dam on the Dolores River.

Table 3–8. Summary of Surface Water Quality Criteria for Aquatic Species

Contaminant of Concern	Protective Acute Criteria (mg/L)	Protective Chronic Criteria (mg/L)	Source of Criteria
Ammonia	1.5 – 41.7[a]	0.17 – 4.13[b]	NRWQC; EPA 1999[c]
Copper	0.013[d,e]	0.009[d,e]	NRWQC; EPA 2002[f]
Manganese	2.3	1.78	Suter and Tsao 1996
Sulfate	N/A	N/A	No published criteria
Uranium	0.142	0.142	Suter and Tsao 1996

[a]Criteria are pH and life-stage dependent; early life stages are assumed to be present, and salmonids are assumed to be absent; range represents calculated criteria based on measured range of surface water pH values at the Moab site from 2000 to 2002 (Appendix D, SOWP; DOE 2003).
[b]Criteria are pH, temperature, and life-stage dependent; early life stages are assumed to be present and salmonids are assumed to be absent; range of values represents calculated criteria based on measured range of surface water pH values and temperature at the Moab site from 2000 to 2002 (Appendix D, SOWP; DOE 2003).
[c]National Recommended Water Quality Criteria (NRWQC) are based on EPA's ambient water quality criteria (EPA 1999).
[d]Criteria for metals are expressed in terms of dissolved metals in the water column.
[e]Criteria are expressed as a function of hardness (milligrams per liter) in the water column. The value listed corresponds to a hardness of 100 mg/L.
[f]National Recommended Water Quality Criteria are based on EPA's criteria (EPA 2002).
N/A = not available; no published criteria available. Note: measured background sulfate concentrations in the surface water range from 84 to 439 mg/L.

Because of terracing and lack of river access during regular high-flow events (less than 5-year occurrence), the floodplain is not considered an “active” floodplain. Most of the surface has been disturbed in the past by milling and soil borrow operations. Some areas are sparsely vegetated, and other areas are dominated by tamarisk. A small patch of mature cottonwoods exists in the northeastern portion of the site.

Courthouse Wash drains 102 square miles and empties into the Colorado River immediately upstream of the Moab site. Moab Wash, which drains approximately 5 square miles, runs through the middle of the site to the Colorado River.

Appendix F, “Floodplain and Wetlands Assessment and Floodplain Statement of Findings for Remedial Action at the Moab Site,” includes a more detailed description of floodplains at the Moab site.

3.1.9 Wetlands

Several areas below the tamarisk next to the Colorado River were investigated in February 2002 and were found to contain wetland plants and soils. Although their boundaries have not been formally delineated, these areas are jurisdictional wetlands. Neither the tamarisk areas nor the vegetated margin of a holding pond for irrigation water qualify as wetlands.

The Matheson Wetlands Preserve, across the river from the Moab site, has a variety of wetland types that include emergent wetlands, shrub wetlands, cottonwood stands, and ponds. This 875-acre preserve contains the only sizable wetland remaining on the Colorado River in Utah. Appendix F includes a more detailed description of wetlands at the Moab site.

No wetlands are known to exist at any vicinity properties, but because desert environments often contain small, isolated wetlands, these properties would be examined for wetlands prior to construction.

Figure 3–16. Colorado River Floodplain Area for the Moab Site

3.1.10 Aquatic Ecology

The aquatic resources within the vicinity of the Moab tailings pile are associated with the Colorado River. The river has historically had seasonal variations in flow and temperature that are based on natural flow cycles. Aquatic species in the river have adapted to physical and chemical conditions that fluctuate naturally, both seasonally and daily. These variable conditions include river flow, bottom scouring by sand and silt, temperature, sediment loading, chemical composition, and salinity (NRC 1999).

The Moab site is near river mile 64 on the Colorado River in a transition zone between two geomorphically distinct reaches. River miles on the Colorado River have been designated for use in research programs; the beginning of the designation (mile 0) is at the confluence of the Green River and the Colorado River (Belknap and Belknap 1991; Osmundson et al. 1997). The Colorado River upstream of the site is predominantly sand bedded with a few cobble bars. Downstream of the site, the river is sand bedded with sandbars and stabilized islands. Much of the shoreline near the site has been stabilized by tamarisk, an invasive species, or stabilized with riprap. The tamarisk can form cutbanks that erode to some degree with each large flood. The shoreline at the Matheson Wetlands Preserve opposite the site has been diked and is heavily colonized by tamarisk (NPS 2003).

The State of Utah has classified the river segment adjacent to the Moab site as protected for warm-water species of game fish and other warm-water aquatic life, including necessary aquatic organisms in their food chains. This river segment has also been designated as critical habitat (50 CFR 17.95) for four federal endangered fish species. Detailed information concerning habitat for these species is addressed in Appendix A1, "Biological Assessment."

Macroinvertebrates (i.e., chironomids and oligochaetes) are thought to dominate the benthic community of the main channel of the Colorado River near the Moab site (NRC 1999, USGS 2002). Backwater areas, such as the wetlands formed by periodic inundation of the floodplain just downstream and across the river from the Moab site, may support a much more diverse and more productive benthos. Similarly, rooted macrophytes (i.e., plants), along with algae and zooplankton, flourish in the backwaters that may provide suitable habitat but are almost nonexistent in the main channel (NRC 1999). The backwaters and inundated floodplains often serve as important nurseries and forage suppliers for fish, including the endangered Colorado pikeminnow (Valdez and Wick 1983). Fish species known or believed to be present in this reach are listed in Table 3–9. This list includes four federal endangered species, one state threatened species, and two state species of special concern.

Many components of the upper Colorado River ecosystem have undergone dramatic changes during the last several decades. An additional important force for change has been the sometimes accidental, but often deliberate, introduction of nonnative fish species into the river, including carp, channel catfish, various minnow species, and largemouth bass (NRC 1999). These introductions, in concert with the physical and chemical alterations of the river, may have contributed to the decline of the native fish populations (Trammell and Chart 1999; NRC 1999; Muth et al. 2000).

Table 3–9. Fish That May Occur in the Colorado River Near the Tailings Pile

Common Name	Scientific Name	Status
Roundtail chub	*Gila robusta*	N, ST
Humpback chub	*Gila cypha*	N, FE, SE
Bonytail	*Gila elegans*	N, FE, SE
Colorado pikeminnow	*Ptychocheilus lucius*	N, FE, SE
Longnose dace	*Rhinichthys cataractae*	I
Speckled dace	*Rhinichthys osculus*	N
Fathead minnow	*Pimephales promelas*	I
Carp	*Cyprinus carpio*	I
Red shiner	*Notropis lutrensis*	I
Sand shiner	*Notropis stramineus*	I
Flannelmouth sucker	*Catostomus latipinnis*	N, SP
Bluehead sucker	*Catostomus discobolus*	N, SP
Razorback sucker	*Xyrauchen texanus*	N, FE, SE
Channel catfish	*Ictalurus punctatus*	I
Black bullhead	*Ictalurus melas*	I
Rio Grande killifish	*Fundulus zebrinus*	I
Largemouth bass	*Micropterus salmoides*	I
Green sunfish	*Lepomis cyanellus*	I

Sources: NRC 1999; Trammell and Chart 1999.
N = native to upper Colorado River; ST = State listed threatened species; FE = federally listed endangered species; SE = State listed endangered species; I = introduced species; and SP = State species of special concern

As reflected in the list of species in Table 3–9, as least as many exotic species as native species of fish are now established in the Colorado River.

The roundtail chub, *Gila robusta*, a Utah state-listed threatened species, is a large minnow native to the Colorado River system. It is most often found in pools and eddies near strong currents in the Colorado River and its large tributaries. These chubs eat terrestrial and aquatic insects, mollusks, other invertebrates, fish, and algae. The species spawns over areas with gravel substrate during the spring and summer. Eggs are fertilized in the water, then drop to the bottom where they adhere to the substrate until hatching about 4 to 7 days later (UDWR 2003a).

The flannelmouth sucker, *Catostomus latipinnis*, and the bluehead sucker, *Catostomus discobolus*, are considered Utah state species of concern because of recent population reductions. Both species are benthic fish that primarily eat algae. The flannelmouth sucker spawns in streams over gravelly areas during the spring and early summer and is often found in deep pools of slow-flowing, low-gradient reaches. The bluehead sucker spawns in streams during the spring and summer. Fast-flowing water in high-gradient reaches of mountain rivers has been identified as important habitat for the bluehead sucker (UDWR 2003a).

3.1.10.1 Aquatic Species Listed in the Endangered Species Act

Four endangered fish species—the Colorado pikeminnow (*Ptychocheilus lucius*), razorback sucker (*Xyrauchen texanus)*, humpback chub (*Gila cypha)*, and bonytail (*Gila elegans)*—are endemic to the Colorado River basin. The Colorado River near the Moab site has been designated as critical habitat (50 CFR 17.95) for all four federal endangered fish species. Detailed information concerning habitat and critical life-history phases for these species is presented in Appendix A1, “Biological Assessment.”

Colorado Pikeminnow

The Colorado pikeminnow, a large fish-eating fish belonging to the minnow family, was once abundant and widely distributed in the Colorado River basin. Pikeminnow less than 2 inches in total length prey on small aquatic invertebrates in side channels and backwaters; juveniles between 2 and 8 inches total length, still in the backwater nursery habitat, eat invertebrates and other fish; pikeminnow greater than 8 inches total length prey mainly on other fish (Muth and Snyder 1995).

Adult pikeminnow use a variety of habitats after spawning, including eddies, backwaters, and shorelines. In the spring and early summer, the adults use shorelines, floodplain habitats, flooded tributary mouths, and lowlands inundated during spring floods (Tyus 1990; USF&WS 2002a). The pikeminnow spawn on gravel beds in whitewater canyons during the period of declining flows in June, July, or August (Tyus and Haines 1991; Muth et al. 2000; Tyus 1990). During the spawning season, adults have been reported to migrate up to 200 miles upstream or downstream to reach spawning areas (Tyus 1990). After hatching, larvae drift downstream, where they are entrained in backwater nursery habitats (Tyus and Haines 1991). Young Colorado pikeminnow remain near the nursery areas for the first 2 to 4 years of life, then move upstream and establish home ranges (Osmundson et al. 1998). Larval pikeminnow (0 to 1 year) show a preference for secondary channel habitats (Trammell and Chart 1998; Rakowski and Schmidt 1996; Day et al. 1999), and they are primarily found in low-velocity waters, which include backwaters (Tyus and Haines 1991; Trammell and Chart 1998). In the fall, they use backwater habitats that are deeper and more persistent than other habitats (Trammell and Chart 1998; Day et al. 1999). These backwaters are created when a secondary channel is cut off at the upper end but remains connected to the river at the downstream end. These areas are considered crucial for overwinter survival of the larval and juvenile fish (Trammell and Chart 1998).

There are 600 to 900 adults in the upper Colorado River (USF&WS 2002a). The two known spawning areas in this reach of the river are near Grand Junction, Colorado, and in the lower Gunnison River (USF&WS 2002a). Fish and juveniles aged 0 to 1 year are found in the upper Colorado River downstream of Palisade, Colorado, to Lake Powell, Utah (USF&WS 2002a). The Moab site is located on river mile 64 and is within the habitats documented to contain current populations of Colorado pikeminnow. Low numbers of Colorado pikeminnow (between 1 and 28 fish) were consistently collected from 1986 to 1996 between river miles 68 and 49 (USGS 2002). Both adults and subadults were collected in Moab Wash and directly below the tailings pile (USGS 2002). As many as 53 young-of-the-year pikeminnow were captured between river miles 48 and 84 (Osmundson et al. 1997). In a mark-recapture study of adult pikeminnow in this reach, 21 of 51 fish (41 percent) were caught between river miles 57 and 65 (Osmundson et al. 1997). Surveys in 1992 to 1996 by Trammell and Chart (1998) found adult and larval pikeminnow between river miles 55 and 65. In addition, pikeminnow are known to use the main channel for spawning migrations and the backwater area of the Matheson Wetlands Preserve as important nursery habitat (NRC 1999). During periods of inundations, the lower Moab Wash and the riparian woodland near the toe of the pile potentially provide habitat for pikeminnow and razorback suckers (NRC 1999). Other backwaters and eddies occur in this reach during periods of relatively low flow and also serve as nurseries (NRC 1999).

As part of the Interagency Standardized Monitoring Program[1], pikeminnow nursery habitat was sampled each fall (1986–2002) between river miles 53.5 and 63.5. The area surveyed began at or near the Moab site (river mile 64) and continued downstream about 10 miles. The purpose of this sampling was to determine relative abundance and distribution of young-of-the-year Colorado pikeminnow. The sampling protocol required sampling two habitats every 5 miles. Sixty backwater locations were sampled between 1986 and 2002, of which 13 were between river miles 61 and 63.5. Five of the 13 backwater areas sampled contained a total of 83 young-of-the-year pikeminnow, composing 24 percent of the total pikeminnow captured in this reach (river miles 53.5 to 63.5) during the sampling (UDWR 2003b).

From 1992 to 1996, 13 flyovers were conducted to determine backwater habitat in this reach (river miles 53.5 to 63.5).

A field visit with UDWR on December 19, 2001, identified areas that may serve as preferred habitat when backwaters are present. These areas begin at the mouth of Moab Wash and extend approximately 1,200 ft south (Hudson 2001). Within this area, three locations (Figure 3–17) extending about 600 to 800 ft south of the wash were tentatively identified as having the greatest potential for habitat preferred by young-of-the-year fishes. Because natural processes can physically alter the characteristics of river channels, the exact location of preferred habitat can change seasonally or annually. Part of the channel to the west is completely inundated during an average spring runoff in April and May when the river flow is greater than approximately 15,000 cfs. Preferred habitat for young-of-the-year fishes develops in the channel as the river recedes below 15,000 cfs in May and June and the sandbar area becomes exposed. As the river level further declines in the fall, the backwaters in the channel become isolated from the river at approximately 5,000 cfs and evaporate to dryness. Habitat availability and quality depend upon the time of year, changes in river structure, and water level.

USF&WS has defined physical characteristics of preferred habitat to include (1) warmer backwater and slow-moving eddies, (2) a sandy/silty substrate, and (3) water depths of less than 2 ft. However, habitat criteria can be less than optimal if other factors, such as food supply, are attractive. Preference parameters can vary significantly and are not prescriptive.

Razorback Sucker

The endangered razorback sucker is one of the most imperiled fish in the basin. It exists naturally as only a few disjunct populations or scattered individuals (Minckley et al. 1991; Muth et al. 2000). Lack of recruitment sufficient to sustain populations has been mainly attributed to the cumulative effects of habitat loss and modification caused by water and land development and predation on early life stages by nonnative fishes (Hamilton 1998; USF&WS 1998; Muth et al. 2000).

Razorback suckers are known to spawn on gravel bars and may also spawn in backwaters (NRC 1999). In the past, they have been observed spawning in early and mid-summer within 2 miles upstream of the tailings pile (NRC 1999). This type of preferred habitat develops in the channel as the river recedes below 15,000 cfs in May and June and the sandbar area becomes exposed. The razorback sucker may be found almost anywhere in the river, including slow runs

[1] This program is a consortium among the U.S. Fish and Wildlife Service; Bureau of Reclamation; Western Area Power Administration; the states of Utah, Colorado and Wyoming; the water user community; and environmental interests (http://www.desertfishes.org/na/catostom/xyrauche/xtexanus/xtexanus.html).

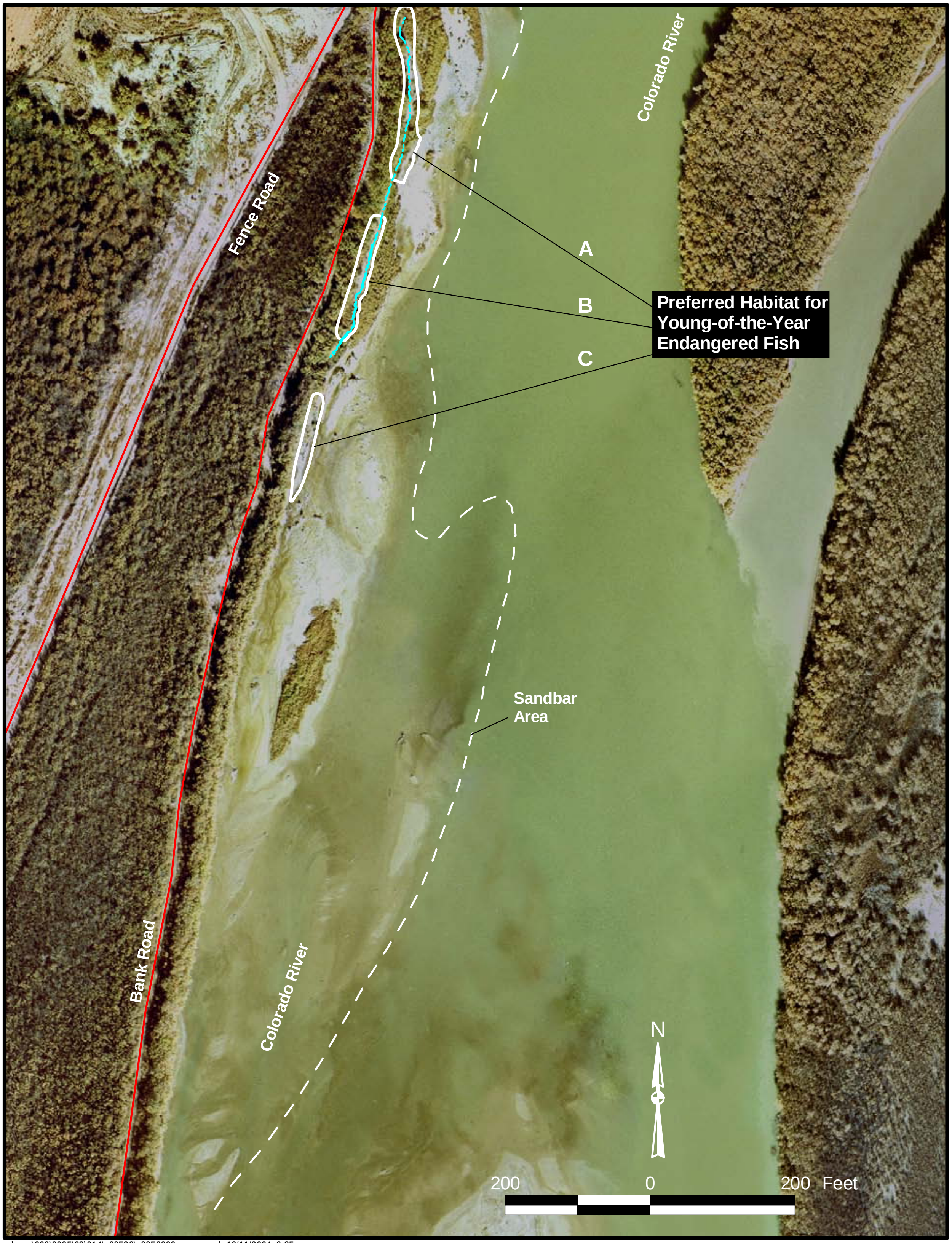


Figure 3–17. Locations of Preferred Habitat for Young-of-the-Year Aquatic Species When Backwaters Are Present

in the main channel, inundated floodplains and tributaries, eddies and backwaters, sandy bottom riffles, and gravel pits (USF&WS 1998). Young razorback suckers require nursery habitat with warm, shallow water such as tributary mouths, backwaters, or inundated floodplains (Modde 1996; Muth et al. 2000). During periods of inundation, the lower Moab Wash and the riparian woodland near the toe of the pile potentially provide habitat for pikeminnow and razorback suckers (NRC 1999). The Matheson Wetlands Preserve area is also potential nursery habitat for the razorback sucker (NPS 2003). For purposes of this EIS, it is assumed that the razorback sucker may be present in the project area.

A limited number of adults have been found in the upper Colorado River since 1974 (USF&WS 2002b). Many of the adults captured during studies have been found in two abandoned gravel pits in Grand Valley, Colorado, just upstream and downstream of the confluence with the Gunnison River (USF&WS 2002b). No young razorback suckers have been captured anywhere in the upper Colorado River since the mid-1960s (USF&WS 2002b; USGS 2002; NPS 2003).

The diet of all life stages is varied and includes invertebrates, zooplankton, phytoplankton, algae, and detritus (Behnke and Benson 1983; Marsh 1987; Muth et al. 1998, 2000).

<u>Humpback Chub</u>

The humpback chub, a large cyprinid fish, prefers deep canyons with swift water and rapids (USF&WS 2002c; Muth et al. 2000). Adults require eddies and sheltered shoreline habitats maintained by high spring flows. These high spring flows maintain channel and habitat diversity, flush sediments from spawning areas, rejuvenate food production, and form gravel and cobble deposits used during spawning. Young require low-velocity shoreline habitats, including eddies and backwaters, that are more prevalent under base-flow conditions (USF&WS 2002c).

Historical abundance of the humpback chub is unknown, and knowledge of historical distribution is incomplete (Muth et al. 2000; USF&WS 2002c). The species exists primarily in relatively inaccessible canyons of the Colorado River Basin and was rare in early collections (USF&WS 2002c).

Humpback chub move substantially less than other native Colorado River fish. Radiotelemetry and tagging studies consistently show that respective humpback chub populations remain in specific river locations.

Five individuals were collected from a reach about 19 river miles downstream of the Moab site, possibly associated with populations upstream of the Moab site in Westwater Canyon and Black Rocks (NRC 1999; Valdez and Williams 1993).

Six extant wild populations are known in the Upper Colorado Basin: (1) Black Rocks, Colorado River, Colorado; (2) Westwater Canyon, Colorado River, Utah; (3) Yampa Canyon, Yampa River, Colorado; (4) Desolation/Gray Canyons, Green River, Utah; (5) Cataract Canyon, Colorado River, Utah; and (6) Colorado River in Marble and Grand Canyons and the little Colorado River, Arizona (USF&WS 2002c). The nearest downstream population occurs in Cataract Canyon (43 miles downstream of the Moab site) (USF&WS 2002c). UDWR, in cooperation with USF&WS, plans to reintroduce the humpback chub into its historical range upstream of the site in the near future.

<u>Bonytail</u>

The bonytail uses mainstem river channels as well as inundated riparian areas. Currently, no self-sustaining populations of bonytail exist in the wild, and few individuals have been caught throughout the Upper Colorado Basin (USF&WS 2002d). Bonytail have been stocked in this reach since 1996; however, these populations have not thrived, and there has been no recruitment (NPS 2003). Only five individuals, all from Cataract Canyon, were collected during surveys by Valdez and Williams from 1985 to 1988 (NRC 1999). The presence of this rare fish near the Moab site has not been confirmed (NRC 1999).

3.1.10.2 Environmental Tolerances

The aquatic environment in the reach of the Colorado River bordering the Moab site is potentially affected by activities at the site. Ground water flow from the pile has introduced chemical and radioactive contaminants into the surface water (see Section 3.1.7.3). Tolerance of the aquatic biota to the contaminants is dependent on their life-stage, location, and duration of exposure. Appendix A1, "Biological Assessment," provides further information on contaminants and their effects on the aquatic biota.

3.1.11 Terrestrial Ecology

Historically, the entire site has been disturbed from natural events such as floods or from milling operations. At present, the relatively barren terrain of the site limits the potential for terrestrial wildlife habitat, with the exception of the southeasternmost portion of the site, where tamarisk are dominant. Approximately 380 acres of the site do not currently support vegetation. Mature tamarisk, with minimal understory, covers approximately 50 acres of the site east of the tailings pile on the Colorado River floodplain. This area provides some habitat for birds and small mammals. Steep rock mesas dominate the area just west of the site. Low-growing desert shrub communities and low-density piñon-juniper forest are the predominant vegetation types west and north of the site along the transportation routes.

3.1.11.1 Terrestrial Vegetation and Wildlife

The existing vegetation reflects a history of disturbance. Plants observed in April 2003 include spike dropseed (*Sporobolus contractus*), sand dropseed (*Sporobolus cryptandrus*), tamarisk (*Tamarix ramosissima*), black greasewood (*Sarcobatus vermiculatus*), gray rabbitbrush (*Ericameria nauseosa*), Douglas rabbitbrush (*Chrysothamnus viscidiflorus*), big sagebrush (*Artemisia tridentata*), and galleta (*Pleuraphis jamesii*). The presence of tamarisk and low-density black greasewood indicates that ground water occurs within 20 to 50 ft of the surface.

Vegetation across the Colorado River, including the Matheson Wetlands Preserve, provides more attractive habitat and consists of riparian woodland, grassland, and shadscale (saltbush) communities. Woodland, dominated by native tree species such as black willow (*Salix nigra*) and Fremont cottonwood (*Populus fremontii*), is present in the preserve. Other plants include tamarisk, sedges (*Carex* spp.), bulrush (*Scirpus* spp.), and cattail (*Typha* spp.) (NRC 1999). More than 175 species of birds have been observed at the preserve, and a great blue heron (*Ardea herodias*) rookery is present in its lower end (NRC 1999).

Without the current disturbance, the potential natural vegetation (i.e., vegetation that would occur in the absence of disturbance) and habitat of the upland soils at the site, Nakai sandy loam (see Section 3.1.2), would include grasses such as Indian ricegrass (*Achnatherum hymenoides*) and galleta and the desert shrubs fourwing saltbush (*Atriplex canescens*), shadscale (*Atriplex confertifolia*), and winterfat (*Krascheninnikovia lanata*). Because of a relatively high composition and productivity of palatable grasses and shrubs in the potential vegetation (Table 3–10), these plant species would normally be of value as forage for livestock. This relative diversity of the potential vegetation could also provide habitat for a variety of small mammals, including white-tailed prairie dog (*Cynomys leucurus*), desert cottontail (*Sylvilagus audubonii*), and black-tailed jackrabbit (*Lepus californicus*). Fourwing saltbush, shadscale, and galleta may be used to some extent by mule deer (*Odocoileus hemionus*) as forage. Coyote (*Canis latrans*), bobcat (*Lynx rufus*), and badger (*Taxidea taxus*) could frequent this area to prey on the small mammals. Raptors, including golden eagle (*Aquila chrysaetos*), red-tailed hawk (*Buteo jamaicensis*), and rough-legged hawk (*Buteo lagopus*), could also use this area as hunting ground.

Table 3–10. Characteristics of the Potential Vegetation on the Nakai Soil Type

Soil Name	Range Site	Characteristic Potential Vegetation	(percent)	Productivity (pounds/acre)	Rooting Depth (inches)
Nakai	Desert Sandy Loam	Fourwing saltbush (*Atriplex canescens*)	10	350–700	40 to >60 depending on depth to bedrock
		Shadscale (*Atriplex confertifolia*)	10		
		Winterfat *(Krascheninnikovia lanata)*	5		
		Torrey Mormon tea (*Ephedra torreyana*)	5		
		Indian ricegrass (*Achnatherum hymenoides*)	20		
		Galleta (*Pleuraphis jamesii*)	10		
		Sand dropseed (*Sporobolus cryptandrus*)	5		
		Globemallow (*Sphaeralcea* spp.)	10		
		Locoweed (*Astragalus* spp.)	5		

Source: NRCS (2002); SCS (1989).

3.1.11.2 Threatened and Endangered Species

This section describes the terrestrial (plant and wildlife) threatened and endangered species that are, or may be, present in the project area. Threatened and endangered plant and wildlife species are those species listed in 50 CFR 17 as threatened, endangered, or candidate species and are subject to USF&WS Section 7 consultation under the Endangered Species Act (ESA). USF&WS (2003) lists 19 threatened and endangered animal species and 24 threatened and endangered plant species for the state of Utah. In March 2003, DOE requested an updated list of threatened and endangered species from USF&WS that may be present or affected by DOE's proposed alternatives. USF&WS responded in April 2003 with a list for Grand County that included one threatened plant, five threatened and endangered animal species, and two animal species that are candidates for protection under the ESA. These are listed in Table 3–11. UDWR (2003a) has identified the white-tailed prairie dog as being considered for candidate status. The status of each of these species in the vicinity of the Moab site is briefly discussed below. Appendix A1, "Biological Assessment," provides more detailed information concerning these federally listed species that may be in the vicinity of the site or could be affected by activities or contaminants at the site.

<u>Jones' Cycladenia</u>

The federally threatened Jones' cycladenia is known to occur relatively near the Moab site. However, USF&WS has determined that this plant species would likely not be located in the proposed project areas. Jones' cycladenia grows in gypsiferous soils that are derived from the

Summerville, Cutler, and Chinle Formations; they are shallow, fine textured, and intermixed with rock fragments. The species can be found in Eriogonum-ephedra, mixed desert shrub, and scattered piñon-juniper communities at elevations ranging from about 4,000 to 6,800 ft. It is restricted to the canyonlands of the Colorado Plateau in Emery, Garfield, Grand, and Kane Counties, Utah, as well as in immediately adjacent Coconino County, Arizona (UDWR 2003a).

Table 3–11. Federally Listed Terrestrial Threatened and Endangered Species Potentially Occurring at the Moab Site

Common Name	Scientific Name	Habitat Present and Affected	Species Present	Status	Comments
Jones' cycladenia	*Cycladenia humilis* var. *jonesii*	Possible	No	Threatened	None
Southwestern willow flycatcher	*Empidonax traillii extimus*	Possible	Unknown	Endangered	Likely migrate through area
Bald eagle	*Haliaeetus leucocephalus*	Possible	Yes	Threatened	Proposed for delisting
Mexican spotted owl	*Strix occidentalis lucida*	Possible	No	Threatened	None
California condor	*Gymnogyps californianus*	No	No	Endangered	None
Black-footed ferret	*Mustela nigripes*	No	No	Endangered	None
Yellow-billed cuckoo	*Coccyzus americanus*	Possible	Unknown	Candidate	None
Gunnison sage grouse	*Centrocercus minimus*	No	No	Candidate	None

<u>Southwestern Willow Flycatcher</u>

Southwestern willow flycatchers (*Empidonax trailii extimus*) are among the few bird species known to nest in habitat dominated by exotic species such as tamarisk and Russian olive (*Eleagnus angustifolia*), invasive species that are prevalent along much of the Colorado River corridor. However, it appears that higher quality habitat exists where tamarisk is intermixed with other trees and shrubs, along with the presence of natural flood regimes, ample water, and beaver activity (USGS 2001). The southwestern willow flycatcher typically nests in riparian areas with dense thickets of trees and shrubs that are on average 13 to 23 ft in height, with dense foliage from 0 to 13 ft above ground. The percent canopy cover is generally high (50 CFR 17).

The southwestern willow flycatcher has been identified as potentially occurring in the Matheson Wetlands Preserve and also several miles downstream of the Moab site. No nesting activity was observed in these areas, and the species has not been observed on the Moab site proper (NRC 1999). Surveys of potentially suitable habitat were conducted along the Colorado River, approximately 6 river miles south of the site in 2002. Willow flycatchers (subspecies not specified) were present during one survey in May (USGS 2002). The survey report concluded that willow flycatchers in this area were migrating and were not using the area for breeding. These results reflected conclusions of a 3-year study (1999 to 2001). However, the study recommended continued monitoring. No designated critical habitat for this species exists within the site area or along transportation corridors.

It appears that the Moab site is at or beyond the northern extent of the range for the southwestern willow flycatcher. According to UDWR (2003a), the known distribution for the southwestern willow flycatcher in Utah is limited to the southern parts of the state. USF&WS (2002e) identifies southern Utah as the north-central limit of the flycatcher's breeding range. However, a similar subspecies, *E.t. adastus*, occurs at higher elevations in central and northern Utah, and the subspecific identity of these two subspecies in the vicinity of the Moab site remains unresolved (USF&WS 2002e).

Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*) ranges over much of North America, and wintering grounds include many areas in Utah (National Geographic Society 1987). The population throughout the lower 48 states has increased significantly during the last several decades, to the point that USF&WS has submitted a proposal to remove the bald eagle from the list of threatened species (64 FR 36453–36464 [1999]). Bald eagles generally avoid areas with nearby human activity and development. Only four nest sites were known in Utah as of 2000 (UDWR 2003a), and none of these are near the Moab site or any of the other sites considered in this analysis. Nesting habitat for this species is limited in the vicinity of the Moab site and does not exist along the proposed transportation corridors between the Moab site and the proposed borrow locations. The BLM Grand Resource Area Management Plan/Environmental Impact Statement (BLM 1985) identified the threatened bald eagle as potentially occurring in the Moab area. Suitable habitats along the Colorado River in the vicinity of the Moab site are likely wintering areas. The Utah Gap Analysis Program indicates that wintering habitat occurs in the Moab vicinity (UDWR 1999).

Mexican Spotted Owl

The Mexican spotted owl (*Strix occidentalis lucida*) occupies a variety of habitats, including thickly wooded canyons and humid forests (National Geographic Society 1987) to steep rocky canyons, which is the primary habitat used in Utah. These owls do not build their own nests, but utilize nests built by other animals or suitable naturally occurring sites. Preferred nesting sites are in trees with broken tops but are also in trunk cavities or on cliffs. Spotted owls are nonmigratory.

According to UDWR (2003a), the spotted owl's current range in Utah includes most of the southern part of the state, including much of San Juan County. Small patches of known distribution occur in the southernmost part of Grand County and parts of Uinta and Carbon Counties. Many of these areas are also designated by USF&WS as critical habitat (66 FR 85–308553). Within these critical habitat areas are protected and restricted habitat areas. Protected habitat "includes all Mexican spotted owl protected activity centers, all areas in mixed-conifer and pine-oak types with slope greater than 40 percent where timber harvest has not occurred in the past 20 years" (UDWR 2003a). Restricted habitat has a similar, but more general, definition and is not tied to specific protected activity centers (i.e., not tied to known nest sites). BLM has identified potentially suitable habitat (Cresto 2003) within 0.5 mile west of the site on the basis of models developed at Northern Arizona University.

California Condor

California condor (*Gymnogyps californianus*) sightings were historically rare in Utah, noted only twice by pioneers in the 1800s. A nonessential experimental population of California condors was established in northern Arizona in 1996 (61 FR 54043–54060 [1996]). Sightings of the birds that were released in northern Arizona were made nearly statewide in Utah in the late 1990s. The known distribution of the California condor in Utah currently consists of the southern third of the state, including most of San Juan County (UDWR 2003a). Individuals may occasionally pass through the Moab area, but they are not likely to land or use habitat in the vicinity of the Moab site or any of the alternative off-site disposal sites or borrow areas.

Black-Footed Ferret

The range of the black-footed ferret (*Mustela nigripes*) historically covered much of the Great Plains and extended west into eastern Utah. Thought to be extinct until 1981, all individuals now in the wild are thought to be the result of a successful captive breeding and reintroduction program. Unconfirmed sightings of naturally occurring ferrets persist throughout eastern Utah (UDWR 2003a).

Black-footed ferrets depend almost exclusively on prairie dog colonies for food, shelter, and denning. The range of the ferret coincides with that of prairie dogs, and ferrets with young have been documented only in the vicinity of active prairie dog colonies. It has been estimated that about 100 to 150 acres of prairie dog colony are needed to support one ferret (USF&WS 1988). Black-footed ferrets were released in Uinta County, Utah, in late 1999, and UDWR now considers much of the central part of Grand County as Critical Value Habitat. Although there may be a few small prairie dog colonies in the vicinity of the Moab site, the Moab region is not considered high-quality habitat for white-tailed prairie dogs (UDWR 2003a), and it is unlikely that colonies of sufficient size to support ferrets occur near enough to the Moab site to be affected by site operations.

Yellow-Billed Cuckoo

The yellow-billed cuckoo (*Coccyzus americanus*) was listed on October 30, 2001 (66 FR 54807), as a candidate species. Nesting habitat is classified as dense lowland riparian areas characterized by a dense subcanopy or shrub layer (regenerating canopy trees, willows, or other riparian shrubs) within about 300 ft of water. Overstory in these habitats may be either large, gallery-forming trees (33 to 90 ft) or developing trees (10 to 27 ft), usually cottonwoods. Nesting habitat is found at low to mid-elevations (2,500 to 6,000 ft) in Utah. Cuckoos may require large tracts (100 to 200 acres) of contiguous riparian nesting habitat. The yellow-billed cuckoo is thus considered a riparian obligate (UDWR 2003a).

Potentially suitable habitat is located south of the Moab site along the Colorado River and possibly across the river in the Matheson Wetlands Preserve. Surveys conducted from 1999 to 2001 south of the Moab site showed few sightings. Sightings that were documented indicated that this species is using potentially suitable habitat as a migrant and is not using the area as breeding habitat (USGS 2001). However, according to USF&WS, there was a breeding record from the Matheson Wetlands Preserve in 1994 (66 FR 38611–38626 [2001]), located across the Colorado River from the Moab site.

Gunnison Sage Grouse

Although the Gunnison sage grouse (*Centrocercus minimus*) may range into southeastern Grand County, it appears that populations of this species in Utah are essentially restricted to San Juan County (UDWR 2003a). It is unlikely that this species would be present at the Moab site. The Gunnison sage grouse was recognized as a species distinct from the greater sage grouse (*Centrocercus urophasianus)* in 2000 (AOU 2000) and was added to the list of ESA candidate species in 2002 (67 FR 40657–40679 [2002]).

White-Tailed Prairie Dog

A petition to list the white-tailed prairie dog as threatened or endangered under the ESA was submitted by a group of environmental organizations in July 2002 (Center for Native

Ecosystems 2002). USF&WS is currently evaluating this petition and is considering adding this species to the list of candidates for ESA protection. As previously stated, the Moab site is not considered to be quality habitat for this species (UDWR 2003a), and it is unlikely to occur at or near the site in substantial numbers.

3.1.11.3 Other Special Status Species

For this EIS, special status species are those that are protected under federal and state regulations other than the ESA, which include the Migratory Bird Treaty Act (MBTA), Executive Order 13186, and Birds of Conservation Concern (USF&WS 2002f). The State of Utah maintains a list of species that it considers threatened, endangered, or otherwise of concern; other federal agencies such as BLM and the U.S. Forest Service (USFS) maintain lists of species considered to be sensitive. However, only those listed by the USF&WS under the ESA are included in Section 7 consultations or in the Biological Assessment. Although special status species are not covered by the ESA and are, therefore, not subject to Section 7 consultations, USF&WS encourages protection of these species.

Table 3–12 lists sensitive plant species considered by state and federal resource agencies to be of concern that may occur in the site region, including transportation routes and borrow areas. A number of the species listed by the State of Utah, or considered sensitive by BLM, are potentially present in the vicinity of the Moab site.

Table 3–13 includes animal species listed by the State of Utah as endangered, threatened, or otherwise of concern that may be present in the project region. The list includes all species identified by UDWR as potentially occurring in Grand County; in some cases, the known population or suitable habitat is well removed from the Moab site. The species listed as endangered or threatened by UDWR are discussed below.

Peregrine Falcon

Peregrine falcons inhabit mountain ranges, river valleys, and coastlines (USF&WS 1999). They prefer to nest on high cliff ledges (National Geographic Society 1987). Peregrine falcons were one of the first species listed as endangered in 1970 (predating the ESA). After a successful recovery program, they are now much more abundant throughout their range, and the species was ultimately removed from the list of threatened and endangered species in 1999 (64 FR 46541−46558). In Utah, the bird is still rare, but primary breeding habitat exists in small, scattered areas throughout the state. The peregrine falcon is believed to be a year-round resident in the vicinity of the Moab site (BLM 1985).

Ferruginous Hawk

Ferruginous hawks (*Buteo regalis*) are found in grasslands, agricultural lands, sagebrush/ saltbush/greasewood shrub lands, and at the edges of piñon-juniper forests. They tend to avoid high elevations, forests, and narrow canyons. Flat and rolling terrain in grassland or shrub steppe are most often used during breeding season. In winter, they use open, arid areas where rabbits, prairie dogs, and other major prey are found. Nest locations show great flexibility, including trees and shrubs, cliffs, creek banks, utility structures, and abandoned buildings; however, they have a preference for elevated nest sites. Ferruginous hawks are widespread throughout the western United States. In Utah, primary breeding grounds are in northern Grand County and in areas of northern and western Utah.

Table 3–12. Sensitive Plant Species That May Occur in the Vicinity of the Moab Site

Common Name	Scientific Name	Habitat Present and Affected	Federal Status	State Status
Clay verbena	*Abronia argillosa*	Possible	None	Watch
Cutler's milkweed	*Asclepias cutleri*	Possible	None	Rare
Fisher Towers milkvetch	*Astragalus piscator*	Possible	None	Rare
Cisco milkvetch	*Astragalus sabulosus*	Possible	BLM	Rare
Ben's buckbrush	*Ceanothus greggii*	Possible	None	Rare
Ruin Park winterfat	*Ceratoides lanata var. ruinina*	Possible	None	Rare
Tall cryptantha	*Cryptantha elata*	Possible	None	Rare
La Sal Mt daisy	*Erigeron mancus*	No	BLM	Rare
Canyonlands desert parsley	*Lomatium latilobum*	No	BLM	Rare
Entrada skeletonweed	*Lygodesmia grandiflora* var. *entrada*	Possible	BLM	Rare
Shultz's blazing star	*Mentzelia shultziorum*	Possible	BLM	Rare
Trotter's spring parsley	*Oreoxis trotteri*	Possible	BLM	Rare
Paradox breadroot	*Pediomelum aromaticum* var. *aromaticum*	Possible	None	Rare
La Sal Mt beardtongue	*Penstemon crandallii* var. *atratus*	No	None	Watch
Alcove rock-daisy	*Perityle specuicola*	Possible	BLM	Rare
Jones indigo-bush	*Psorothamnus polydenius*	Possible	BLM	Rare
La Sal Mts butterweed	*Senecio fremontii* var. *inexpectatus*	No	BLM	Rare
Jane's globemallow	*Sphaeralcea leptophylla* var. *janeae*	Possible	BLM	Rare
San Rafael globemallow	*Sphaeralcea psoraloides*	Possible	BLM	Rare
Canyonlands woody aster	*Xylorhiza glabriuscula*	Possible	None	Rare

Habitat Present and Affected: Possible—habitat for the species is present in the vicinity of the site, transportation routes, or borrow areas; No—species is listed for this county, but habitat is not close to the site.
Federal Status: BLM—plants on the interim sensitive list adopted by the BLM Utah Office.
State Status: Rare—plants with known or suspected rangewide viability concern; Watch—plants regionally endemic but without rangewide viability concern;
Source: UDWR 2003a.

Table 3–13. *State-Listed Wildlife Species That May Occur in the Vicinity of the Moab Site*

Common Name	Scientific Name	Habitat Present and Affected	State Status			Species Present	Actions/Comments
			E	T	SC		
Mammals							
American pika	*Ochotona princeps*	No			x	No	
Abert's squirrel	*Sciurus aberti*	No			x	No	
Allen's big-eared bat	*Idionycteris phyllotis*	Unknown			x	Unknown	
Big free-tailed bat	*Nyctinomops macrotis*	Unknown			x	Unknown	
Spotted bat	*Euderma maculatum*	Unknown			x	Unknown	
Brazilian free-tailed bat	*Tadarida brasiliensis*	Unknown			x	Unknown	
Fringed myotis	*Myotis thysanodes*	Unknown			x	Unknown	
Townsend's big-eared bat	*Corynorhinus townsendii*	Unknown			x	Unknown	
Northern flying squirrel	*Glaucomys sabrinus*	No			x	No	
Northern river otter	*Lontra Canadensis*	No			x	No	
Dwarf shrew	*Sorex Nanus*	No			x	No	
Birds							
Peregrine falcon	*Falco peregrinus*	Yes	x			Yes	Federally delisted
Ferruginous hawk	*Buteo regalis*	Possible		x		Yes	
Common yellowthroat	*Geothlypis trichas*	Unknown			x	Unknown	
Burrowing owl	*Athene Cunicularia*	No			x	No	
Swainson's hawk	*Buteo swainsoni*	Possible			x	Unknown	
American white pelican	*Pelecanus erythrorhynchos*	No			x	No	
Lewis's woodpecker	*Melanerpes lewis*	No			x	No	
Three-toed woodpecker	*Picoides tridactylus*	No			x	No	
Greater sage grouse	*Centrocercus urophasianus*	No			x	No	
Blue grosbeak	*Passerina caerulea*	Unknown			x	Unknown	
Northern goshawk	*Accipiter gentiles*	Unknown			x	Unknown	
Amphibians and Reptiles							
Northern Leopard Frog	*Rena pipiens*	Possible			x	Unknown	
Western toad	*Bufo boreas*	Possible			x	Unknown	
Arizona toad	Bufo microscaphus	Possible			x	No	
Cornsnake	*Elaphe guttata*	Yes			x	Unknown	
Milksnake	*Lampropeltis traingulum*	Possible			x	Unkown	
Plateau striped whiptail	*Cnemidophorus (Aspidoscelis) velox*	Unknown			x	Unknown	
Smith's black-headed snake	*Tantilla hobartsmithii*	Unknown			x	Unknown	
Snails							
Eureka mountainsnail	*Oreohelix eurekensis*	No			x	No	

Status: T—Threatened, E—Endangered, SC—State concern.
Source: UDWR 2003a.

Table 3–14 lists sensitive bird species, including migratory birds, that may occur in the vicinity of the site, although on-site habitat limits typical nesting and breeding activities. Most of these species are protected under the MBTA, which prohibits take or destruction of birds, nests, or eggs of listed migratory birds.

Table 3–14. Sensitive Bird Species Protected Under the Fish and Wildlife Conservation Act and Migratory Bird Treaty Act That May Occur Near the Moab Site

Species	Potential to Occur in Project Area
Order Gaviiformes—Open-water birds	
Common loon *(Gavia immer)*	Low
Order Ciconiiformes—Long-legged waders	
American bittern *(Botaurus lentiginosus)*	Moderate
White-faced ibis *(Plegadis chihi)*	Moderate
Order Falconiformes—Birds of prey	
Golden eagle *(Aquila chrysaetos)*	High
Northern harrier *(Circus cyaneous)*	Moderate
Prairie falcon *(Falco mexicanus)*	Moderate
Red-tailed hawk (*Buteo jamaicensis*)	High
Turkey vulture (*Cathartes aura)*	High
Order Gruiformes—Marsh and open country birds	
Black rail *(Laterallus jamaicensis)*	Moderate
Yellow rail *(Coturnicops noveboracensis)*	Low
Order Charadriiformes—Shorebirds	
Black tern *(Chlidonias niger)*	Moderate
Long-billed curlew *(Numenius americanus)*	Moderate
Marbled godwit *(Limosa fedoa)*	Moderate
Snowy plover *(Charadrius alexandrinus)*	Moderate
Solitary sandpiper *(Tringa solitaria)*	Moderate
Upland sandpiper *(Bartramia longicauda)*	Low
Wilson's phalarope *(Phalaropus tricolor)*	Moderate
Order Strigiformes—Nocturnal birds of prey	
Barn owl *(Tyto alba)*	Low
Flammulated owl *(Otus flammeolus)*	Low
Short-eared owl *(Asio flammeus)*	Low
Order Apodiformes—Small swallowlike birds	
Black swift *(Cypseloides niger)*	Low
Vaux's swift *(Chaetura vauxi)*	Low
Order Piciformes—Wood-boring birds	
Red-headed woodpecker *(Melanerpes erythrocephalus)*	Low
Williamson's sapsucker *(Sphyrapicus thyroideus)*	Low
Order Passeriformes—Perching birds	
Olive-sided flycatcher *(Contopus borealis)*	Low
Gray flycatcher *(Empidonax wrightii)*	Moderate
Pinyon jay *(Gymnorhinus cyaneocephalus)*	Low
Bendire's thrasher *(Toxostoma bendirei)*	High
Crissal thrasher *(Toxostoma dorsale)*	High
Bewick's wren *(Thryomanes bewickii)*	Moderate
Sedge wren *(Cistothorus platensis)*	Low
Verry *(Catharus fuscenscens)*	Moderate
Sprague's pipit *(Anthus spragueii)*	Low
Loggerhead shrike *(Lanius ludovicianus)*	Moderate

Note: Birds listed in the table are protected under the Fish and Wildlife Conservation Act (Birds of Conservation Concern [2000] [USF&WS 2002f] and the MBTA [50 CFR 10], Executive Order 13186). Species listed as threatened or endangered under the ESA or considered endangered, threatened, or rare by the State of Utah are not included here.

3.1.12 Land Use

Federal, state, city, or county entities administer approximately 90 percent of the land in Grand County. Among federal agencies, BLM administers the greatest percentage of land. Several national parks are in the vicinity of the Moab site. Arches National Park is adjacent to the north border of the site, and Canyonlands National Park is approximately 12 miles (see Figure 2–2) southwest of the site (in San Juan and Wayne Counties). The closest boundary to the Uinta and Ouray Indian Reservation is located approximately 44 air miles north-northwest of the site; however, the closest populated area within the reservation is considerably farther at Duchesne, about 120 air miles north of Moab.

Most of the land in this area is open to recreational uses, and tourism is an important part of the Moab economy. Favorable weather allows off-road access for hikers, bikers, and off-highway vehicles in virtually all seasons. The Colorado River adjacent to the site is a source of extensive recreational use for spring and summer water sports. Because the land directly south of the site adjoins the river and access is not limited, it is often used by campers and hikers throughout the summer months. The entrance to Arches National Park is within 1 mile of the site boundary. It is the northern end of a crescent of national parks and recreation areas that curve southwesterly to the Grand Canyon in Arizona. Most of the visitors to Arches National Park are there for the day only. During 2002, 765,000 visitor days were recorded at the park, of which 41,524 included at least one overnight stay. This park includes exceptional viewpoints and is known for its many spectacular arches.

Grand County has little land suitable for farming. Areas that are suitable for cultivation are limited to Moab Valley and Spanish Valley. Grand County has no prime or unique farmlands. Residential and commercial development has been increasing since 1979, and agricultural use has declined. Grazing occurs throughout the region, including on the plateaus. However, low rainfall and sparse vegetation limit livestock numbers. Except where irrigation is present, federal grazing allotments cover large areas.

Land use in the vicinity of the Moab site is largely commercial, with few residents in the immediate area. The nearest full-time residence is at the northeast corner of the site between Courthouse Wash and the easternmost site boundary. A river tours and gift shop business is located adjacent to the east side of Courthouse Wash. A restaurant, a residence, and two commercial parks for recreational vehicles, motor homes, and trailers are along US-191 approximately 0.75 to 1.5 miles east of the site. Area land use between the Moab and Crescent Junction sites is shown on Figure 3–18.

Land directly south of the site is privately owned and is vacant. The northwest edge of the main residential and commercial area of the city of Moab is across the Colorado River, approximately 1.8 miles southeast of the site.

The land directly across and adjoining the Colorado River to the east is designated as the Matheson Wetlands Preserve. It is jointly owned and managed by UDWR and the Nature Conservancy. The 875-acre preserve includes a trail system, educational kiosks, wildlife viewing platforms, and a water delivery system. Land uses farther downstream along the Colorado River include residences for about 15 families, 100 to 150 acres of forage crops, grazing, and a potash facility (NRC 1999).

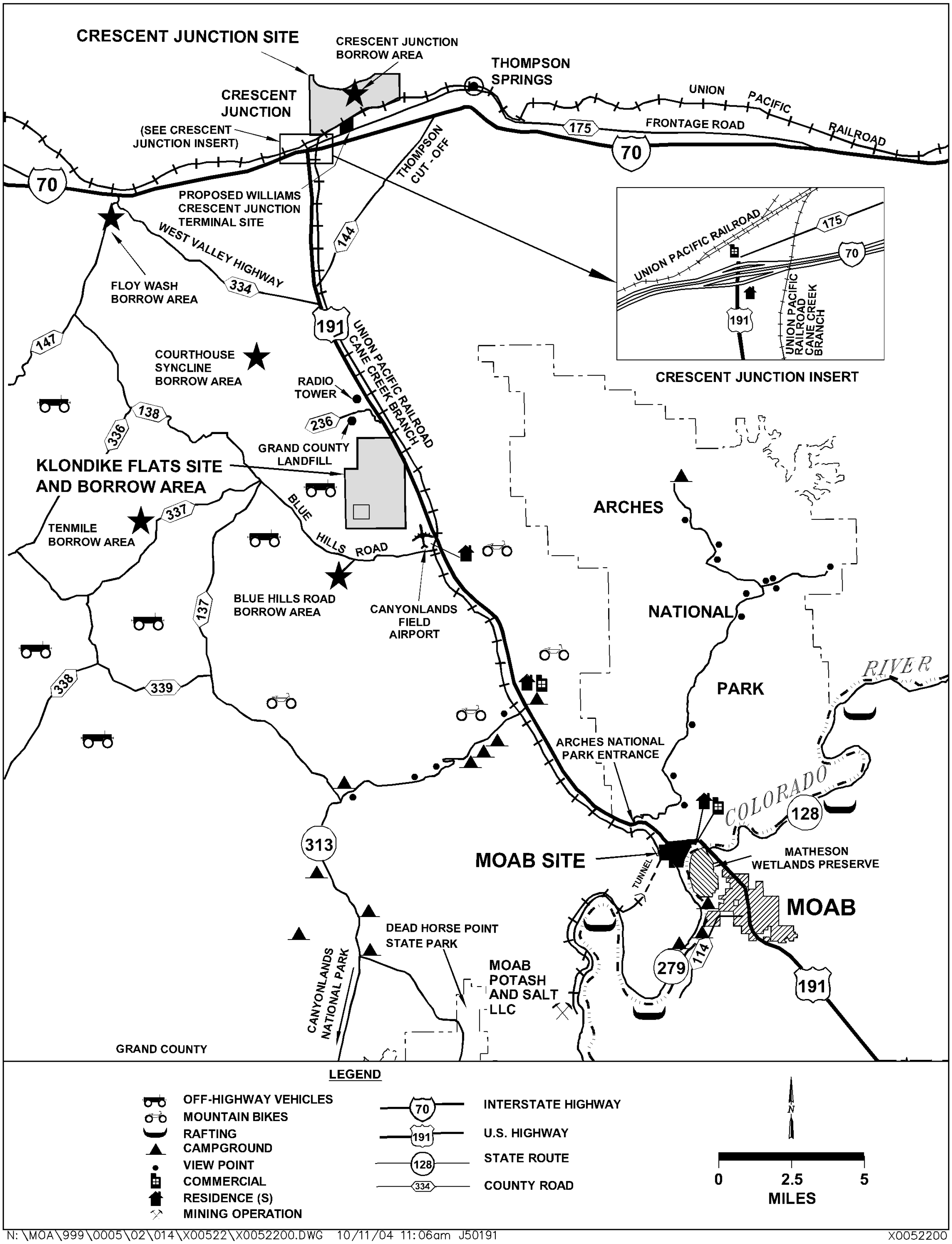


Figure 3–18. Land Use in the Moab to Crescent Junction Area

The headquarters and staff residences for Arches National Park are located about 1.2 miles northwest of the Moab site. No residences or residential areas, other than those identified above, are known to be located within 2 miles of the site.

3.1.13 Cultural Resources

3.1.13.1 Cultural History of Southeastern Utah

The earliest known humans to inhabit southeastern Utah were believed to have arrived around 10,000 B.C. These paleoindian people were nomadic hunters of large game animals, which at that time included the mammoth, horse, camel, bison, and giant sloth. Stone weapon points from this period have been found in southeastern Utah. These hunters were believed to have migrated out of the area soon after the end of the Pleistocene (Berry 2003).

From 7800 to approximately 500 B.C., Archaic people inhabited southeastern Utah. These were hunter-gatherers who depended more on small game and plants for subsistence. Sometime after 2000 B.C., agriculture was adopted by many of the Archaic people, and a more sedentary, group-oriented lifestyle began. A number of archaeological sites containing evidence of Archaic-age tools, weapons, and structures have been discovered throughout southeastern Utah.

With the advent of horticulture, populations of tribal groups within the southeastern Utah area expanded and diversified. Between A.D. 1 and 1300, several distinct cultural groups inhabited the area, the best known of which were the Anasazi and Fremont. Grand County is thought to have been the northern limit of Anasazi habitation, although some rock art and pottery remains have been found in the Moab and Arches National Park areas. The Fremont group is believed to have inhabited areas primarily north of Moab. Numerous lithic sites, granaries, and storage pits have been found in the area between Arches National Park and the Book Cliffs. The abundant pictographs and petroglyphs discovered throughout southeastern Utah derive from the Anasazi and Fremont people. Both of these groups abandoned the Four Corners region between A.D. 1250 and 1400.

The ancestors of the present-day Ute and Southern Paiute tribes entered southeastern Utah about A.D. 1200. They were mainly hunter-gatherers who hunted and traveled in small bands composed of two to two dozen individuals. By the time Anglo-Americans arrived in southeastern Utah, the San Juan Southern Paiutes and several bands of Utes were well established in the area.

The Ute people were closely tied to the land, not so much through agriculture but through hunting and gathering; thus, their survival depended heavily upon having complete access to the land (Cuch 2000).

In the late 1800s and early 1900s, their free-roaming lifestyle ended when the Utes were removed from their ancestral lands and forced onto reservations. Today, the Ute bands that once roamed the lands of southeastern Utah are concentrated in reservations in a number of areas: the White Mesa Ute community 9 miles south of Blanding, Utah; the Ute Mountain Utes in Towaoc, Colorado; the Southern Utes in Ignacio, Colorado; and the Northern Utes in White Rocks, Fort Duchesne, and Randlett, Utah.

The Navajos migrated into the Four Corners region sometime between A.D. 900 and 1400. In San Juan County, the earliest known Navajo site, discovered in White Canyon (adjacent to the

Colorado River and west of Blanding), is estimated to be 380 years old. Several Spanish maps dating from the 1660s pictured Navajo territory as far north as the present-day town of Green River, Utah (Cuch 2000). However, the primary homeland of the early Navajos was in a large area known as Dinétah, located southeast of present-day Farmington, New Mexico.

In 1868, a treaty was signed between the Navajos and President Andrew Johnson that allowed the Navajos to return to their homeland. Today, 110 chapters of the Navajo Nation are located in northern Arizona, northwestern New Mexico, and southeastern Utah. The Aneth and Red Mesa Chapters in southeastern Utah are approximately 30 and 45 miles, respectively, southeast of the White Mesa Mill site.

Spanish explorers and traders traveled through southeastern Utah from the late 1600s to about 1848, when Mexico ceded to the United States the tract of land south of the forty-second parallel, including the state of Utah. The best known of the explorers were Juan María Antonio de Rivera, who traveled the area in 1765, and Francisco Atansio Domínguez and Francisco Silvestre Vélez de Escalante, who traveled the area in 1776. During this period, the Old Spanish Trail was developed as a major trade route between California and Santa Fe, New Mexico Highway. I-70 to Denver and the Union Pacific Railroad line follow the northern branch of this route, and US-191 from Crescent Junction to Blanding follows the historic main branch of the trail (Berry 2003).

The first Anglo-Americans to settle the southeastern Utah area were Mormon missionaries. They came in 1855 to convert the Utes to Mormonism and teach them farming. During their brief stay at the Elk Mountain Mission, which they constructed north of present-day Moab, they raised cattle and grew crops. Their efforts were soon thwarted by conflicts with the Utes, and they departed the area "in haste" about 4 months after their arrival. Mormon farmers and ranchers did not permanently settle southeastern Utah until 1877, when the United States signed a peace treaty with the Ute Tribe and established reservations in eastern Utah and southwestern Colorado (Firmage 1996).

Prospectors settled in the Moab area between the 1880s and 1920s to mine gold, copper, uranium, and radium. Moab, Grand County, and southeastern Utah were forever changed by a uraninite discovery on July 6, 1952, by Texas prospector Charles A. Steen. His strike was the richest single lode of uranium ore discovered anywhere to that date and led to Moab becoming the "Uranium Capital of the World." Steen built his own $8 million processing mill on the north side of the Colorado River 3 miles north of Moab in 1956. In 1962, the Atlas Corporation purchased Steen's mill for $25 million and operated it until it closed in April 1984. This mill operation generated the tailings pile that is the subject of this document (NRC 1999).

3.1.13.2 Cultural Resource Inventories of Potentially Affected Areas

DOE contracted two professional archaeological consultants to conduct Class I cultural resource inventories of areas that could be affected by the proposed alternatives (Berry 2003; Davis et al. 2003). Class I inventories are inventories of existing cultural resource data. Archaeologists study published and unpublished documents, records, files, and other sources to determine if previous cultural resource investigations have been conducted within an area. If cultural resources have been identified, the federal agency conducting the action, in consultation with the State Historic Preservation Officer and affected Native American tribes, determine whether the cultural resources are included or are eligible for inclusion in the National Register of Historic Places. DOE is required by the National Historic Preservation Act to consider the effects of its actions on any "district, site, building, structure, or object" that is included or eligible for inclusion in the National Register of Historic Places. If DOE's action would have an adverse effect on an eligible cultural resource, DOE would be required to implement a process called the Section 106 consultation process. This process would require DOE to consult with the State Historic Preservation Officer and others in an effort to find ways to make the action less harmful. Others who would be consulted might include Native American tribes, BLM, NPS, UDOT, Bureau of Indian Affairs, and other federal and state agencies, organizations, and private individuals.

The National Historic Preservation Act also requires DOE to inventory surface and subsurface cultural resource sites in areas before they are disturbed. These on-the-ground "Class III" surveys would be conducted by professional archaeologists before DOE implemented any of the proposed alternatives. A Class III survey is "a continuous, intensive survey of an entire target area, aimed at locating and recording all archaeological properties that have surface indications, by walking close-interval parallel transects until the area has been thoroughly examined" (BLM 2003a).

Some culturally significant properties or places may be eligible for inclusion in the National Register of Historic Places but may not be readily identifiable by archaeologists during a Class I inventory or Class III survey. These "traditional cultural properties" may be associated with the cultural practices or beliefs of a community and may be significant to the community's history or may be important in maintaining the community's cultural identity. The National Historic Preservation Act requires that these properties or places be considered by federal agencies in the same manner as other eligible cultural resources through the Section 106 consultation process. To identify traditional cultural properties that may be affected by its proposed actions, DOE contracted a cultural anthropologist to assist in communicating with tribal members who may have knowledge of such properties. Because Class III cultural resource surveys have not yet been completed in many portions of the project area, all potential traditional cultural properties cannot yet be identified. Information contained in this EIS concerning traditional cultural properties is preliminary and not complete. Once a preferred alternative is selected, site-specific studies and additional interviews would be conducted in conjunction with the Class III surveys to identify all potential traditional cultural properties.

3.1.13.3 Section 106 Consultation Process

In April 2003, DOE initiated the Section 106 consultation process by notifying potentially interested stakeholders that DOE was preparing this EIS. DOE contacted federally recognized Native American tribes that resided in or had cultural ties to the project area to inform them of DOE's proposed alternatives and to solicit their concerns or comments. A total of 38 representatives from 14 Native American tribes and the Navajo Utah Commission were contacted by mail and telephone. To date, the Ute Mountain Ute Tribe (including White Mesa Ute Tribe), Southern Ute Tribe, Uintah-Ouray Ute Tribe, Navajo Nation (including Aneth Chapter, Red Mesa Chapter, and Oljato Chapter), Navajo Utah Commission, and Hopi Tribe have expressed interest in or concerns with DOE's proposed alternatives.

DOE also contacted potentially affected federal agencies, including BLM, NPS, Bureau of Indian Affairs, and UDOT about the proposed alternatives. BLM and NPS are cooperating agencies for the EIS.

3.1.13.4 Moab Site Inventory Results

DOE contracted a Class III cultural resource survey of the Moab site in January and March 2004 (Christensen 2004; Christensen and Lindsay 2004 [in progress]). As a result of that survey, DOE determined that five cultural sites eligible for inclusion in the National Register of Historic Places are present on DOE property. The eligible sites include (1) a prehistoric site, (2) a section of the historic US-160 that parallels and pre-dates the present-day US-191, (3) a sign identifying the historic livestock driveway from Moab to Crescent Junction, (4) a collapsed farmstead dating from the Depression era, and (5) the remaining structures associated with the uranium mill. The primary contributing features associated with the historic millsite include the Uranium Reduction Company general office/warehouse/machine shop, Colorado River pump station and pipeline, ore loadout structure on the railroad spur, and scale house. Although the millsite features are less than 50 years old, DOE determined that they are eligible for nomination to the National Register of Historic Places, primarily because of their association with the "greatest mining boom in American history" (Christensen 2004), a boom that facilitated the Unites States' dominance as a nuclear superpower. The features also are "representative of the uranium milling industry that brought many jobs to Grand County, contributing to the current community structure of Moab to a degree far greater than any other single mechanism in regional history" (Christensen 2004).

One recorded traditional cultural property associated with the Ute Tribe is present near the Moab site (Berry 2003).

3.1.14 Noise and Vibration

Noise is technically defined as sound waves that are unwanted and perceived as a nuisance by humans. Sound waves are characterized by frequency and measured in hertz (Hz); sound pressure is expressed as decibels (dB). Humans have a perceptible hearing range of 31 to 20,000 Hz. The threshold of audibility ranges from about 60 dB at a frequency of 31 Hz to less than about 1 dB between 900 and 8,000 Hz. For regulatory purposes, noise levels for perceptible frequencies are weighted to provide an A-weighted sound level [dBA] that correlates highly with individual community response to noise. Sound pressure levels outside the range of human hearing are not considered noise in a regulatory sense, even though wildlife may be able to hear at those frequencies. A better understanding of noise impacts is facilitated by associating noise levels with common activities or sources (Figure 3–19).

Noise levels are often reported as the equivalent sound level (L_{eq}). The L_{eq} is expressed in dBA over a specified period of time, usually 1 or 24 hours. The L_{eq} is the equivalent steady sound level that, if continuous during

Noise Measurement

What are *sound* and *noise*?

When an object vibrates it possesses energy, some of which transfers to the air, causing the air molecules to vibrate. The disturbance in the air travels to the eardrum, causing it to vibrate at the same frequency. The ear and brain translate the vibration of the eardrum to what we call *sound*. *Noise* is simply unwanted sound.

How is sound measured?

The human ear responds to sound pressures over an extremely wide range of values. The range of sounds people normally experience extends from low to high pressures by a factor of 1 million. Accordingly, scientists have devised a special scale to measure sound. The term decibel (abbreviated dB), borrowed from electrical engineering, is the unit commonly used.

Another common sound measurement is the A-weighted sound level, denoted as dBA. The A-weighting accounts for the fact that the human ear responds more effectively to some frequencies than others. Higher frequencies receive less weighting than lower ones. Most of the sound levels provided in this report are A-weighted; however, some are in decibels because of lack of information on the frequency spectrum of the sound. Figure 3–19 shows common references to sound on the A-weighted sound-level scale.

SOUND SOURCE	SOUND LEVEL (dBA)	RESPONSE
Carrier deck jet operation	140	
Civil defense siren (at 100 ft)	130	Painfully loud
Jet takeoff (at 200 ft)	120	Threshold of feeling and pain
Riveting machine (at 1 ft)	110	
Ambulance siren (at 100 ft)	100	Very loud
Heavy truck (at 50 ft)	90	
Freight train cars (at 50 ft)	80	
Vacuum cleaner (at 10 ft)	70	Moderately loud
Air conditioning unit (at 20 ft)	60	
Speech in normal voice (at 15 ft)	50	
Residence, no TV or radio	40	Quiet
Soft whisper (at 5 ft)	30	
Recording studio	20	
	10	
	0	Threshold of hearing

Figure 3–19. Comparison of A-Weighted Sound Pressure Levels Associated With Different Sources of Noise

a specified time period, would contain the same total energy as the actual time-varying sound over the monitored or modeled time period. Another expression of noise levels is the day-night sound level (L_{dn}). This is the average of the day and nighttime A-weighted sound level with a built-in penalty of 10 dB at night. The L_{dn} is particularly useful for evaluating community-level noise effects.

The Moab site is located in a quiet, open desert environment where natural phenomena such as wind, rain, and wildlife account for most natural background noise. At times, insect activity and birds may account for significant portions of environmental noise. The Arches National Park is a potential sensitive site located close to the Moab site. The park maintains two housing complexes near the park entrance. The housing complex that is closer to US-191 provides temporary housing for seasonal employees, students, and official visitors but does not have any permanent residents. The permanent housing complex is located farther from US-191 and consists of three permanent residences for park employees and families. Sources of man-made background noise near the Moab site may include automobile traffic on US-191, trains on the Union Pacific Railroad, aircraft flying overhead, and outdoor recreational activities in adjacent areas.

The city of Moab is located about 3 miles southeast of the Moab site and is outside the influence of noise originating at the site. Expected noise levels in and around the city of Moab likely range from 45 to 55 dBA, with levels approaching 65 dBA around busy roads. The city of Moab has a noise ordinance specifying that noise levels not exceed 65 dBA (Moab City Ordinance 17.74.080, "Noise Levels"). This applies to residential zones from 10:00 p.m. to 7:00 a.m. Monday through Saturday and not before 9:00 a.m. on Sunday. For commercial zones, the standard applies to the time interval between 10:00 p.m. and 6:00 a.m. the following day. The acoustic environment in open desert in Utah is typical of other desert environments where average L_{dn} values range from 22 dB on calm days to 38 dB on windy days (Brattstrom and Bondello 1983).

Ground vibration is generally not perceived as a characteristic of the environment because background ground vibration is not perceptible to humans. Ground vibration is expressed as the average vibration root mean square (rms) velocity in decibels (expressed as dBV) with a reference to 10^{-6} inch per second. The highest mean value of rms velocity over a given event is called the maximum rms velocity. It is a more suitable expression of ground vibration energy for addressing human annoyance because of the response time for humans to respond to ground vibration stimuli. The human threshold for the perception of ground vibration is 62 to 65 dBV. A large truck or bus can produce ground vibration levels of about 62 dBV. About 70 dBV will result in notable human response.

Natural sources of ground vibration include wave action, strong winds striking natural or man-made structures, and, infrequently, seismic activity. Human activities that can create perceptible levels of ground vibration (such as blasting, pile driving, operation of heavy earth-moving equipment, or rail traffic) are important when sensitive sites, structures, or activities may be affected. The most significant background component of ground vibration in the Moab area is railroad traffic.

No background noise or ground vibration data are available for the Moab site. A single residence is located to the northeast of the site; otherwise, there are no residences located close to the site.

3.1.15 Visual Resources

Visual resources are the visible physical features of a landscape that impart scenic value. Southeastern Utah is known worldwide for its unique scenic qualities and unusual landscape features. It is a land of deep canyons, rock arches, towering rock formations, badlands, and expansive panoramas. Many of the more spectacular features are preserved in national and state parks or monuments, three of which—Arches and Canyonlands National Parks and Deadhorse Point State Park—are located near Moab, and one of which—Natural Bridges National Monument—is located west of Blanding.

BLM has developed a Visual Resource Management system that helps federal agencies classify and manage landscapes and their associated scenic values. The system allows landscapes to be ranked and placed into one of four classes. Each class has a management objective that is related to the value placed on the scenic characteristics of the landscape (BLM 2003b).

Class I Objective: Preserve the existing character of the landscape. The level of change to the characteristic landscape should be very low and must not attract attention.

Class II Objective: Retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen but should not attract the attention of the casual observer. Changes must repeat the basic elements of form, line, color, and texture of the predominant natural features of the characteristic landscape.

Class III Objective: Partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements of the predominant natural features of the characteristic landscape.

Class IV Objective: Provide for management activities that require major modifications of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repetition of basic elements.

BLM classifies BLM-managed lands surrounding the Moab site as Class II, primarily because of the nearness of the Colorado River, Arches National Park, and stunning landform features in the area (BLM 2003b).

The Moab site is on the floodplain of the Colorado River and is immediately adjacent to US-191 and Potash Road SR-279. Depending on the viewing location, the backdrop to the site may be the steep, red sandstone cliffs that define the western edge of Moab valley; The Portal, where the Colorado River re-enters its steep, narrow canyon; or the towering and often snow-covered La Sal Mountains. In any direction, the contrasts in the green-patchwork valley floor and vertical red cliffs impart a spectacular quality to the views.

The Moab site tailings pile can be viewed by northbound and southbound travelers on US-191 and Potash Road and by tourists from two unmarked scenic turnouts on the Arches National Park road. The tailings pile is a relatively large, flat, geometrically shaped landform that has smooth steep side slopes on the south and east sides and terraced, step-like side slopes on the north and west sides. The predominant horizontal lines created by the pile provide a moderate contrast to the adjacent vertical sandstone cliffs; however, the red color of the soils currently covering the tailings blends with the reds of the surrounding cliffs, allowing the pile to go unnoticed by many first-time visitors to the area. Because of its size, the tailings pile moderately to strongly dominates the view from most of the viewing locations. It can be seen from one residence located directly northeast of the site and a residence at The Portal RV and Park across the river from the site. Figure 3–20 shows the current view of the tailings pile from southbound US-191.

Figure 3–20. View of the Moab Site Tailings Pile from Southbound US-191
[Before UDOT widened US-191]

3.1.16 Infrastructure

3.1.16.1 Waste Management

Nonradioactive solid waste at the Moab site is disposed of by a commercial contractor in the Grand County landfill, which has a remaining projected lifespan of 64 years at a disposal rate of 30,000 to 35,000 yd^3 per year.

Currently, two portable toilets are on the site for managing nonradioactive sanitary waste. Each portable toilet can support up to 25 workers. The sanitary waste is emptied from the portable toilet one or two times per week, depending on the size of the on-site workforce and is disposed of by a commercial contractor in the Moab sewage treatment plant, which has a capacity of 1.5 million gallons per day. The treatment plant currently treats an average of 800,000 to 900,000 gallons per day; it restricts discharge of concentrated sewage from portable toilets to 9,000 gallons per day and limits receipts to 3 days per week.

3.1.16.2 Electrical Power Supplies

A three-phase overhead power line runs along the north boundary of the property, and an electrical substation on the property feeds power to the site. The electrical utility servicing the site is Utah Power, a subsidiary of PacifiCorp.

3.1.16.3 Water

The Moab site has its own pump station that can pump nonpotable water from the Colorado River. DOE currently has a water right for consumptive use of Colorado River water at the Moab site of 3.3 cfs (approximately 2,366 acre-feet per year). This right includes an additional 3.03 cfs (about 2,194 acre-feet per year) for nonconsumptive use. Potable water is available in the city of Moab. The city's potable water supply system is provided by the Glen Canyon aquifer (see Section 3.1.6.4) and can produce 3 million to 5 million gallons per day.

3.1.17 Transportation

3.1.17.1 Vehicular Traffic

US-191 provides highway access to the Moab site. It is generally two lanes wide but does have occasional passing lanes. Originating at the Arizona-Utah border and terminating at the Crescent Junction and I-70 intersection, US-191 provides north-south travel access in eastern Utah and also carries significant truck traffic. As much as 30 percent of the total vehicle volume consists of trucks.

Table 3–15 presents a summary of annual average daily traffic (AADT) counts, degree of congestion, percentage of truck traffic, number of accidents, and accident rates for US-191 between the White Mesa Mill site and Crescent Junction where it intersects with I-70. AADT volume is based on vehicle counts from continuously operating automatic traffic counters that do not discern direction of travel. The reported AADT is a combination of vehicles traveling in both directions for a specific route segment. Congestion is a reflection of the actual number of vehicles on a highway segment in relation to how many the road can safely handle. Various other factors, such as the geometry of the roadway and number of lanes, are also considered in determining whether a road is congested. Truck traffic is defined as single-unit delivery trucks or larger sized vehicles. Truck traffic is shown as a percent of the AADT. Accident rates are determined by comparing actual recorded crashes to expected accident rates for a specific road segment and per 1 million miles of vehicle travel. Expected accident rates are a 5-year average of accidents that occur on similar highway segments and include all types of vehicles. The rates provided in Table 3–15 are based on the 1997–2001 time period (Ames 2003).

As shown in Table 3–15, central Moab is considered congested and had a high accident rate of 3.5 accidents per 1 million miles of vehicular travel in 2001. Based on accident averages, it was expected to have an accident rate of 1.77. US-191 increases to four lanes in the downtown area to accommodate the increase in traffic. Within 1,400 ft of the north city limits, US-191 reduces to two lanes, congestion is no longer a problem, and the accident rate reduces to low, which is characteristic of most sections of US-191 (Ames 2003). It is assumed that the large increase in traffic volume in the downtown area reflects downtown business activity and cross traffic that stays within the city. No state or federal routes converge with US-191 in Moab.

The city of Moab is concerned about traffic congestion within the central area, which continues to get progressively worse as the city grows and attracts increasing tourism and tourism-related commerce and recreation. The city has considered a bypass to relieve traffic congestion; however, it has not yet begun a feasibility study (Vaughn 2003).

Table 3–15. Annual Average Daily Traffic, Road Congestion, Truck Percent, and Highway Accidents for US-191 and I-70 in 2001

Road Segment (or MP[a])	AADT	Congestion	Truck Percent	Accidents[b]		Rate
				Expected	Actual	
On I-70, 7 miles west of Crescent Junction (Floy Wash area)	7,040	No	16	0.81	0.31	Less than expected
On I-70 just east of US-191	7,030	No	15	0.81	0.9	More than expected
On US-191 at Crescent Junction and I-70	2,855	No	30	1.95	1.08	Less than expected
US-191 and MP 140.8-141.8	2,855	No	30	1.72	1.92	More than expected
US-191 and MP 138.2-139	2,855	No	30	1.72	0.43	Less than expected
US-191 and MP138.2	2,855	No	30	1.72	0.43	Less than expected
US-191 and SR-313 (MP137.2)	2,855	No	30	1.72	1.71	Less than expected
US-191 and entrance to Arches National Park (MP 131.27)	2,855	No	30	1.72	1.3	Less than expected
US-191 Junction with SR-128 (MP128.62)	5,520	No	16	2.01	0.92	Less than expected
US-191 and North Moab city limits (MP127.43)	5,942	No	10	1.77	0.7	Less than expected
US-191 and Central Moab (MP 126.26)	16,045	High	4	1.77	3.5	Much more than expected
US-191 and San Juan/Grand County line (MP 119.44)	8,510	No	14	2.01	1.02	Less than expected
US-191 and La Sal Junction at SR-46 (MP 103.91)	3,255	No	14	1.72	1.50	Less than expected
US-191 and Monticello (MP 72.14)	3,110	No	14	1.72	7.72	Much more than expected
US-191 and south Blanding city limits (MP 50.13)	7,450	No	7	1.72	0.99	Less than expected
US-191 and SR-95, 4 miles south of Blanding (MP 47.47)	3,970	No	10	1.72	2.29	More than expected
US-191 and White Mesa Mill site (MP 44.61)	2,861	No	13	1.72	1.47	Less than expected

[a]MP is mile point along the road measured from the Arizona-Utah state line.
[b]Accidents rates are based on actual number of crashes per 1 million miles of vehicular travel and compared to expected numbers of accidents per 1 million miles of vehicular travel.
Reference: UDOT 2002a; Ames 2003.

Although US-191 is part of a national truck route that originates in Texas and ends in Washington, with several exceptions (notably in Moab), this highway does not carry large traffic volumes, is not considered congested or operating near capacity, and has a low accident rate (Ames 2003). Figure 3–21 shows area roads, AADT on US-191, areas with accident rates that are higher than expected, and the location of the Union Pacific Railroad.

Peak traffic levels in this area are reported between the months of March and October, when the average daily traffic (ADT) volumes may increase by as much as 77 percent between February and March and peak traffic occurs in May or June. Between October and November, the ADT may reduce by an estimated 35 percent (UDOT 2002a). Table 3–16 provides average monthly vehicle travel for the period of 2000 to 2002. The 12-month period in 2002 showed a 4-percent increase over the 2001 time period.

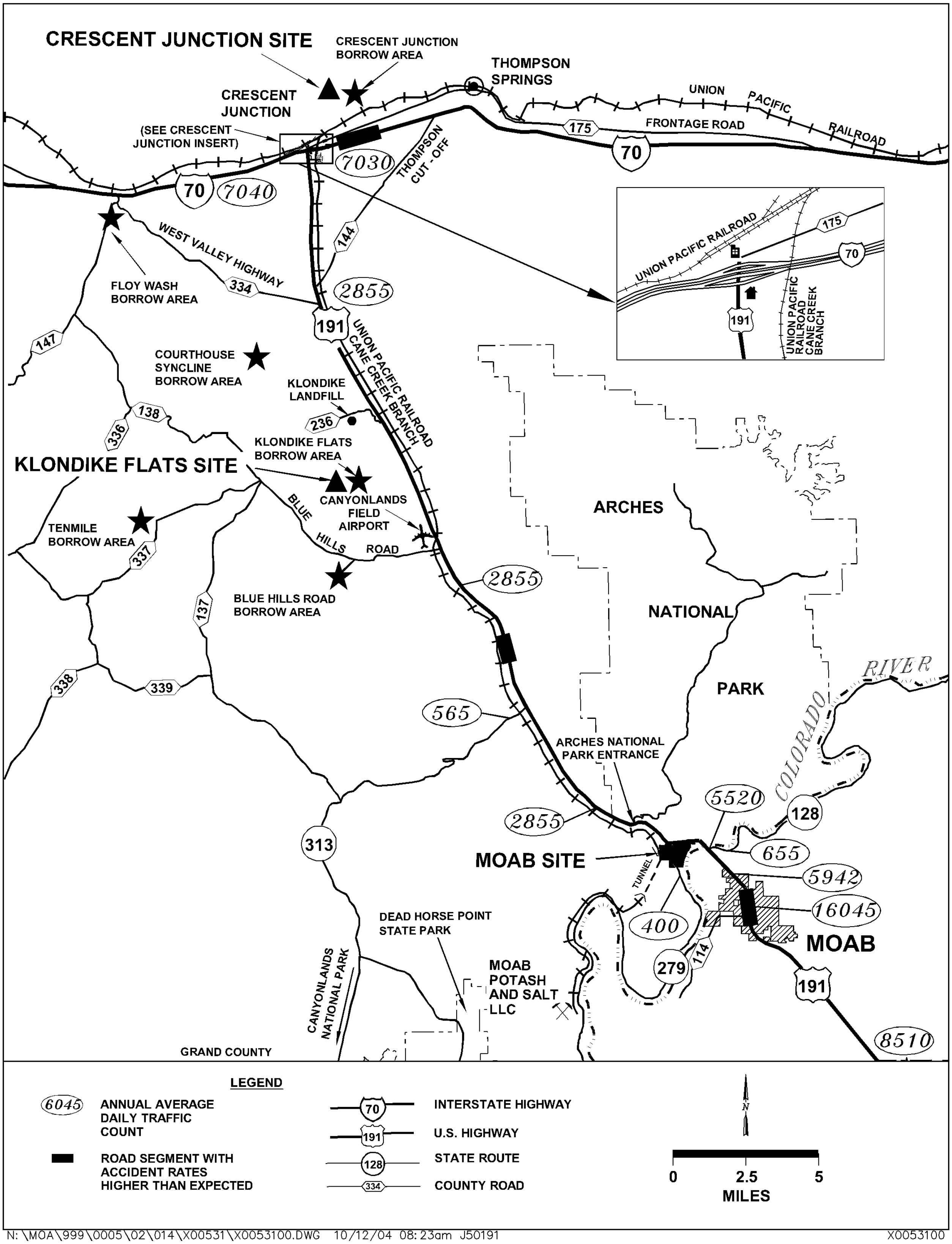


Figure 3–21. Transportation Routes and Selected Roads in the Moab to Crescent Junction Area

Table 3–16. Average Monthly Vehicle Traffic Near the North Boundary of Moab

Month	2000		2001		2002	
	Traffic Count	Percent Change From Previous Month	Traffic Count	Percent Change From Previous Month	Traffic Count	Percent Change From Previous Month
January	2,902		2,847	–12	2,938	–9
February	3,324	15	3,251	14	3,638	24
March	5,257	58	5,312	63	6,443	77
April	7,212	37	7,235	36	6,915	7
May	7,646	6	7,627	5	7,913	14
June	7,722	1	6,897	–10	7,136	–10
July	7,601	–2	6,519	–5	6,715	–6
August	6,052	–20	6,542	0.4	6,400	–5
September	6,703	11	6,433	–2	6,590	3
October	6,068	–9	5,866	–9	6,357	–4
November	3,554	–41	4,340	–26	4,146	–35
December	3,252	–8	3,216	–26	3,582	–14
Year Totals	**67,293**		**66,085**		**68,773**	

Reference: UDOT 2002a.

Numerous county roads in the area (see Figure 3–21) are used for recreational travel by off-highway vehicles, motorcycles, or mountain bikes to backcountry areas. Some of the roads are former highway routes that pre-date I-70 construction and some are the result of seismic exploration activities.

CR-138, 1 mile south of the Canyonlands Field Airport, is locally known as Blue Hills Road. This is a dirt surface, two-lane road that carries heavy off-highway vehicle traffic to backcountry areas. The road surface is wider than the typical two-lane road. During the peak summer use season, 100 vehicles per day may travel the road (Vaughn 2003). BLM recorded 53,000 vehicle counts on CR-138 during a 12-month period in 2002. Although there are many connecting road choices, it is believed that the majority of the vehicles also return to US-191 by using CR-138 (Von Koch 2003).

CR-236 provides access to the Grand County landfill, locally known as the Klondike landfill, and to a radio tower. The landfill is about 1 mile west of US-191 and is operated by the Grand County Solid Waste District. The amount of daily traffic accessing the landfill on this road is unknown. CR-236 continues as a dirt track past the landfill.

Another former highway alignment out of use since about 1911 is CR-144, also known as the Thompson Cut-Off Road. This road has a gravel surface and is locally used to access I-70 at Thompson Springs.

CR-175 is north of I-70 at Crescent Junction. This road also predates I-70 and still carries local or frontage road traffic from Crescent Junction to Thompson Springs or farther to a point near Cisco. It is a two-lane road from Crescent Junction to the bridge over Thompson Wash, where it narrows to one lane because of the condition of the bridge. It continues as a two-lane road east of Thompson Springs. Although there may be occasional local use of this frontage road, most of the asphalt pavement is deteriorating and would need resurfacing for any sustained increase in use.

The stretch of US-191 area between the Canyonlands Field Airport (Blue Hills Road) and CR-334 to the north is locally considered a potentially dangerous section of the highway. The combination of terrain, slower moving vehicles, and the two-lane limitation can create dangerous passing situations (Vaughn 2003). In addition, according to UDOT highway statistics, a 2-mile stretch of US-191 south of Blue Hills Road sustains more accidents than expected (Ames 2003).

To relieve congestion associated with traffic in the Arches National Park entrance area, a new entrance road has been constructed within the park that will connect with US-191 approximately three-quarters of a mile south of the existing entrance to the park.

In 2004, UDOT upgraded US-191 to four lanes from the area just north of SR-128 to the area just north of SR-313; adding two turn lanes at the entrance to Arches National Park, at Gemini Bridges, and at SR-313; adding a 2-mile-long bicycle lane on the northeast side of US-191; and adding center divides along some stretches of US-191.

3.1.17.2 Rail Transport

The Union Pacific Railroad parallels I-70 and offers predominantly freight rail service. On a daily basis, there is usually one Burlington Northern train carrying 75 to 100 cars of mixed manifest; two to three freight trains of 105 to 134 empty coal cars; one to two loaded coal trains of 105 cars; and an east-bound passenger train and a west-bound passenger train. The California Zephyr passenger train stops in Green River, Utah, and Grand Junction, Colorado (Legg 2003).

The Cane Creek Branch of the Union Pacific Railroad parallels US-191 and provides weekly freight service to the Moab Potash and Salt Mine. It carries potash and salt to Crescent Junction and continues on the Union Pacific Railroad to Grand Junction for distribution to points east and west. This train consists of between 40 and 50 cars. It does not stop between the Moab Potash and Salt Mine and Crescent Junction but does cross several county roads with unguarded and unmarked rail crossings. As shown on Figure 3–21, just north of Blue Hills Road (CR-138), the railroad crosses under US-191 from the east to the west side, where it continues south toward the Moab Potash and Salt Mine. At the Blue Hills Road crossing, there is a stop sign but no rail guard arms or signal. After traversing a tunnel, the railroad emerges several miles from the Moab Potash and Salt Mine and continues on the north side of SR-279. The Moab Potash and Salt Mine is located 16 miles from the intersection of US-191 and SR-279.

There was one recorded fatality on the Cane Creek Branch during the period of 1974 or 1975 to 2003. Injuries of all kinds for all travel on the Union Pacific Railroad are reported as averaging 2.9 per 100,000 man-hours of work. Derailments are reported per ton-mile and were estimated at possibly 0.009 percent (Legg 2003).

3.1.18 Socioeconomics

This section describes the socioeconomic environment of Grand and San Juan counties, Utah, in terms of their demographic, economic, and natural resource features.

3.1.18.1 Population, Workforce, and Job Base

Grand County covers 3,689 square miles and had a 2000 census population of 8,485. Its population has grown 28.2 percent since 1990. Prior to 1990, the population declined by 19.7 percent relative to 1980 levels, coinciding with the closure of the Atlas mill in 1984. The recent trends in population growth mark a turnaround; tourism-recreation now forms the basis of economic activity and growth in the regional economy. This fundamental change reflects that the minerals industry (uranium, potash, oil, and gas), which in 1980 directly and indirectly generated 62 percent of all income of Grand County residents, now contributes only 2 percent to the overall labor income. Table 3–17 provides population information for Grand and San Juan Counties.

Table 3–17. Population and Labor Force Information for Grand and San Juan Counties, Utah

Demographic Features	Grand County	San Juan County
2000 population	8,485	14,413
1990–2000 percent change	28.2	14.2
1980–1990 percent change	–19.7	3.0
2000 population per square mile	2.3	1.8
2000 civilian labor force	5,164	4,593
1999–2000 percent change	–4.5	–6.0
2000 unemployment rate	6.5	9.2
Government employment		
Federal	245	285
State-local	545	1,313
Total	**790**	**1,598**

From 2000 Census
Source: U.S. Census Bureau, County and City Data Book: 2000

Population effects from tourism and recreation are most notable in Moab, the Grand County seat. Moab is the largest town in southeastern Utah, and in the 2000 census had a permanent population of 4,779. At the time of the 2000 census, more than half of Grand County's population resided in Moab. By comparison, San Juan County covers 8,103 square miles and had a reported population of 14,412 during the same census period. This county also experienced accelerated population growth during the last 2 decades. It grew 3 percent between 1980 and 1990 and 14.2 percent between 1990 and 2000. According to the 2000 census, the population density in San Juan County is lower than in Grand County, averaging 1.8 individuals per square mile, compared to Grand County's density of 2.3 individuals per square mile. The population density of both counties is well below the statewide average of 27.2 persons per square mile.

Table 3–17 also provides labor force information for Grand and San Juan Counties. The civilian component of the labor force is similar in size for the two counties, numbering 5,164 in Grand County and 4,593 in San Juan County. This labor force is primarily employed by a service economy founded on tourism-recreation, especially in Grand County. The combination of federal, state, and local government employment is nearly twice as high in San Juan County relative to Grand County, mostly because of the state and local components. Despite the larger number of government jobs in San Juan County, its local unemployment rate was 9.2 percent, compared to 6.5 percent in Grand County. Both counties had significantly higher unemployment rates during the first half of 2000 compared to the state average of 3.7 percent. These indicators of human resource availability vary because of the seasonal nature of employment opportunities and job turnover rates in the tourism-recreation job base. For example, seasonal unemployment in Grand County has ranged from 6.2 percent to 7.3 percent (GPU 2003).

Meanwhile, over the longer term (since 1995), tourism-recreation employment has grown by some 20 percent, now accounting for at least 45 percent of Grand County's total employment (GPU 2003). An estimated 1,878 jobs are now tourism-related (GPU 2003). By comparison, mining has decreased from a 16-percent share of total area employment in 1995 to a 2-percent share in 2000, and government employment has increased from 10 to 19 percent (GPU 2003). Federal land management agencies are among the major employers in the regional economy. At the center of this activity is the city of Moab, which acts as a gateway to Arches and Canyonlands National Parks, as well as Dead Horse Point State Park and the famous Slickrock Bike Trail. In the year 2000, Arches National Park attracted some 790,000 visitors, and Canyonlands National Park received 400,000 visitors.

3.1.18.2 Housing and Income Characteristics

Census data for 2000 show significant increases in both the number of housing units and the number of households in the study region. In Grand County, the number of housing units increased by more than 35 percent compared to 1990 levels, and the number of households increased by 38 percent relative to 1990 levels. Although the growth rates for San Juan County tended to be half as large as those of Grand County, the residents of San Juan County had a larger percentage of owner-occupied dwellings (79.3 percent compared to 71 percent). Table 3–18 provides information on housing and income characteristics in Grand and San Juan counties.

Table 3–18. Housing and Income Information for Grand and San Juan Counties, Utah

Housing and Income	Grand County	San Juan County
2000 housing units	4,062	5,449
1990–2000 percent change	35.8	17.2
Percent owner occupied	71.0	79.3
Number of households	3,434	4,089
1990–2000 percent change	38.0	21.2
1997 median household income (1997 dollars)	$28,881	$26,723
1989–1997 percent change	33.1	54.6
1998 per capita income	$19,505	$12,685
Percent of national average	71.7	46.6
Percent of Utah average	87.7 (71.7/81.8)	56.9 (46.6/81.8)

Source: U.S. Census Bureau, County and City Data Book: 2000. Percentage of Utah average is calculated by dividing the county per capita income as a percentage of national average (71.7 percent and 46.6 percent, respectively) by the state per capita income as percentage of national average (81.8 percent).

Temporary housing and accommodations in Moab are available for the large influx of tourist and recreational visitors in various forms, including motels and hotels (1,583 rooms); bed and breakfasts, apartment units, condominiums, and guest houses (278 rooms); and numerous campsites (GPU 2003). Additional temporary housing and accommodations are available in the towns of Monticello and Green River. For example, Monticello (55 miles south of Moab) has more than 200 motel and hotel rooms, 2 bed and breakfasts, and 5 campsite-RV parks. Temporary housing accommodations in Green River include 650 hotel and motel rooms, 1 bed and breakfast, and 3 camp parks.

The vacancy rates for temporary housing in Moab tend to follow the pattern of the seasonal tourist economy. The availability of apartment rental units, as well as mobile homes and trailers, is greatest between November and mid-February. By early spring, most rental units are occupied by seasonal employees staffing motels, restaurants, shops, and other tourist service businesses (e.g., bike shops, raft tour companies). Outside of Moab, temporary housing is also limited to a few motels, trailers, and campgrounds in towns such as Green River (52 miles northwest of Moab), Monticello (54 miles south of Moab), and Blanding (78 miles south of Moab).

Table 3–18 also reports median household incomes (1997) and per capita incomes (1998) for the two counties. These statistics suggest that the typical resident of Grand County had a slightly larger median household income and a relatively larger per capita income than the typical resident in San Juan County. The similarity of values for median household incomes is attributable to relatively faster income growth in San Juan County during 1989 to 1997 (54.6 percent compared to Grand County's 33.1 percent). Per capita income in San Juan County is less than that of Grand County ($12,685 compared to $19,505) and makes up only 56.9 percent of the average per capita income in Utah and only 46.6 percent of the average per capita income in the United States. By comparison, Grand County's per capita income is closer to the state and national averages (87.7 percent and 71.7 percent, respectively).

3.1.18.3 Commercial Business and Farm-Based Enterprise

In 1998, there were an estimated 360 private nonfarm businesses in Grand County, many supporting the expanding tourism-recreation sector. The number of private businesses in Grand County grew by 67.4 percent between 1990 and 1998, reflecting a period of relative prosperity in the local and regional economy. In 2000, tourists spent an estimated $99.2 million in Grand County, making it the seventh highest county for tourist dollars spent in Utah (GPU 2003). By comparison, San Juan County had an estimated 242 private nonfarm businesses in 1998, an increase of 22.2 percent over 1990. Table 3–19 provides information on the number and growth of private commercial businesses and farm-based enterprise in the two-county region.

Table 3–19. Commercial and Farm-Based Enterprise in Grand and San Juan Counties

Enterprise	Grand County	San Juan County
Private nonfarm businesses, 1998	360	242
1990–1998 percent change	67.4	22.2
1998 annual payroll per worker	$15,188	$16,464
Percent of national average	49.6	53.8
Percent of Utah average	59.3 (49.6/83.7)	64.3 (53.8/83.7)
1997 accommodation and food service firms	82	38
Paid employees	1,141	382
1997 number of farms	85	231
Land in farms (acres × 1,000)	76	1,673
1997 value of farm products, average per farm	$26,929	$39,381

Source: U.S. Census Bureau, County and City Data Book: 2000. Percentage of Utah average is calculated by dividing the county annual payroll per employee as a percentage of national average (49.6 percent, 53.8 percent) by the state annual payroll per employee as percentage of national average (83.7 percent).

Signs of a new growth economy are apparent in the service sector, particularly in the number of accommodation and food service firms located in Grand County. In 1997, this sector had 82 firms (mostly located in Moab), supporting 1,141 paid employees. Taxable retail sales, services, and business equipment purchases for Grand County amounted to $159.6 million in 2000 (GPU 2003). Grand County and the city of Moab have experienced significant accommodations growth; lodging capacity increased from 612 rooms to 1,861 rooms (GPU 2003). As a result, the local tax base is heavily dependent on the level of tourism-recreation activity.

By contrast, San Juan County has a much smaller service sector supporting the tourism-recreation-based economy; in 1997, 38 firms provided accommodation and food services and employed 382 workers.

The annual payroll per worker for both Grand County and San Juan County ($15,188 and $16,464, respectively) remained well below state and national averages despite growth and development in the tourism-recreation economy. In Grand County, for example, the annual payroll per worker is only 59.3 percent of the state average and 49.6 percent of the national average. The percentages for San Juan County are somewhat higher than those for Grand County (64.3 percent and 53.8 percent), possibly because its service sector and underlying labor force are less dependent on tourism- and recreation-based activities.

Table 3–19 also provides information on farm-based enterprise in the two-county region. San Juan County had 231 farms in 1997 occupying over 1.6 million acres of land. On average, each farm contributed $39,381 worth of farm products to the local economy, signifying the relative importance of farm-based activity in San Juan's local economy. Farm-based activity in Grand County plays a relatively minor role in its local economy. In 1997, Grand County had 85 farms covering 76,000 acres of land and producing an average value of $26,929 worth of farm products per farm.

The availability of land in Grand County for expanding economic activity is restricted, given the predominant role of state and federal governments in managing nearly 94 percent of Grand County's total land area. For example, only 4.3 percent of the land in Grand County is privately owned; most of the remaining land is managed by the federal government (71.7 percent), owned by the state (15.5 percent), or held in trust as American Indian tribal land (4.4 percent). Other land stakeholders in Grand County include the USFS (1.2 percent) and the U.S. Department of Defense (0.08 percent) (GPU 2003).

3.1.19 Human Health

Human health at and near the Moab site is influenced by the radiation sources in the environment and the contaminants associated with the mill tailings at the site. Exposures occur to occupational workers and members of the public that may live near or recreate adjacent to the site. This section evaluates the potential risks to human health at the Moab site. Appendix D presents a detailed evaluation of the risk to the public.

3.1.19.1 Natural Radiation Environment

Everyone is exposed to three types of ionizing radiation: (1) natural sources unaffected by human activities, (2) those of a natural origin that are affected by human activities, and (3) man-made sources. Natural sources include cosmic radiation from space and naturally occurring radionuclides in soils and rocks. The tailings pile at the Moab site is an example of radiation from a natural origin that has been affected (concentrated) by human activities. Man-made sources include nuclear medicine, medical x-rays, nuclear fallout, and consumer products.

For most of the population, natural background radiation is the largest contributor to their overall radiation dose. The natural occurrence of cosmic radiation and radionuclides at the earth's surface varies throughout the world and depends mostly on the altitude where the exposure occurs and the nearby geology. Cosmic radiation consists of charged particles (primarily extraterrestrial) that generate secondary particles that have direct and indirect ionizing properties. The main radionuclide contributors to external terrestrial gamma radiation are potassium-40 and the members of the thorium and uranium decay series. Impacts (terrestrial gamma and radon gas and its decay products) are mostly from the top several inches of soil.

3.1.19.2 Current Risk to Members of the Public

To evaluate current risk to members of the public, the region of influence is considered to be a 50-mile radius of the Moab site (Figure 3–22). The estimated population in this region is approximately 11,000; most of this population lives within 10 miles of the Moab site.

The majority of the affected population lives in Moab, which is approximately 3 miles from the site. According to the 2000 census, the population of Moab was 4,779. The primary individuals exposed to contaminants at the Moab site are the nearby residents (the closest residents live adjacent to the site approximately 2,200 ft from the tailings pile) and recreational users of land adjacent to the site. Recreational users include Moab residents and tourists. The major recreational activities near the site are rafting on the Colorado River and camping on adjacent lands. Although some minor trespassing has occurred since DOE began managing the Moab site, no members of the public are receiving prolonged exposure to on-site contaminants.

The site contaminants consist of both radioactive and nonradioactive components (e.g., heavy metals). Because members of the public do not have access to the site, essentially all the risks are associated with the radioactive contaminants through exposure to gamma radiation and inhalation of radon gas.

Table 3–20 summarizes the potential dose to members of the public from the radioactive contaminants at the Moab site and from other sources (natural and man-made). This table provides three types of risk numbers. Two sets of numbers are site-related, and the third is an average radiation risk for the U.S. population from natural radiation sources. Site-related risk information is provided for the types of activities that currently occur near the site (rafting and camping) and for the individual who lives closest to the Moab site (the maximally exposed individual). Table 3–20 indicates that the most significant contribution to total dose comes from background sources, not from the Moab site.

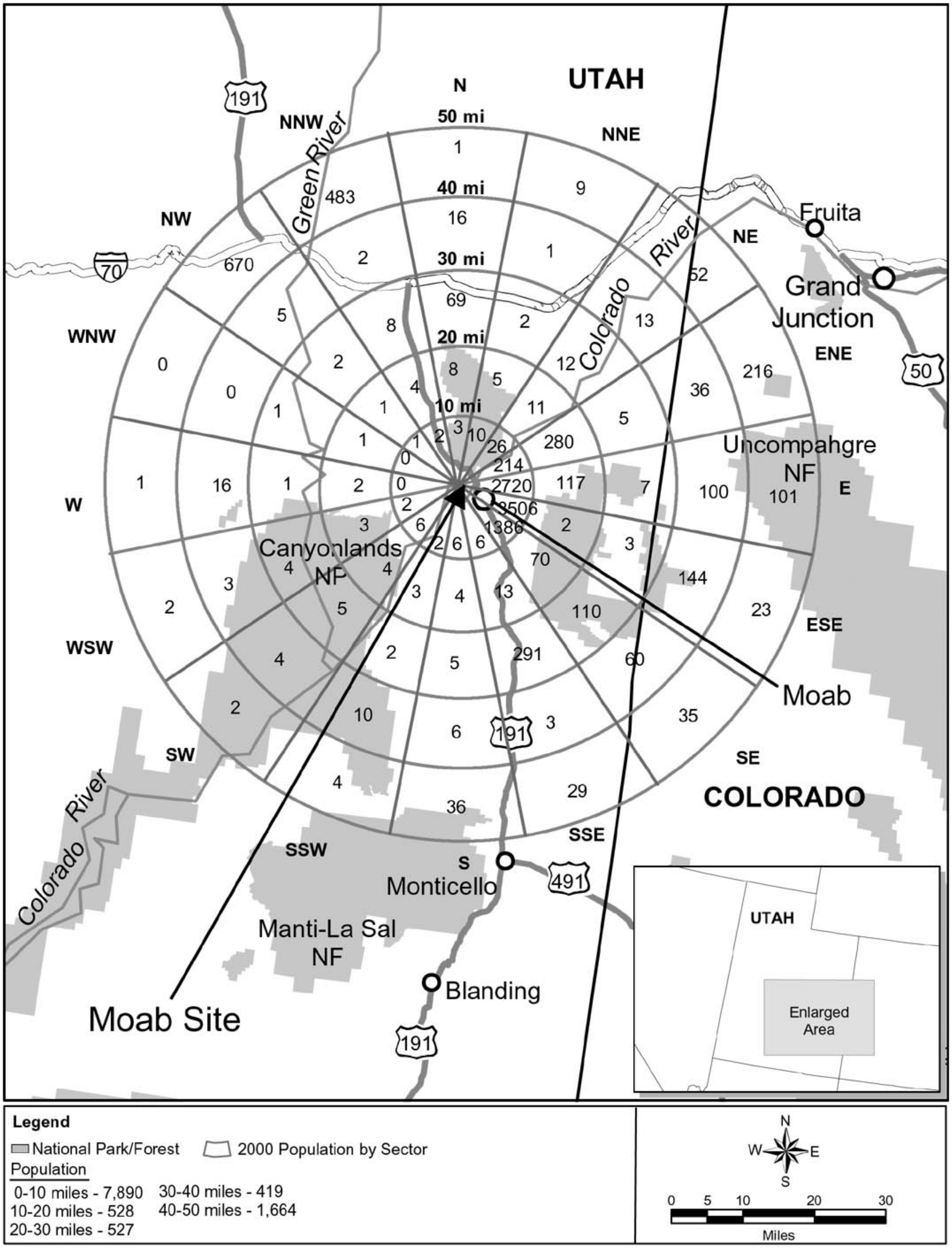


Figure 3–22. Population Within 50 Miles of the Moab Site

(Based on 2000 U.S. Census Data)

Table 3–20. Annual Doses From Background Radiation (Millirem per Year) Compared to Doses From Radon and Gamma Associated With Tailings at the Moab Site

Scenario	Central Tendency[a] (site related)		Background (U.S. average)	Total	RME[b] (site-related)		Background (U.S. average)	Total
	Radon	Gamma			Radon	Gamma		
Camping	15.0	4.0	300	319.0	30.0	7.9	300	337.9
Rafting	7.4	1.6	300	309.0	11.1	2.4	300	313.4
MEI[c]	105.7	16.0	300	421.7	132.3	20.0	300	452.3

Notes: The backup assumptions and calculation sheets are presented in Appendix D.
[a]Central tendency risks are based on more typical exposure assumptions that are still somewhat conservative. Exposure assumptions include the time spent in contaminated areas and the amounts of contaminated material ingested that have a direct impact on the estimated risks.
[b]RME = reasonable maximum exposure.
[c]MEI = maximally exposed individual (the resident closest to the site).

The two types of site-related risks are based on (1) typical exposure assumptions (called central tendency exposures [e.g., amount of contaminated soil accidentally ingested, number of days camping next to the site]), and (2) exposure assumptions that tend to reflect the worst case and result in high-end risks (called reasonable maximum exposures [RMEs]). These high-end risks are based on conservative exposure assumptions resulting in high-end risk estimates. Exposure assumptions include factors such as the number of days spent camping at a site. The site-related exposure doses are based on time spent near the site-related contamination. Details on the assumptions and the calculation approach are presented in Appendix D.

Table 3–20 shows the radiation levels that occur from natural sources such as cosmic rays and natural radioactive materials in the earth. Actual background radiation doses vary with location. In the case of the Moab site, data for Blanding, Utah, were used. The natural background doses assume exposure for an entire year. The *Final Environmental Impact Statement for Remedial Action Standards at Uranium Processing Sites* (EPA 1982) provides more information on the radiation standards.

3.1.19.3 Existing Occupational Risks

DOE contract personnel are on the site Monday through Thursday, except on holidays. On-site personnel conduct maintenance and environmental characterization activities. Maintenance activities include controlling dust using calcium chloride or water spraying, repairing the tailings pile after major precipitation events, and removing process-related material from the site.

Environmental characterization includes collecting samples of soil, ground water, and surface water; conducting gamma surveys of the surface soils; installing ground water monitor wells; conducting land surveys; and conducting vegetation surveys.

Table 3–21 summarizes the 2002 annual personnel exposure report for those employees with a measurable dose.

Table 3–21. 2002 Annual Personnel Exposure Summary Report

Employees with Measured Dose	External Dose (gamma) (mrem/yr)	Internal Dose (whole body from radon) (mrem/yr)	Total Effective Dose Equivalent (mrem/yr)
1	0	31	31
2	0	145	145
3	0	150	150
4	13	60	73
5	10	160	170
6	0	115	116
7	0	567	567
8	13	40	53
9	0	216	216
10	0	186	186
11	13	122	135
Average	**4.5**	**163**	**167**

Eleven other employees that participated in the personnel dose monitors did not have any measurable doses. This table indicates that the most significant dose contribution is from the ingestion of radon gas and that doses to workers vary considerably. All doses are below DOE benchmarks of up to 5,000 millirem per year (mrem/yr).

3.1.20 Environmental Justice

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (59 FR 7629), directs federal agencies to identify and address, as appropriate, any activities that may affect minority and low-income populations. A minority has been defined as individual(s) who are members of the following population groups: American Indian or Alaska Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic. A minority population has been identified where the minority population of the affected area exceeds 50 percent of the population. Low-income populations are groups with an annual income below the poverty threshold.

Table 3–22 presents the minority and low-income populations in Grand and San Juan Counties. A portion of the Uinta and Ouray Indian Reservation is located in northern Grand County. The Ute Mountain (White Mesa Utes) and the Navajo Reservations are situated along the southern border of San Juan County, and American Indians make up the majority of the population in San Juan County: 57 percent of the 14,413 population base. The Hispanic population in Grand County represents the next largest minority population in either of the two counties (5.6 percent).

Table 3–22 also presents the percentage of persons below the poverty line as defined by the U.S. Department of Commerce. San Juan County has a relatively large percentage of individuals below the poverty line (30 percent) compared to Grand County (18 percent). The county poverty trends from 1989 through 1997 show that the percentage of the population falling below the poverty level increased by 34 percent in Grand County and decreased by 10 percent in San Juan County during that time.

Table 3–22. Minority and Low-Income Populations in Grand and San Juan Counties

Population Group	Grand County	San Juan County
2000 population	8,485	14,413
Percent Hispanic or Latino	5.6	3.7
2000 population by race	8,373	14,195
White Non-Hispanic (percent)	7,861 (94%)	5,876 (41%)
Black or African American (percent)	21 (0.3%)	18 (0.1%)
American Indian (percent)	327 (4%)	8,026 (57%)
Some other race (percent)	164 (2%)	275 (2%)
Percent of people below 1997 poverty level	18	30
Percent change 1989–1997	34	–10

Source: 2000 Census

Demographic information obtained from the U.S. Census Bureau was used to identify low-income and minority populations within 50 miles of the Moab site and the proposed off-site alternatives (Klondike Flats, Crescent Junction, and the White Mesa Mill). This radius is consistent with that used to evaluate collective dose for human health effects from the proposed on-site and off-site disposal of the Moab mill tailings and contaminated material from vicinity properties. Census data are compiled at a variety of levels corresponding to geographic areas. In order of decreasing size, the areas used are states, counties, census tracts, block groups, and blocks. A “block” is geographically the smallest census area; it is usually bounded by visible features such as streets or streams or by invisible boundaries such as city limits, township lines, or property boundaries and offers the finest spatial resolution. Block data were used to characterize minority distribution. Because block data are so specific to the individuals within a block (for example, sometimes only one family may live in a block), income data are available only at the block group level and above. For this reason, block group data were used to identify low-income populations.

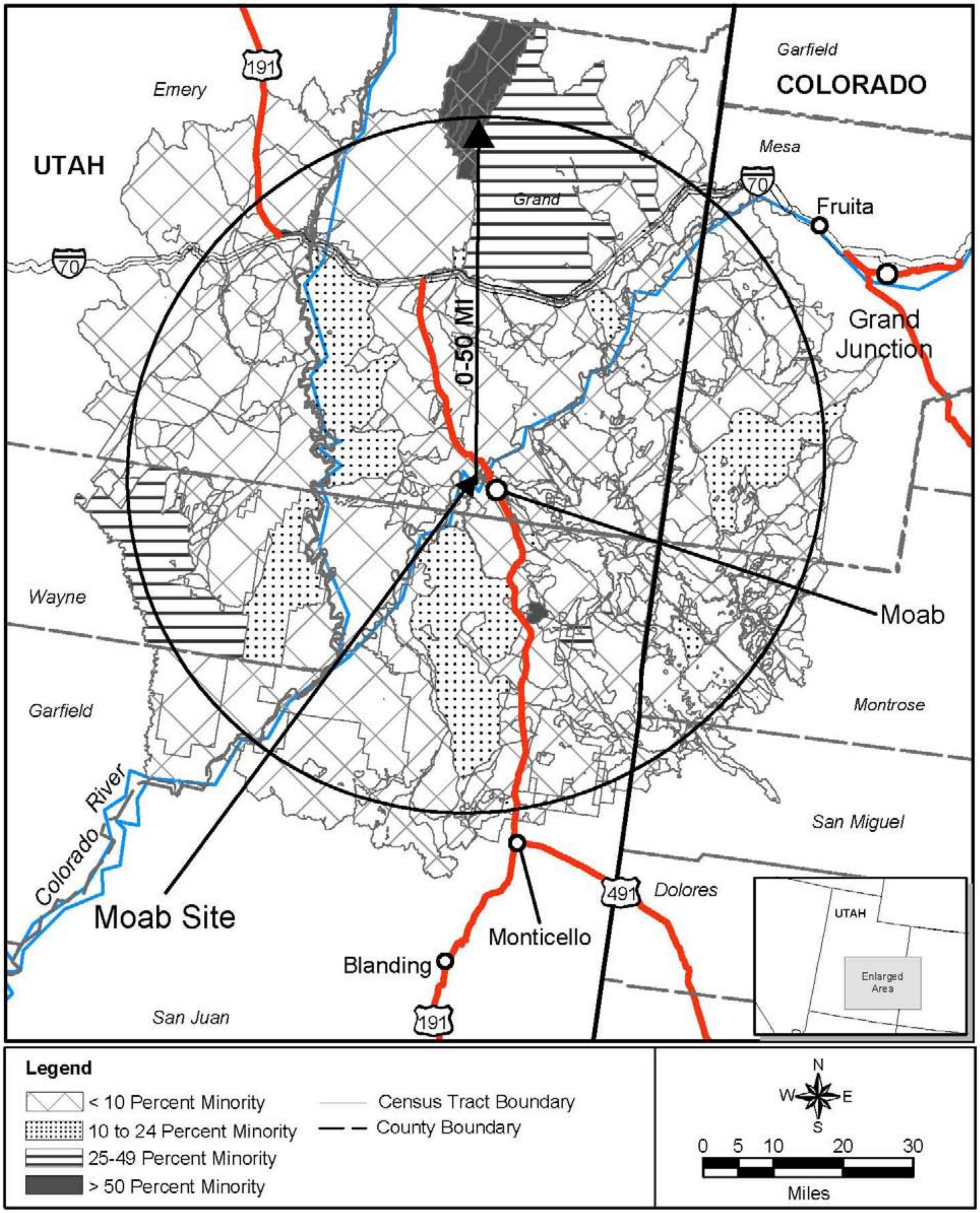
Demographic maps were prepared using 2000 census data for minority populations and for low-income populations. Figure 3–23 shows census blocks with minority populations that are more than 50 percent within 50 miles. The nearest block occurs about 20 miles south of Moab.

The poverty level established by the Census Bureau for 2000 for a family of four is $18,244. Figure 3–24 shows average household income for the year 2000. Assessment of the census data determined that within the 50-mile area, less than 1 percent of the population had a household income below the poverty level.

3.2 Klondike Flats Site

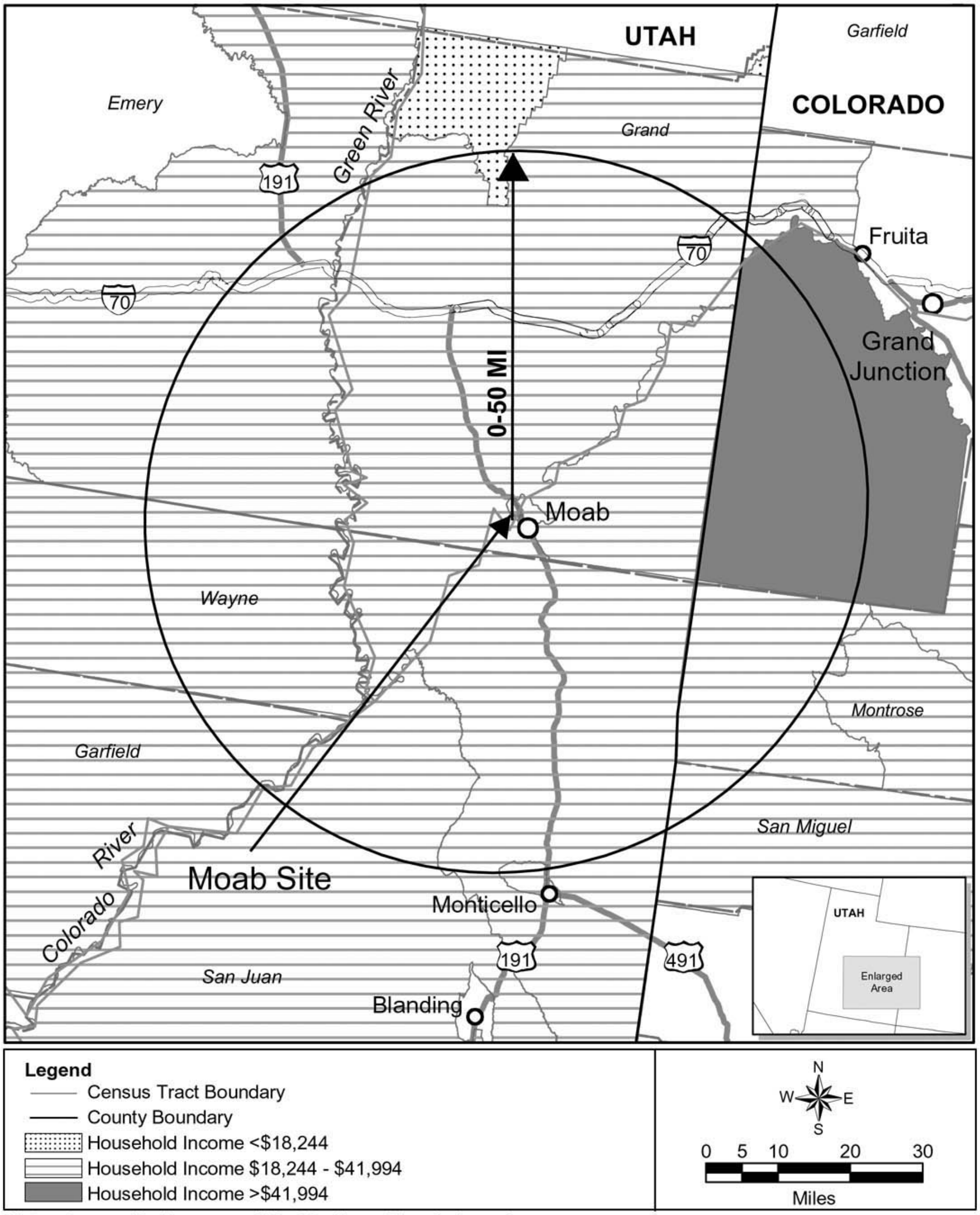
The proposed Klondike Flats disposal site (Klondike Flats site) is located about 18 miles northwest of the Moab site and just west of US-191. It is remote from populations and behind a low bluff such that the Klondike Flats site is not visible from the highway.

Air quality in this area would be considered similar to and likely better than air quality at the Moab site. There are no major sources of pollutants and no developed industries; regular vehicle use does not occur in the area under consideration. The Moab region is classified as an attainment area under the NAAQS; therefore, the Klondike Flats site is also considered to be an attainment area according to these standards, and air quality is not considered further.



Note: Census blocks and American Indian Reservations within 50 miles of the site boundary.

Figure 3–23. Minority Population Distribution Within a 50-Mile Radius of Moab, Utah



Note: Census block groups within 50 miles of the site boundary.

Figure 3–24. Household Income Distribution Within a 50-Mile Radius of Moab, Utah

There are no perennial streams in or near this area; therefore, aquatic ecology is not considered further. Ephemeral streams are present throughout the region; the washes in the Klondike Flats site area may carry heavy flows after significant storm events. The course of these ephemeral water bodies is well established, and these washes are unlikely to migrate in a different direction or pattern; therefore, the potential for river migration is not considered further.

Any future use as a disposal site would require importing potable water and exporting nonradioactive solid and sanitary waste. An existing three-phase distribution line parallels US-191 adjacent to the site that is within the service territory of Utah Power.

3.2.1 Geology

The Klondike Flats site is in the north part of the Canyonlands section in the north-central part of the Colorado Plateau physiographic province. The surface of the site slopes gently westward, and the elevation ranges from about 4,600 to 4,750 ft. The site is in the northwest part of the ancestral Paradox Basin, which is discussed in Section 3.1.1 (Figure 3–1).

3.2.1.1 Stratigraphy

Bedrock exposed at the site is the lower part of the Mancos Shale (Figure 3–25). Approximately 300 to 700 ft (estimated) of Mancos Shale is present in the Klondike Flats site area. Just west of the site, an old oil test well (Klondike well) penetrated about 700 ft of Mancos Shale at its total depth (Doelling 1997; Lupton 1914).

The following members (in descending order) represent the lower part of the Mancos Shale in this area: Blue Gate Shale, Ferron Sandstone, and Tununk Shale. Approximately 100 to 200 ft of the lowermost part of the Blue Gate Shale Member is present in the western part of the site.

The Ferron Sandstone Member is exposed in the eastern and southern parts of the site. The lowermost member of the Mancos, the Tununk Shale, is exposed in the slope below the Ferron Sandstone cuesta around the east and south margins of the site area. The Dakota Sandstone of Early Cretaceous age underlies the Mancos Shale and consists of 50 to 100 ft of resistant sandstone, conglomeratic sandstone, and conglomerate. This formation likely represents the shallowest bedrock unit containing ground water. The Cedar Mountain Formation of Early Cretaceous age underlies the Dakota Sandstone and consists of one or two beds up to 30 ft thick of sandstone, conglomeratic sandstone, and conglomerate separated by thick, gray-green and lavender mudstone. The total thickness of the formation is 100 to 200 ft.

Bedrock (Mancos Shale) exposures are covered in some of the western part of the site by alluvial mud (Doelling 1997). These deposits fill swales in poorly developed drainages between bedrock ridges of Blue Gate Shale. Mostly residual, these deposits of mud, silt, and clay formed as the shale weathered; thickness is up to 20 ft.

3.2.1.2 Structure

The site is in a prominently exposed structural feature known as the Courthouse syncline. The surface expression of the syncline is hyperbolic and is well-defined by the Ferron Sandstone double cuesta. The site area roughly straddles the syncline axis, which runs approximately across Section 36, from its northwest to southeast corners. The southwest flank of the syncline terminates along the Moab Fault system and its northwest extension, the Moab splay faults (Figure 3–3).

Age	Formation and Member	Thickness (ft)
Late Cretaceous	Mancos Shale, Blue Gate Shale Member	Up to 3,000 preserved at Crescent Junction Site
	Mancos Shale, Ferron Sandstone Member	60
	Mancos Shale, Tununk Shale Member	250–300
Early Cretaceous	Dakota Sandstone	50–100
	Cedar Mountain Formation	100–200
Jurassic	Morrison Formation, Brushy Basin Member	200–400
	Morrison Formation, Salt Wash Member	150–250
	Curtis Formation, Moab Member	80–110
	Entrada Sandstone, Slick Rock Member	200–300
	Carmel Formation, Dewey Bridge Member	100–200
	Navajo Sandstone	300–500
	Kayenta Formation	150–300
	Wingate Sandstone	200–300
Triassic	Chinle Formation	200–800
	Moenkopi Formation	Up to 1,500
Permian	Cutler Formation	Up to 1,500
Pennsylvanian	Honaker Trail Formation	Up to 2,000
	Paradox Formation	Up to 12,000

Figure 3–25. Generalized Stratigraphic Column for the Klondike Flats and Crescent Junction Alternative Disposal Sites

No faults are obvious in the Klondike Flats site area. A minor northeast-striking normal fault, inferred by Doelling (1997), extends northeast and ends in Section 35.

3.2.1.3 Geologic Resources

There are no known oil and gas resources in this area. Evaporite deposits, such as potash and rock salt, occur in the Paradox Formation in the Salt Valley salt-cored anticline about 8 miles northeast of the Klondike Flats site area. However, no commercially viable deposits are present at the site.

Some minor uranium and vanadium deposits are known to occur in this area at a depth of 1,500 to 3,000 ft; however, this depth makes further exploration of such deposits uneconomical. No sand and gravel deposits are present at the site.

3.2.1.4 Geologic Hazards

Montmorillonite, a clay that is characterized by its ability to swell and shrink, is found in the Mancos Shale that is exposed over most of the area (Mulvey 1992). Changes in water content cause the shrinking and swelling, which leads to subsidence and is known to be the cause of highway road damage because of heave of concrete slab structures present over the Mancos Shale. Wetting of the shale surface from rainstorms often causes unimproved roads to be impassable for several days. No hazard exists at the site for landslides, slumping, or rock falls because of the low slopes and homogeneity of the Mancos Shale bedrock.

Earthquake risk and seismic activity in this area are low. The site is in Uniform Building Code 1, indicating lowest potential for earthquake damage (Olig 1991). The nearest faults with Quaternary movement are about 1 to 1.5 miles to the west and southwest of the site and are associated with the Moab splay faults (Hecker 1993).

The site has a high radon-hazard potential for occurrence of indoor radon because of the naturally occurring geologic factors of uranium concentration, soil permeability, and ground water depth (Black 1993). The high rating stems from the relatively high concentration of naturally occurring uranium in Mancos Shale, the relatively high soil permeability caused by shrinking and swelling of the Mancos-derived soil, and the relatively deep depth to ground water (shallow water retards radon migration to the atmosphere).

3.2.2 Soils

The more widespread soil classification units at the site are the Chipeta Complex in upland areas and the Toddler, Ravola, Glenton families in alluvial fans, drainages, and floodplains.

The surface is covered with less than 18 inches of Chipeta silty clay loam or Chipeta Complex soils. These soils have low infiltration characteristics (0.06 to 0.2 inch per hour) and are highly erodible (SCS 1989). These strongly saline, strongly alkaline, relatively well-drained clayey soils are generally shallow; weathered shale is often within 5 to 20 inches of the surface. Slopes vary from 0 to 10 percent. Hydrocollapse and subsidence potential are low. Liquefaction potential is also low because no liquefiable materials or conditions are present.

Grouped together, the Ravola, Toddler, and Glenton soil families occur on the floodplains of the major drainages to the north and west of the marine shale slopes that dominate the landscape. Some of the drainages are deeply incised. Soils of all three families are very deep and well-drained. The soil families grade one into another across the landscape and vary primarily in the origin of the alluvium within which they formed.

Water erosion hazard is moderate; however, the soils are subject to gully formation and piping where runoff is concentrated. Toddler family soils formed in alluvium derived from a mixture of marine shale to the north and east and sandstone to the south and west and are moderately to strongly saline. Runoff is slow and the erosion hazard is moderate. The Glenton soils, formed in alluvium derived mainly from sandstone, are very deep, are well-drained, and exhibit fairly rapid permeability. Runoff is moderate to slow and erosion hazard is relatively low; however, deep gullies have formed in areas where runoff is concentrated.

Cryptobiotic soil crusts and associated pedestal soil are found within the Klondike Flats site area. The cryptobiotic soil crusts reduce soil loss and are evidence of light to moderate grazing. A rock veneer also occurs over much of the site. Lag layers of surface rock can form by winnowing, frost heaving, and movement of soil gases during and after rain. Large and small burrows are common on the site, possibly dug by kangaroo rats, ground squirrels, and badgers. Burrowing is evidence that soils are being churned and that the Klondike Flats site is an active habitat.

Table 3–23 identifies soil properties associated with the Chipeta Complex and Ravola, Toddler, and Glenton soil families.

3.2.3 Climate and Meteorology

The closest available weather statistics are from the National Weather Service Canyonlands Field Airport meteorological station, located 2 to 4 miles southeast of the site. Weather information is available for only a short period from June 1998 to January 2002. Mean annual temperature is 55.6 ºF; temperatures have ranged from –2 ºF in January to 107 ºF in August.

Average annual precipitation is 9.2 inches; frequency for precipitation events greater than 0.125 inch is less than 10 percent of the time. Most of the precipitation occurs during the southwest monsoon season, July to September. Most surface water flow in the Klondike Flats site area is from infrequent large thunderstorm events that occur in the late summer part of the monsoon season. The potential annual evaporation is 55 to 60 inches, which greatly exceeds annual precipitation (Robson and Banta 1995).

Average wind direction is from the north most of the time, as shown on Figure 3–26. Wind speed monitored at Canyonlands Field Airport indicated that 24 percent of the time the wind blows less than 1 mph, and 5 percent of the time the wind blows greater than 9 mph (Figure 3–27).

3.2.4 Ground Water

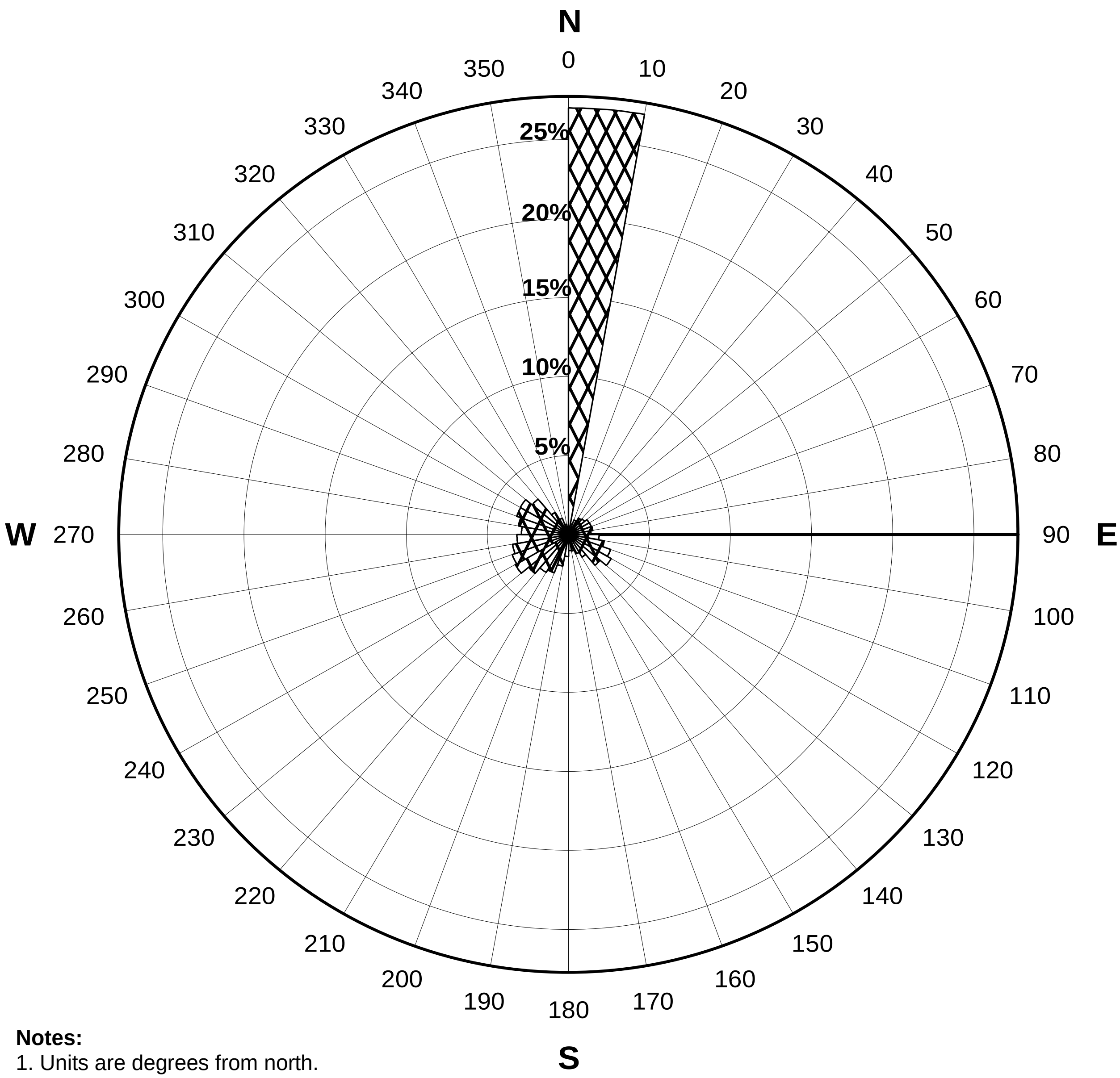
3.2.4.1 Hydrostratigraphy

Ground water in the Klondike Flats area occurs in several aquifers ranging from the Dakota Sandstone and Cedar Mountain Formation of Cretaceous age to the Navajo Sandstone of Jurassic age. Few data exist to evaluate ground water resources in the Courthouse syncline area; bedrock aquifers are largely untested, and only a few water wells are present in the area. The near-surface hydrostratigraphic unit (all geologic units younger than the Moenkopi Formation of Triassic age) includes aquifers consisting of sandstone and coarse unconsolidated units. This hydrostratigraphic unit is characterized by many perched zones and local systems with short flow paths. Local precipitation is the source of recharge, which occurs when winter snows melt and during the infrequent summer and early fall thundershowers (generally restricted to small areas).

Table 3–23. Soil Types and Properties at the Klondike Flats Site

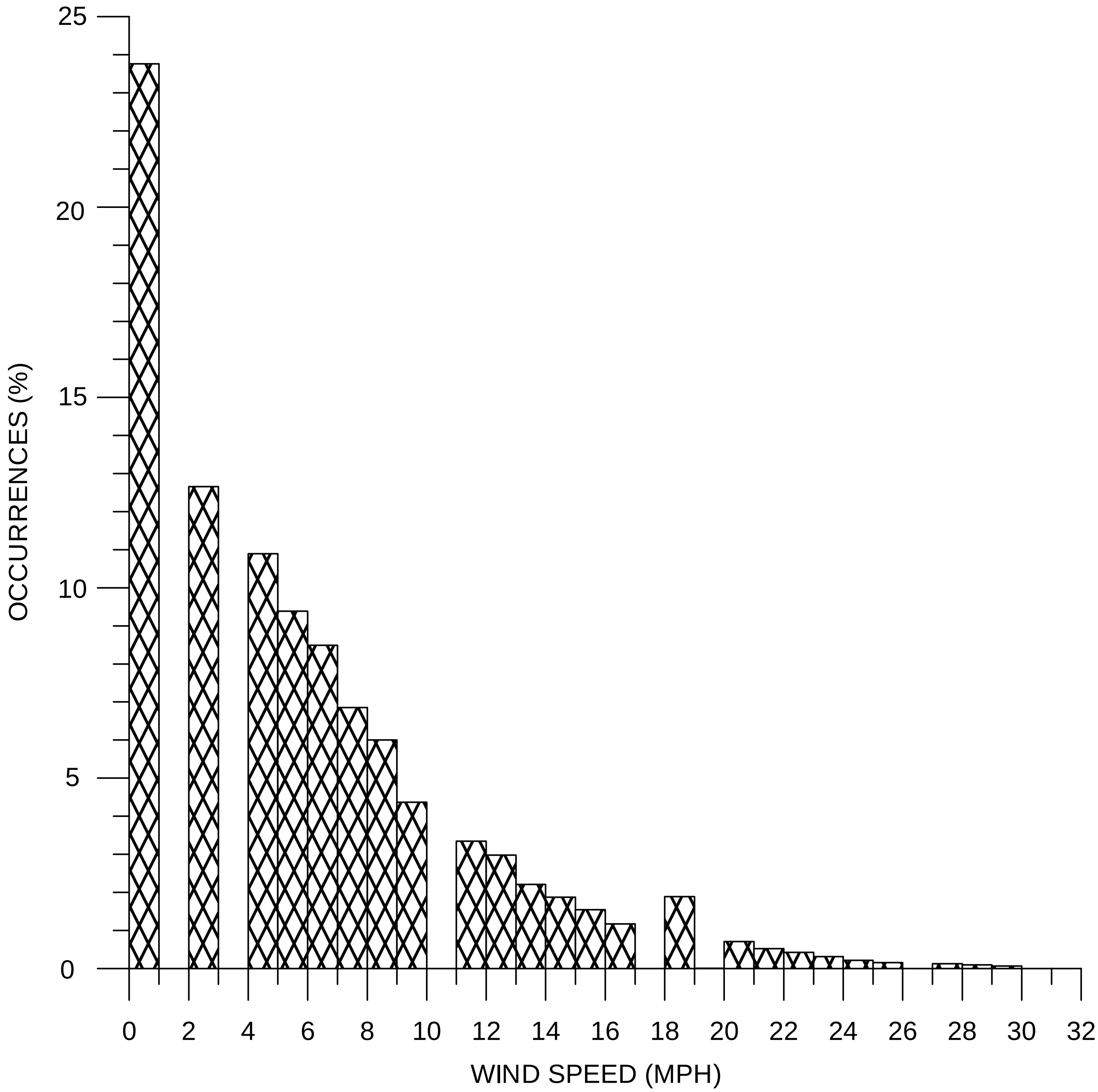
Soil Name	Taxonomy	Depth (inches)	pH	Salinity (mmho/cm)	Permeability (inches/hour)	Available Water (percent)	Textural Class	Clay (percent)	Erodibility Factors[a]
Chipeta	Clayey, mixed (calcareous), mesic, Typic Torriorthents	5–20	7.4–9.0	8–16	0.06–0.2	9–16	Clay to silty clay loam	30–45	K = 0.43 T = 1 Wind = 6
Ravola	Fine-silty, mixed (calcareous), mesic Typic Torrifluvents	> 60	7.9–9.0	4–16	0.2–6.0	10–18	Silt loam	15–35	K = 0.43 T = 5 Wind = 4
Toddler	Fine-silty, mixed (calcareous), mesic Typic Torrifluvents	> 60	7.9–9.0	2–8	0.6–2.0	10–18	Silt loam to fine sandy loam	18–35	K = 0.32 T = 5 Wind = 4
Glenton	Coarse-loamy, mixed (calcareous), mesic Typic Torrifluvents	> 60	7.9–8.4	< 8	2.0–6.0	8–18	Silt loam to fine sandy loam	5–18	K = 0.24 T = 5 Wind = 3
Nakai	Coarse-loamy, mixed, mesic Typic Calciorthids	40–>60	7.4–8.4	< 2	2.0–6.0	10–16	Fine sandy loam to loamy fine sand	10–18	K = 0.28 T = 3 Wind = 3

[a]Erodibility factors:
K, used in the Universal Soil Loss Equation, is an indicator of the susceptibility of a soil to sheet and rill erosion by water. Values range from 0.02 to 0.69; the higher the value, the more susceptible the soil is to sheet and rill erosion.
T is an estimate of the maximum average annual rate of water or wind erosion in tons per acre per year.
Wind erosion factors range from 1 to 8; the lower the value, the more susceptible the soil is to wind erosion.
mmho/cm = millimhos per centimeter.
Source: SCS 1989.



Notes:
1. Units are degrees from north.
2. Average hourly data 6/25/1998 – 1/10/2002 (wind blowing <u>from</u> direction shown) (Ref. National Weather Service, Canyonlands Field Airport Meteorological Station).
3. Percent shown indicates frequency of occurrence.

Figure 3–26. Prevailing Wind Direction at Klondike Flats Site



Note:
Average hourly data 6/25/1998 – 5/07/2001
(Ref. National Weather Service, Canyonlands
Field Airport Meteorological Station).

Figure 3–27. Wind Speed at Klondike Flats Site

Water percolates downward through fractures and weathered rock into the sandstone units. Water generally moves a short distance through the aquifer and is then lost through intermittently flowing springs and seeps. Discharge rates are low; many springs and seeps flow during the spring and are dry during other seasons.

3.2.4.2 Ground Water Occurrence

In 1994, Grand County Solid Waste Management drilled a well (Landfill No. 1) to a depth of 500 ft through the Ferron Sandstone Member and into the base of the Mancos Shale near the county landfill north-northwest of the site (Figure 3–28). The hole was dry and was abandoned. The Ferron Sandstone Member consists of a relatively thin set of resistant sandstone beds approximately 250 to 300 ft above the base of the Mancos Shale and is not a water-bearing unit. During earlier minerals exploration drilling, most or all of the Mancos Shale drilled was dry. It was concluded that the Mancos Shale does not yield ground water and that it forms an aquitard that inhibits ground water migration to deeper stratigraphic units (Blanchard 1990).

Limited data are available to assess ground water quality in the Dakota Sandstone or Cedar Mountain Formations at the site. Three wells have been drilled in which ground water was present at depths between 400 and 500 ft. Ground water may be present in these formations, but additional investigation would be necessary to determine if the quantities and yield are significant.

Ground water is present in the Brushy Basin and Salt Wash Members of the Morrison Formation at depths from 600 to 2,500 ft (Blanchard 1990). The Brushy Basin Member is composed largely of bentonitic shale that has a tendency to seal itself if it becomes fractured. This unit acts mainly as an aquitard. The Salt Wash Member forms an aquifer that is composed of lenticular fluvial sandstone deposits interbedded with siltstone and shale. The Salt Wash Member is not recognized as a regional aquifer and probably has limited production compared to eolian sandstone units below it.

The Moab Member of the Curtis Formation and the Slick Rock Member of the Entrada Sandstone are sandstone beds in the site area that have a high potential for containing usable ground water. However, no local well data are available to determine the water resource potential of the Curtis or Entrada Formations in the Klondike Flats site area.

The Navajo Sandstone, approximately 1,500 to 2,000 ft beneath the land surface, is the first significant water-producing aquifer in the area beneath the proposed site and is a major ground water resource throughout the region. Specific capacities of two water-supply wells at the entrance to Arches National Park, completed in the Navajo Sandstone, were 1.7 and 14.5 gpm per foot (Blanchard 1990).

3.2.4.3 Ground Water Quality

Ground water quality from potential aquifers in the Dakota Sandstone and Cedar Mountain Formation beneath the Klondike Flats site has not been determined. Ground water collected from a flowing well south of Cisco and from a spring east of the Klondike Flats area had TDS concentrations of 1,470 and 1,020 mg/L, respectively (Blanchard 1990). This would be classified as drinking water under the Utah Ground Water Quality Protection Regulations (UAC 2003a).

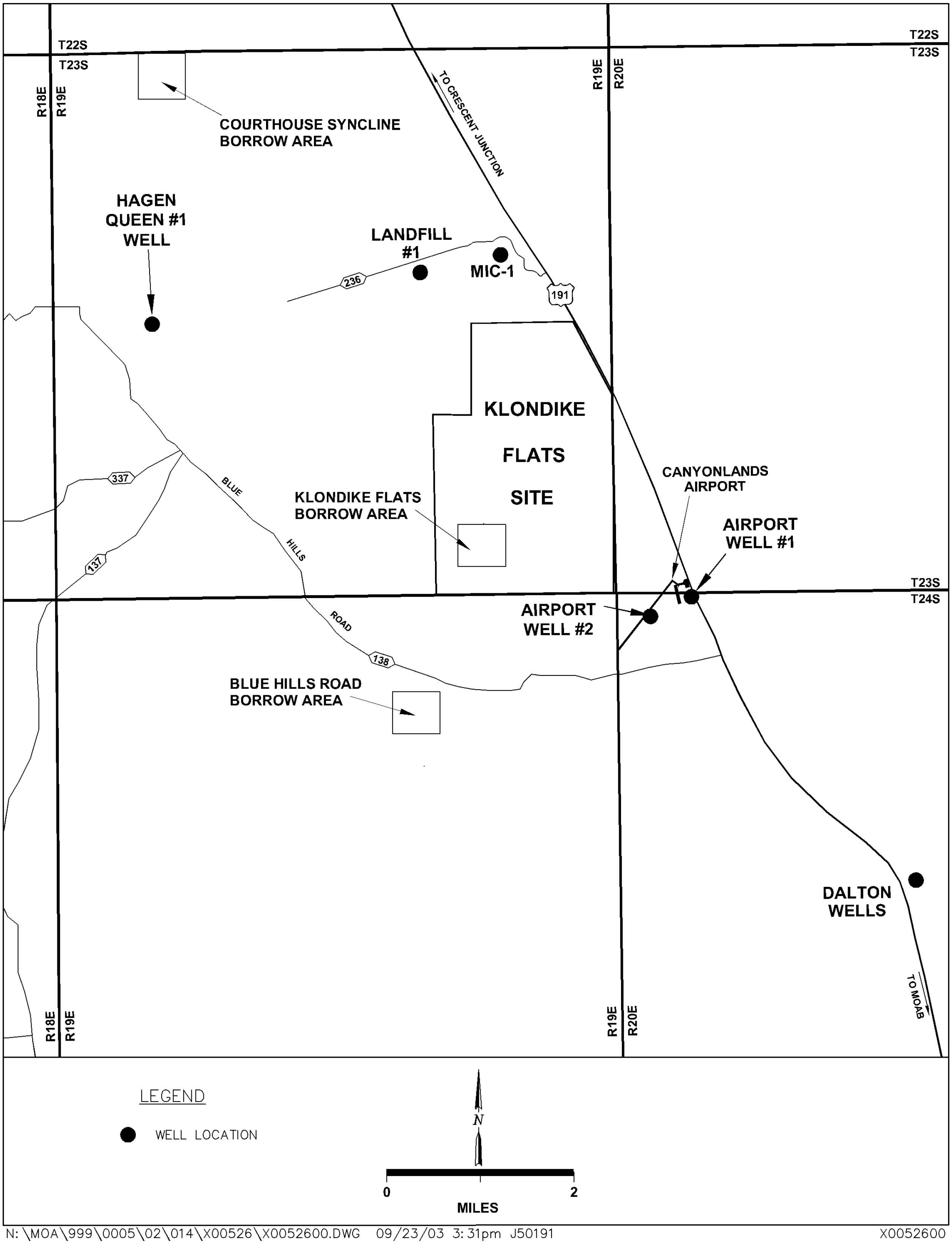


Figure 3–28. Location of Domestic Wells in the Klondike Flats Area

Ground water in the Salt Wash and Brushy Basin Members of the Morrison Formation has highly variable TDS concentrations ranging from 1,020 to 25,700 mg/L (Blanchard 1990). No data are available to evaluate local ground water quality in the Salt Wash Member.

Ground water in the Entrada Sandstone is generally good quality, with TDS concentrations typically less than 220 mg/L (Doelling and Morgan 2000). Ground water sampled from an Entrada Sandstone well approximately 1 mile south of the Klondike Flats area has a TDS concentration of 300 mg/L (Blanchard 1990). The Entrada Sandstone contains much higher concentrations of TDS in the deep subsurface. TDS concentrations in nine deep wells (depths of 900 to 5,300 ft) in the Entrada Sandstone north of I-70 between Crescent Junction and Cisco range from 9,470 to 104,000 mg/L (Blanchard 1990). One of these wells is approximately 5 miles north of the Klondike Flats area and contains a TDS concentration of 10,300 mg/L at 1,750 ft.

Ground water quality in the Navajo Sandstone is generally good; concentrations of TDS average less than 220 mg/L (Blanchard 1990). The water type is calcium bicarbonate or calcium magnesium bicarbonate, and the water is moderately hard to hard.

3.2.4.4 Ground Water Use

The Navajo Sandstone is the most important source of drinking water in Moab Valley, about 20 miles southeast of the Klondike Flats area (Eisinger and Lowe 1999). Wells in the Navajo Sandstone produce more than 1,000 gpm of high-quality water for the city of Moab water supply (Sumsion 1971). Numerous springs flow from the Navajo Sandstone where it is exposed about 5 miles south of the site. Flow from these springs is less than 10 gpm but is sufficient to provide water for a few cattle (Doelling and Morgan 2000).

The Hagen No. 1 Tenmile Wash (also known as Queen) well, approximately 4 miles west of the site, was drilled to 920 ft. Fresh water is present in white sandstone at a depth of 425 ft, and the well was converted to a water well (McKnight 1940; Doelling 1997). Salty water issued from another aquifer at a depth of 600 ft. The specific water-bearing units were not identified (McKnight 1940), but the depths and the location on the geologic map by Doelling (1997) indicate that the water is likely from the Dakota Sandstone and Cedar Mountain Formation.

Ground water use from two wells approximately 1 mile southeast and 1 mile north of the site reportedly completed in the Dakota Sandstone or Cedar Mountain Formation (Airport Well No. 2 and MIC-1, respectively) has not been confirmed and is under investigation.

Four water wells were drilled on state sections in the vicinity of Dalton Wells (approximately 4 miles southeast of the airport) (Utah Division of Water Rights 2004). No information is provided in the files, but a preliminary field check indicates that these wells are providing water for crop irrigation. The size of drilling equipment observed on the site in March 2002 suggests that the likely target would be the Navajo Sandstone. Figure 3–28 provides the locations of domestic wells in the Klondike Flats area.

3.2.5 Surface Water

3.2.5.1 Surface Water Resources

The Klondike Flats site is located near a surface water divide between the Colorado and Green Rivers. Tenmile Wash flows southwestward from Klondike Flats to the Green River. Another unnamed wash drains southeastward from the site toward Canyonlands Field Airport, and it eventually joins Bartlett and Klondike Washes, which discharge to Courthouse Wash and the Colorado River. Headwaters emanating from the Klondike Flats site area drain small areas. All of these washes are ephemeral, are dry much of the year, and are ungaged. Extreme floodwater surface elevations or the effects of these storm events are unknown.

3.2.5.2 Surface Water Quality

Water bodies in the Klondike Flats site area consist primarily of ephemeral washes that are dry most of the year. Flow occurs in these washes primarily after significant storm events. No information is available on water quality during these events; however, it is expected that the water would be heavily loaded with sediment from surface water collection coming off Mancos Shale. Soils associated with Mancos Shale are alkaline and may have high concentrations of selenium. It would be expected that the water quality of flows through these washes would be characterized as saline, very turbid, having considerable hardness, and having elevated levels of sulfate and selenium. Surface water use is limited to a few stock-watering dams.

3.2.5.3 Water Quality Standards

All ephemeral water bodies in the Klondike Flats site area eventually flow into either the Green River or the Colorado River; therefore, they are subject to the classifications specified in Utah Administrative Code R317-2-13 for the affected segments of both the Green and the Colorado Rivers and their tributaries (see Chapter 7.0).

3.2.6 Floodplains

No perennial rivers or streams and no floodplains are present at the Klondike Flats site. The site contains numerous ephemeral washes where surface flooding occurs, but these areas are not floodplains.

3.2.7 Wetlands

No wetlands are known to exist at the site, but because riparian vegetation is present in places, the area would be investigated for any small, isolated wetlands prior to construction. Appendix F includes a more detailed description of floodplains and wetlands at the Klondike Flats site.

3.2.8 Terrestrial Ecology

This section discusses the existing vegetation and wildlife, including threatened and endangered species and sensitive species, at the Klondike Flats site. The Klondike Flats site is within an area designated by the BLM as moderate to heavy use. The presence of human-related features, such as Canyonlands Field Airport to the south and the Grand County landfill to the northwest, may serve as limiting factors in the density and diversity of wildlife species present, such as larger mammals with large home ranges. The presence of human activity (primarily recreation) in this area further limits wildlife diversity and densities.

3.2.8.1 Terrestrial Vegetation and Wildlife

The vegetation on Chipeta soil (see Section 3.2.2) within the Klondike Flats site area is close to the potential natural vegetation as described in the Grand County Soil Survey (SCS 1989). In upland areas, vegetation is dominated by low saltbushes (mat and Gardner saltbush [*Atriplex corrugata* and *Atriplex gardneri*]) with scattered plants of bud sagebrush (*Picrothamnus desertorum*), galleta, Indian ricegrass, and desert trumpet (*Eriogonum inflatum*). Prickly pear cactus, a grazing increaser in upland areas, is a potential indicator of past overgrazing. A few hedgehog cacti (*Echinocereus* spp.) were also observed in upland areas. At the confluence of drainages where greater amounts of moisture occur seasonally, vegetation consists of abundant rubber rabbitbrush with a relatively dense understory of galleta. This is evidence that a slight increase in moisture can significantly increase plant abundance.

Plant abundance and diversity are very low, even for arid rangeland, because the low-permeability soils promote rapid runoff, have low available water capacity, and are often highly saline. Rooting depths vary from 5 to 20 inches. The plant community consists primarily of low shrubs, which includes mat saltbush and Gardner saltbush with occasional shadscale and bud sagebrush. A desert shadscale/saltbush community dominates habitat in this area. The existing low-growing vegetative cover is limited and sparse (about 50 percent cover), which reflects the low rainfall characteristic of the desert ecosystem and possibly overgrazing by cattle. Vegetation growing on Chipeta Complex soils has limited value for grazing because of the low productivity and poor palatability of dominant species.

Table 3–24 provides vegetation characteristics associated with soil types in the proposed Klondike Flats site area. Russian thistle, rabbitbrush, prickly pear cactus, and snakeweed are known to occur in the area. As shown in Table 3–24, the potential vegetation of the Ravola-Toddler-Glenton soils may consist of greater than 50 percent grasses that are palatable to livestock, such as Indian ricegrass and galleta, and these soils, therefore, have a somewhat higher value for grazing than Chipeta soils on nearby marine shale hills. The ephemeral washes support greasewood and tamarisk and also provide valuable cover for wildlife (BLM 1995).

Wildlife population diversity and densities are limited by sparse vegetation and poor habitat. This area is also likely to support fewer and less diverse wildlife populations than the Moab site because of the lack of water. However, large mammals adapted to a desert environment, such as the pronghorn antelope (*Antilocapra americana*), may inhabit the area to the north of the Klondike Flats site area. Smaller wildlife populations adapted to a desert environment, including mammal, bird, and reptile populations, are also present. Upland areas have poor forage and cover for wildlife. Nearby pockets of black greasewood provide cover for some birds and smaller mammals such as white-tailed prairie dog and black-tailed jackrabbit.

No critical winter or summer range has been identified for wildlife for the Klondike Flats site area.

3.2.8.2 Threatened and Endangered Species

This section describes federally listed terrestrial threatened and endangered, proposed, or candidate species that are or may be present in the Klondike Flats site area. In March 2003, DOE requested an updated list of such species from USF&WS that may be present or affected by DOE's proposed alternatives. USF&WS responded in April 2003 with a list for Grand County. Table 3–25 lists a subset of those species that may occur in the vicinity of the Klondike Flats site.

Table 3–24. Characteristics of Potential Vegetation on the Various Soil Types at the Klondike Flats Site

Soil Name	Range Site	Characteristic Potential Vegetation[a]	Percent	Productivity (pounds/acre)	Rooting Depth (inches)
Chipeta	Desert clay and desert shallow clay	Mat saltbush *(Atriplex corrugata)*	45	100–375	5–20
		Gardner saltbush *(Atriplex gardneri)*	25		
		Bud sagebrush *(Picrothamnus desertorum)*	5		
		Galleta *(Pleuraphis jamesii)*	10		
		Indian ricegrass *(Achnatherum hymenoides)*	5		
		Bottlebrush squirreltail *(Elymus elymoides)*	5		
		Desert trumpet *(Eriogonum inflatum)*	5		
Ravola	Alkali flat	Black greasewood *(Sarcobatus vermiculatus)*	30	500–1,000	>60
		Shadscale *(Atriplex confertifolia)*	10		
		Bottlebrush squirreltail *(Elymus elymoides)*	10		
		Alkali sacaton *(Sporobolus airoides)*	10		
		Galleta *(Pleuraphis jamesii)*	5		
		Indian ricegrass *(Achnatherum hymenoides)*	5		
		Seepweed *(Suaeda* spp.*)*	5		
Toddler	Alkali fan	Gardner saltbush *(Atriplex gardneri)*	20	200–500	>60
		Bud sagebrush *(Picrothamnus desertorum)*	5		
		Winterfat *(Ceratoides arborescens)*	5		
		Galleta *(Pleuraphis jamesii)*	20		
		Indian ricegrass *(Achnatherum hymenoides)*	15		
		Globemallow *(Sphaeralcea* spp.*)*	5		
Glenton	Alkali fan	Gardner saltbush *(Atriplex gardneri)*	20	200–500	>60
		Bud sagebrush *(Picrothamnus desertorum)*	5		
		Winterfat *(Ceratoides arborescens)*	5		
		Galleta *(Pleuraphis jamesii)*	20		
		Indian ricegrass *(Achnatherum hymenoides)*	15		
		Globemallow *(Sphaeralcea* spp.*)*	5		

[a]Source: NRCS 2002; SCS 1989.

Table 3–25. Federally Listed Threatened and Endangered Species Potentially Occurring in the Vicinity of the Klondike Flats Site

Common Name	Scientific Name	Habitat Present and Affected	Species Present	Status	Comments
Jones' cycladenia	*Cycladenia humilis* var. *jonesii*	Possible	Possible	Threatened	
Black-footed ferret	*Mustela nigripes*	No	No	Endangered	
California condor	*Gymnogyps californianus*	No	No	Endangered	
Mexican spotted owl	*Strix occidentalis lucida*	Possible	Possible	Threatened	
Bald eagle	*Haliaeetus leucocephalus*	Possible	Possible	Threatened	Proposed for Delisting

Spatial data for the species listed in Table 3–25 were obtained from the Utah Conservation Data Center (UCDC). This data set was compiled by the Utah Natural Heritage Program (UNHP) of UDWR, in which species occurrences are depicted as points at a scale of 1:24,000 on 7.5-minute topographic quad maps. Spatial data depicting the Klondike Flats site were overlaid on the species of concern spatial data to evaluate known species occurrences in the area.

The status of each of these species in the vicinity of the Klondike Flats site is briefly discussed below. Appendix A1, "Biological Assessment," provides more detailed information concerning these federally listed species that may be in the vicinity of the Klondike Flats site or could be affected by activities at the site.

There is a cluster of known populations of Jones' cycladenia on BLM land in Grand County approximately 11 to 17 miles northeast of Moab (UDWR 2003b). However, there are no known occurrences of the species on the Klondike Flats site.

UDWR (2003b) reported an unconfirmed ferret sighting in the vicinity of the Klondike Flats site in 1989. All black-footed ferrets currently in the wild are believed to be the result of a federal reintroduction program. It is highly unlikely that the black-footed ferrets reintroduced in Uinta and Duchesne Counties in 1999 or their offspring could occur on or in the vicinity of the Klondike Flats site.

Surveys for white-tailed prairie dogs (currently in review for federal listing) have been conducted at the Klondike Flats site (BLM 1995). At that time, it was determined that all the colonies were relatively small and isolated, such that they would not support black-footed ferrets.

A UDOT environmental study (UDOT 2002b) included the California condor as potentially occurring in the Klondike Flats area in sparsely inhabited mountain ranges, mesas, and open rangeland. However, based on habitat needs, it is unlikely that this species exists in the vicinity of the site.

Data provided by UDWR (2003a) indicated that there were no occurrences of the Mexican spotted owl in any of the project areas. However, habitat models (BLM 2003b) indicate that potential habitat areas may exist in the canyons near US-191 over the first 7 miles north from the Moab tailings pile. Nonetheless, these models are primarily based on physical and topographic features and do not consider vegetation requirements. Mexican spotted owls nest, roost, and forage in an array of different community types, but mixed-conifer forests dominated by Douglas fir and/or white fir are most common (USF&WS 2001). However, they may also nest, but less frequently so, in arid, rocky, mostly unvegetated canyons (Romin 2004). Although there are no forested areas in the vicinity of US-191 north of Moab, there are arid canyons that largely or altogether lack forest-type vegetation. Thus, it is unlikely but possible that spotted owls occur in the canyons near US-191 over the first 7 miles north of the Moab site. It is, thus, even more unlikely that spotted owls occur at the Klondike Flats site.

The Utah Gap Analysis (UDWR 1999) indicates that potential high-quality bald eagle wintering habitat exists throughout many of the project areas. However, it is not known to nest or night roost nor is it known to have been observed in the vicinity of the Klondike Flats site.

There is no designated or proposed critical habitat for any of the above federally protected species in the vicinity of the Klondike Flats site.

DOE, in consultation with USF&WS and BLM, would determine the need for additional habitat evaluations and surveys for species that may be affected by the proposed action should this alternative be selected.

3.2.8.3 Other Special Status Species

Special status species are those that are protected under federal and state regulations other than the ESA, which include the MBTA, Executive Order 13186, and Birds of Conservation Concern (USF&WS 2002f). The State of Utah maintains a list of species that it considers threatened, endangered, or otherwise of concern; other federal agencies such as BLM and USFS also maintain lists of species considered to be sensitive. UDWR notified DOE of species that should be considered under this EIS (UDWR 2003b). Although the special status species are not covered by the ESA and are therefore not subject to Section 7 consultation, USF&WS encourages protection of these species.

Table 3–26 lists sensitive plant species that may occur in the site region and are considered by state and federal resource management agencies to be of concern. A number of species listed by the State of Utah or considered sensitive by BLM are potentially present in the vicinity of the Klondike Flats site.

Table 3–27 includes animal species listed by the state to be of concern and may be present in the project region. The list includes all species identified by UDWR as potentially occurring in Grand County; in some cases, the known populations or suitable habitat are not close to the Klondike Flats site. Some species have been eliminated from the site list because of site-specific habitat.

Table 3–28 lists sensitive bird species, including birds protected under the MBTA, that may occur in the vicinity of the site, although current on-site habitat may limit typical nesting and breeding activities. Most of these species are protected under the MBTA, which prohibits take or destruction of birds, nests, or eggs of listed migratory birds.

Birds of primary concern are the burrowing owl (*Athene cunicularia*), Swainson's hawk, ferruginous hawk, and peregrine falcon. Although these species are not federally listed species, they are included on the state list and are also protected under the MBTA. Because of previous sightings, it can be assumed that the peregrine falcon and ferruginous hawk may be present.

Table 3–26. Sensitive Plant Species Potentially Occurring in the Klondike Flats Site Area

Common Name	Scientific Name	Habitat Present and Affected	Federal Status	State Status
Clay verbena	*Abronia argillosa*	Possible	None	Watch
Cutler's milkweed	*Asclepias cutleri*	Possible	None	Rare
Fisher Towers milkvetch	*Astragalus piscator*	Possible	None	Rare
Cisco milkvetch	*Astragalus sabulosus*	Possible	BLM	Rare
Ben's buckbrush	*Ceanothus greggii*	Possible	None	Rare
Ruin Park winterfat	*Ceratoides lanata var. ruinina*	Possible	None	Rare
Tall cryptantha	*Cryptantha elata*	Possible	None	Rare
La Sal Mt daisy	*Erigeron mancus*	No	FS	Rare
Canyonlands desert parsley	*Lomatium latilobum*	No	BLM	Rare
Entrada skeletonweed	*Lygodesmia grandiflora* var. *entrada*	Possible	BLM	Rare
Shultz's blazing star	*Mentzelia shultziorum*	Possible	BLM	Rare
Paradox breadroot	*Pediomelum aromaticum* var. *aromaticum*	Possible	None	Rare
La Sal Mt beardtongue	*Penstemon crandallii* var. *atratus*	No	BLM	Watch
Jones indigo-bush	*Psorothamnus polydenius*	Possible	BLM	Rare
La Sal Mts butterweed	*Senecio fremontii* var. *inexpectatus*	No	BLM	Rare
Jane's globemallow	*Spharalcea leptophylla* var. *janeae*	Possible	BLM	Rare
San Rafael globemallow	*Spharalcea psoraloides*	Possible	BLM	Rare
Canyonlands woody aster	*Xylorhiza glabriuscula*	Possible	None	Rare

Habitat Present and Affects: Possible—habitat for the species is present in the vicinity of the site, transportation routes, or borrow areas; No—species is listed for this county, but habitat is not close to the site.
Federal Status: BLM—plants on the interim sensitive list adopted by the BLM Utah State Office. FS—U.S. Forest Service sensitive.
State Status: Watch—plants regionally endemic but without rangewide viability concern; Rare—plants with known or suspected rangewide viability concern.

Table 3–27. State-Listed Animal Species That May Occur in the Vicinity of the Klondike Flats Site

Common Name	Scientific Name	Habitat Present and Affected	State Status			Species Present	Actions/Comments
			E	T	SC		
Mammals							
Allen's big-eared bat	*Idionycteris phyllotis*	Unknown			x	Unknown	
Big free-tailed bat	*Nyctinomops macrotis*	Unknown			x	Unknown	
Spotted bat	*Euderma maculatum*	Unknown			x	Unknown	
Townsend's big-eared bat	*Corynorhinus townsendii*	Unknown			x	Unknown	
Kit fox	*Vulpes macrotis*	Unknown			x	Unknown	
Dwarf shrew	*Sorex Nanus*	No			x	No	
Birds							
Peregrine falcon	*Falco peregrinus*	Yes	x			Yes	Federally delisted
Ferruginous hawk	*Buteo regalis*	Possible		x		Yes	
Common yellowthroat	*Geothlypis trichas*	Unknown			x	Unknown	
Burrowing owl	*Athene Cunicularia*	Possible			x	Possible	
Swainson's hawk	*Buteo swainsoni*	Possible			x	Likely	
Greater sage grouse	*Centrocercus urophasianus*	No			x	No	
Blue grosbeak	*Guiraca caerulea*	Unknown			x	Unknown	
Northern goshawk	*Accipiter gentiles*	Unknown			x	Unknown	
Amphibians and Reptiles							
cornsnake	*Elaphe guttata*	Yes			X	Unknown	
milksnake	*Lampropeltis traingulum*	Possible			X	Unknown	
Plateau striped whiptail	*Cnemidophorus (Aspidoscelis) velox*	Unknown			X	Unknown	
Smith's black-headed snake	*Tantilla hobartsmithii*	Unknown			X	Unknown	

Status: E—Endangered, T—Threatened, SC—State concern.

Table 3–28. Sensitive Bird Species Protected Under the Fish and Wildlife Conservation Act and Migratory Bird Treaty Act That May Occur Near the Klondike Flats Site

Species	Potential To Occur in Project Area
Order Falconiformes—Birds of prey	
Golden eagle *(Aquila chrysaetos)*	High
Northern harrier *(Circus cyaneous)*	Moderate
Prairie falcon *(Falco mexicanus)*	Moderate
Red-tailed hawk (*Buteo jamaicensis*)	High
Turkey vulture (*Cathartes aura)*	High
Order Gruiformes—Marsh and open country birds	
Black rail *(Laterallus jamaicensis)*	Moderate
Yellow rail *(Coturnicops noveboracensis)*	Low
Order Strigiformes—Nocturnal birds of prey	
Barn owl *(Tyto alba)*	Low
Flammulated owl *(Otus flammeolus)*	Low
Short-eared owl *(Asio flammeus)*	Low
Order Apodiformes—Small swallowlike birds	
Black swift *(Cypseloides niger)*	Low
Vaux's swift *(Chaetura vauxi)*	Low
Order Passeriformes—Perching birds	
Olive-sided flycatcher *(Contopus borealis)*	Low
Gray flycatcher *(Empidonax wrightii)*	Moderate
Pinyon jay *(Gymnorhinus cyaneocephalus)*	Low
Bendire's thrasher *(Toxostoma bendirei)*	High
Crissal thrasher *(Toxostoma dorsale)*	High
Bewick's wren *(Thryomanes bewickii)*	Moderate
Sedge wren *(Cistothorus platensis)*	Low
Verry *(Catharus fuscenscens)*	Moderate
Sprague's pipit *(Anthus spragueii)*	Low
Loggerhead shrike *(Lanius ludovicianus)*	Moderate
Gray vireo *(Vireo vicinior)*	Moderate
Virginia's warbler *(Vermivora virginiae)*	Moderate
Black-throated warbler *(Dendroica nigrescens)*	Low
Grace's warbler *(Dendroica graciae)*	Low
Blackpoll warbler *(Dendroica striata)*	Low
Dickcissell *(Spiza americana)*	Low
Sage sparrow *(Amphispiza belli)*	Low
Cassin's sparrow *(Aimophila cassinii)*	Low
Brewer's sparrow (*Spizella breweri)*	Moderate
Lark bunting *(Calamospiza melanocorys)*	High
Baird's sparrow *(Ammodramus bairdii)*	Low
Grasshopper sparrow *(Ammodramus savannarum)*	Low
McCown's longspur *(Calcarius mccownii)*	Low
Chestnut-collared longspur *(Calcarius ornatus)*	Low

Note: Birds listed in the table are protected under the Fish and Wildlife Conservation Act (Birds of Conservation Concern [2000] [USF&WS 2002f] and the MBTA [50 CFR 10], Executive Order 13186). Species listed as threatened or endangered under the ESA or considered endangered, threatened, or rare by the State of Utah are not included here.

Burrowing owl habitat may exist in the vicinity of white-tailed prairie dog colonies. Although burrowing owls have not been documented as occurring in the vicinity of the Klondike Flats site, prairie dog burrows may provide suitable habitat for nesting.

3.2.9 Land Use

The Klondike Flats site area is located in Grand County, Utah, on land administered by BLM. The area under consideration is approximately 18 miles northwest of the city of Moab and west of US-191 and the Union Pacific Railroad. Arches National Park is approximately 3.5 miles east of US-191 (see Figure 3–18).

The general area is undeveloped land administered by BLM. A portion of the site area under consideration is designated for disposal in BLM's resource management plan (BLM 1983). The Grand County landfill is located adjacent to the area identified for disposal. BLM has stated that it would pursue necessary real estate actions to have adjacent areas available for a disposal site.

The nearest commercial property is the Canyonlands Field Airport, which is immediately southeast of the Klondike Flats site area. Four employees live at the airfield year-round, and up to seven employees live at the airport during peak season (Albrecht 2003). There are no other nearby residents. Access to the Grand County landfill is approximately 1 mile north of the Klondike Flats site area and 1 mile west of US-191 on CR-236. Crescent Junction and the I-70 interchange are approximately 10 miles north along US-191.

The area surrounding and including the Klondike Flats site is available for recreation and other uses; existing roadways limit access. However, several dirt roads are used for recreational access. Favorable weather allows recreational access for hikers, campers, mountain bikers, and off-highway vehicles during most of the year. Most of the recreational activities occur south and west of the Klondike Flats site along CR-138, also known as the Blue Hills Road. This road provides access to desirable areas to the west that are used mainly for mountain biking and all-terrain vehicles. Although the amount of recreational use west of the site is unknown, it is possible that as many as 53,000 recreational use visits occurred in 2002. This estimate is based on vehicle counts on Blue Hills Road. An off-highway vehicle play area is located southwest of Canyonlands Field Airport. The track was established in the 1970s and fell into disuse; however, in recent years it has had renewed interest and use because of the popularity of all-terrain vehicles and motorcycles. An estimated 1,000 user-days per year occur at this track. Peak use occurs during the spring and fall.

In addition to recreation, BLM allows grazing, oil and gas leasing, and mining claims. The Klondike Flats site area is part of the Big Flat grazing allotment, which is currently under a grazing permit until 2013. There are no mineral, oil, or gas leases in effect for the potential site, and BLM has closed this area to any new leases.

Two sections of land to the south and southeast of the site are administered by the State of Utah SITLA. SITLA administers sections of land throughout the state with the express mandate of maximizing the value of the holdings for use by the state's educational institutions. SITLA contains provisions for easements or rights-of-way crossings.

3.2.10 Cultural Resources

The cultural history of the Klondike Flats site is included in the more general cultural history of southeastern Utah described in Section 3.1.13.1; the Class I cultural resource inventory that was conducted for this site is described in Section 3.1.13.2.

Results of the Class I inventory indicate that Class III cultural resource surveys have not been conducted on most of the Klondike Flats site. Two sites have been recorded within the boundaries of the site, but neither has been recommended as eligible for inclusion in the National Register of Historic Places. Both are located on the site margin adjacent to US-191, where numerous linear surveys have been conducted. An additional seven sites have been recorded immediately adjacent to the eastern boundary of the site, again, where linear surveys associated with projects that parallel US-191 have been conducted.

The potential for cultural resources to occur in unsurveyed portions of the site is high on the basis of soil types and adjacent surveys. Cultural site densities of 22.4 to 27.4 sites per square mile are predicted for the soil types and landforms found on the site (Berry 2003). Class III cultural resource surveys from areas approximately 1 to 10 miles to the west and southwest of the site indicate densities of 20 or more cultural sites per square mile in some instances. The surveys indicate the presence of Paleoindian, Archaic, Formative (represented by Anasazi), and historic sites (Berry 2003).

No data exist concerning the presence of potential traditional cultural properties on the Klondike Flats site. On the basis of Class I cultural resource inventory results, tribal interviews, and published and unpublished literature, the likelihood of their occurrence and their estimated density on the site are low (on a scale of low-medium-high-extremely high) for traditional cultural properties associated with the Ute Mountain Ute Tribe, White Mesa Ute Tribe, Southern Ute Tribe, and Navajo Nation. The likelihood of occurrence and their estimated density on the site are medium for traditional cultural properties associated with the Uintah-Ouray Ute Tribe and Hopi Tribe (Fritz 2004).

3.2.11 Noise and Vibration

The Klondike Flats site is located in a quiet desert environment where natural phenomena such as wind, rain, and wildlife account for most natural background noise. The acoustic environment in open desert in Utah is typical of other desert environments where average L_{dn} range from 22 dB on calm days to 38 dB on windy days (Brattstrom and Bondello 1983). Sources of man-made background noise may include automobile traffic on US-191 (about 1 mile away), trains on the Union Pacific Railroad, aircraft flying overhead, a landfill located near the site, and outdoor recreational activity.

Neither background noise nor ground vibration data are available for the Klondike Flats site. Estimated average background noise for the site from natural and man-made sources is about 45 dBA, but could exceed 55 dBA within 1,300 ft of US-191. No residences are in the immediate surrounding areas, and the land is used for outdoor recreation.

3.2.12 Visual Resources

The Klondike Flats site is remotely located on the back slopes of the bluffs that border the western side of US-191. It is characterized by gently rolling, buff-colored hills that are dotted with prickly pear cactus and low-growing shrubs (Figure 3–29). From a distance, the horizontal and diagonal lines of the landscape features are smooth and unbroken except for an occasional drainage. From most viewing locations on the site, the background scenery is composed of red-rock cliffs and sandstone mesas. Most of the site is not visible to travelers on Blue Hills Road or US-191 because it is shielded by the steep bluff side slopes that parallel both of these roads.

Figure 3–29. View Northeast of the Klondike Flats Site

Although no roads or trails currently cross the Klondike Flats site, it may be viewed occasionally by off-road recreationists who stray from existing roads and trails. BLM (2003b) classifies visual resources in this area as Class III (see Section 3.1.15 for an explanation of visual resource classes).

3.2.13 Infrastructure

With few exceptions, the infrastructure that currently supports the Moab site (see Section 3.1.16) is the same for the Klondike Flats site area. Nonpotable water is obtained from the Moab site at the river water pump station and transported to the Klondike Flats site. Potable water is obtained from the city of Moab and transported to the Klondike Flats site. A Utah Power three-phase overhead distribution line runs along US-191, approximately 3 miles from the disposal cell area.

3.2.14 Transportation

Section 3.1.17 provides details related to area federal, state, and county road use. Table 3–15 in Section 3.1.17 provides AADT, level of congestion, truck percent, and accident rates for US-191 from Moab to Crescent Junction. Table 3–16 in Section 3.1.17 provides monthly traffic at the junction of SR-279 and US-191. Figure 3–21 illustrates area access possibilities.

AADT on US-191 in the Klondike Flats area is low and contains high percentages (30 percent) of truck traffic. Of the AADT of 2,855 vehicles, an estimated 856 vehicles would be trucks. Between Blue Hills Road (CR-138) and SR-313, accident rates increase above expected rates but are still close to expected rates identified for similar highways (Ames 2003).

As shown on Figure 3–21, the Union Pacific Cane Creek Branch Railroad parallels US-191 between Crescent Junction and Moab. However, just south of CR-138 (Blue Hills Road), the railroad track goes under US-191 and continues south on the west side of US-191. As discussed in Section 3.1.17, current rail usage on the segment between Moab and the main line at Crescent Junction is limited to one train per week that hauls freight from the Moab Potash and Salt Mine on SR-279.

The Canyonlands Field Airport (see Figure 3–21) provides commuter and scenic air tour services. A local aviation company operates the airport and services 22 fixed-wing flights a day year-round. There are three daily commercial flights by an airline carrier; the remaining flights are a combination of charter and scenic flying services. An average of one helicopter flight per day year-round provides mostly fuel service (Albrecht 2003).

3.2.15 Socioeconomics

The Klondike Flats site is situated 18 miles north of the Moab site in Grand County, Utah. Section 3.1.18 discusses Grand County socioeconomic characteristics. The Canyonlands Field Airport is the only commercial employer in the site area. It employs 11 full-time employees year-round; of that number, four people live at the airport year-round and seven employees live there during the peak season. There are no other commercial businesses or residences in the site area.

3.2.16 Human Health

3.2.16.1 Background Radon/Natural Radiation

Nationwide, people are exposed to an average of about 300 mrem/yr of natural background radiation (NCRP 1987). Table 3–29 summarizes the radiation doses from natural background, assuming residential exposure is occurring at the Klondike Flats site.

Table 3–29. United States and the Klondike Flats Site Natural Background Radiation Doses

Source	U.S. Average Natural Background Radiation Dose (millirem/yr)	Klondike Flats Natural Background Radiation Dose (millirem/yr)
Cosmic and cosmogenic radioactivity	28	68
Terrestrial radioactivity	28	74
Internal radioactivity	40	40
Inhaled radioactivity	200	260
Rounded Total	**300**	**440**

The largest natural source is inhaled radioactivity, mostly from radon-222 and its radioactive decay products in homes and buildings, which accounts for about 200 mrem/yr. Additional natural sources include radioactive material in the earth (primarily external radiation from the uranium and thorium decay series), radioactive material in the body (primarily potassium-40), and cosmic rays from space filtered by the atmosphere.

The actual radiation dose from natural background radiation varies with location. According to data for Blanding, the radiation dose from cosmic and cosmogenic radioactivity is about 68 mrem/yr at the Klondike Flats site; the dose from external terrestrial radioactivity is about 74 mrem/yr; and the dose from radon-222 and its radioactive decay products is about 260 mrem/yr (IUC 2003). The total natural background radiation dose at the Klondike Flats site would be about 440 mrem/yr, considerably higher than the national average.

No one currently resides at the Klondike Flats site, and only 15 people live within 10 miles of the site. According to 2000 census data, the population within 50 miles of the Klondike Flats site was about 10,500 (Figure 3–30). Assuming that all residents were exposed to 440 mrem/yr, the population dose would be about 4,600 person-rem per year.

3.2.17 Environmental Justice

Several small pockets of minority populations greater than 50 percent of the total population within a census block are found south and east of the Klondike Flats site within 50 miles from the site. As shown in Figure 3–31, there are no areas with minority populations greater than 50 percent of the total population closer than 20 miles to the site. Approximately 94 percent of Grand County was identified by the census as white, non-Hispanic. One census group block area with a reported annual household income less than $18,244 is identified about 30 miles north of the site (Figure 3–32).

3.2.18 Pipeline Corridor

3.2.18.1 Geology

Seismicity (and seismic risk) is low in this part of the northern Paradox Basin and has a low rate of occurrence with small- to moderate-magnitude earthquakes (Wong and Humphrey 1989). The proposed slurry pipeline route is in Uniform Building Code 1, indicating the lowest potential for earthquake damage (Olig 1991).

Geologic conditions for subsidence and landslides were evaluated in the EIS for the Questar, Williams, and Kern River pipeline route, which closely follows the proposed pipeline route from the Moab site to Klondike Flats (DOI 2001). In that EIS, no risks for landslides, soil liquefaction, or collapsible soils were noted for the Moab site to Klondike Flats portion of the pipeline route.

The northernmost 3 miles of the proposed pipeline route crosses over the lower part of the Mancos Shale, which contains expansive clay (montmorillonite) that can potentially cause engineering geologic problems. Changes in water content cause the clay to shrink and swell, leading to subsidence or heave of concrete slab structures.

3.2.18.2 Soils

Soils within the proposed pipeline corridor between the Moab site and the Klondike Flats site are formed primarily on marine shale uplands and pediments and on alluvial fans and drainages consisting of sediments derived from nearby shale and sandstone uplands. Three general soil map units occur along this segment of the proposed pipeline corridor from south to north: Rock Outcrop-Nakai-Moenkopi, Chipeta-Killpack-Blueflat, and Toddler-Ravola-Glenton (SCS 1989).

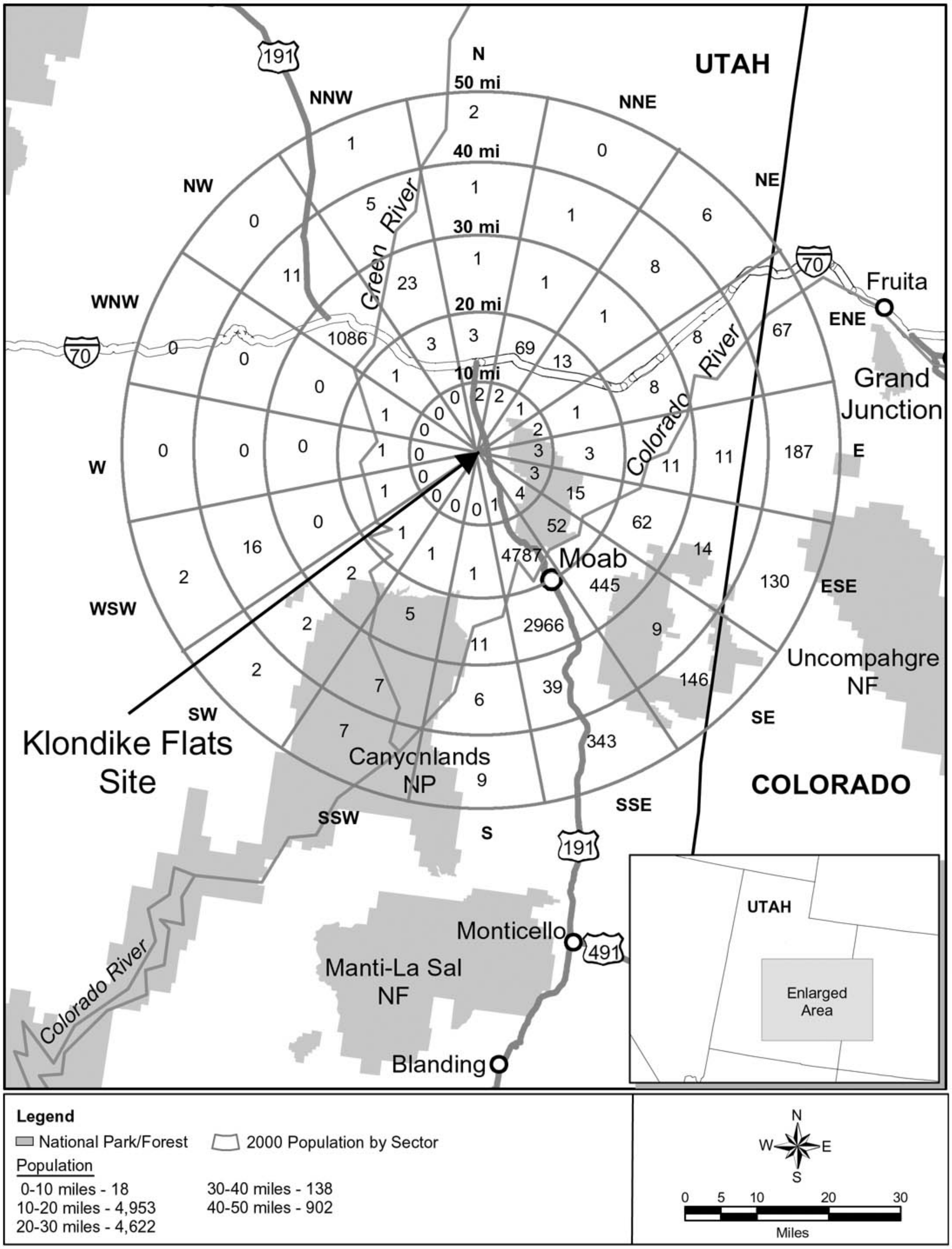
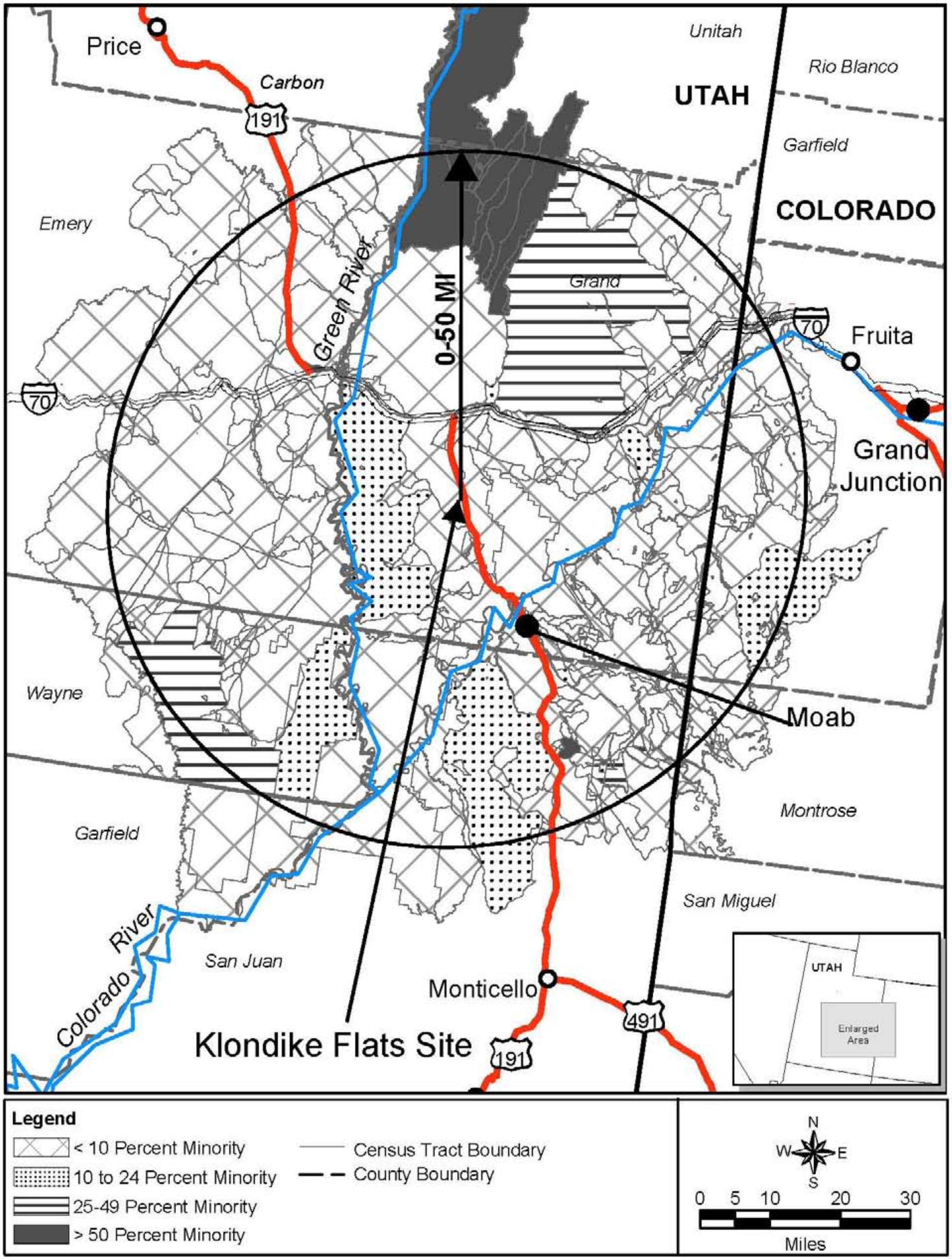
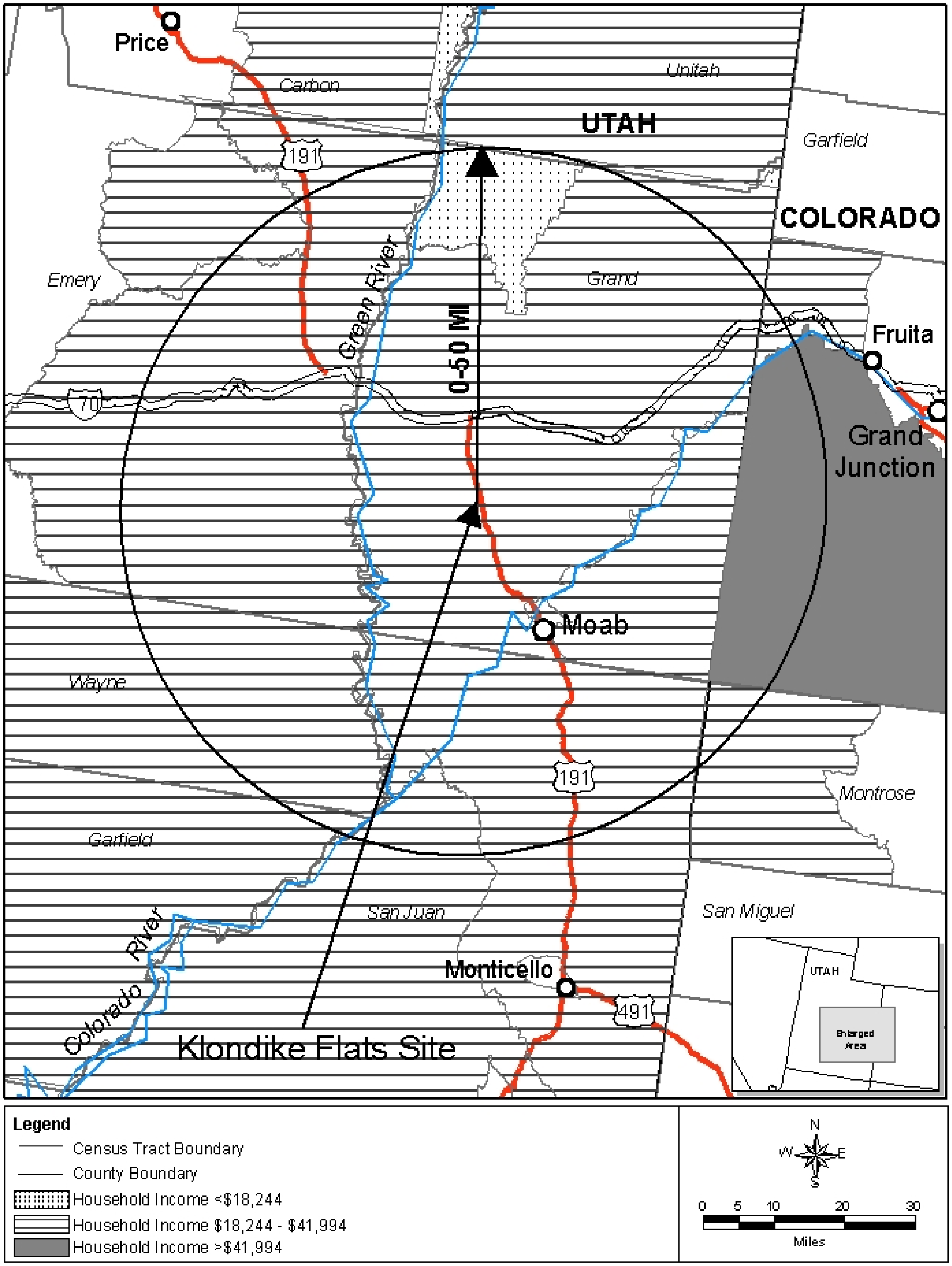


Figure 3–30. Population Within 50 Miles of the Klondike Flats Site



Note: Census blocks and American Indian Reservations within 50 miles of the site boundary.

Figure 3–31. Minority Population Distribution Within a 50-Mile Radius of the Klondike Flats Site



Note: Census block groups within 50 miles of the site boundary.

Figure 3–32. Household Income Distribution Within a 50-Mile Radius of the Klondike Flats Site

3.2.18.3 Ground Water

Depths to ground water vary widely along the length of the proposed pipeline corridor from the Moab site to the Klondike Flats site. For the first mile of the pipeline corridor northwest of the Moab site, ground water is in Quaternary alluvium and detritus in Moab Wash at depths less than 100 ft. For the next 6 to 7 miles through Moab Canyon to about Sevenmile Canyon, the pipeline corridor is on the southwest (upthrown) side of the Moab Fault, where ground water is several hundred feet deep in sandstone of the Cutler or Honaker Trail Formations. North of Sevenmile Canyon, where the proposed pipeline corridor is on the northeast (downthrown) side of the Moab Fault, ground water would be in the Entrada Sandstone at estimated depths of 200 to 500 ft. About 4 miles north of Sevenmile Canyon along the pipeline route are seeps at the base of the Cedar Mountain Formation, and ground water is shallow in the Cedar Mountain Formation or Dakota Sandstone for about the next 2 miles to where Bartlett Wash comes in from the west. For the last 3 to 4 miles, where the pipeline corridor turns to the west and passes over increasing thicknesses of Mancos Shale, ground water depths to the Dakota Sandstone increase from 200 to about 700 ft.

3.2.18.4 Surface Water

No perennial surface waters are present within the pipeline corridor. The proposed slurry pipeline corridor extending north from the Moab site to the Klondike Flats site would cross several streams and washes (Moab Wash, Sevenmile Wash, Klondike Wash, and Tusher Canyon Wash) and numerous other smaller, unnamed drainage features, all of which are ephemeral. Storm water runoff in the local ephemeral streams is characterized by a rapid rise in flow rates, followed by rapid recession, primarily because of the small storage capacity of the surface soils in the area. The flows in these drainage features occur primarily in response to local heavy rainfall and occasionally to snowmelt runoff.

Water Quality and Existing Surface Water Contamination

When storm water flows through washes within this proposed pipeline corridor, the water is laden with sediment, and water quality is anticipated to be poor. These ephemeral washes collect surface water runoff from areas composed predominantly of the Mancos Shale Formation, which are highly alkaline and may have high concentrations of selenium. As a result, surface water quality from these drainage features would likely be characterized as having high salinity, turbidity, and hardness and having elevated levels of sulfate and selenium.

Relevant Water Quality Standards

All ephemeral water bodies in this proposed pipeline corridor are eventually tributaries to either the Green River or the Colorado River; therefore, they are subject to the water quality classifications specified in Utah Administrative Code R317-2-13 (see Chapter 7.0).

3.2.18.5 Floodplains and Wetlands

No known floodplain or wetland areas would be affected by the pipeline corridor.

3.2.18.6 Terrestrial Ecology

Section 3.2.8 describes the affected environment for terrestrial ecology on a regional basis between the Moab site and the Klondike Flats site (Maps 2–4, Appendix C). This section addresses only the areas, wildlife, and habitat that would be affected by the proposed pipeline corridor. General information applicable to the regional descriptions as described in Section 3.2.8 is not repeated in this section. Although vegetation is sparse and habitat is limited, large mammals adapted to a desert environment, such as the pronghorn antelope, coyote, and black-tailed jackrabbit, are anticipated to be present intermittently in the proposed corridor.

Recreational activities (e.g., motorized off-highway vehicles) on the west side of US-191 and highway traffic from Moab limit wildlife diversity and densities. However, the desert bighorn sheep is a Utah species of high interest and is known to frequent area transportation corridors (US-191 and the Union Pacific Railroad) from the Moab site as far north as 14 miles toward the Klondike Flats site (Maps 3 and 4, Appendix C). The desert bighorn prefers rocky, relatively steep slopes characteristic of the area between Moab and the Klondike Flats site. Road traffic has resulted in mortality to this species.

Table 3–25 in Section 3.2.8.2 presents a list of federally listed threatened and endangered species that may occur in the vicinity of the Klondike Flats site. Appendix A1, "Biological Assessment," provides more detailed information concerning these species. Of these species, the black-footed ferret, Mexican spotted owl, and bald eagle, as described in Section 3.2.8.2, are the primary federally listed species of concern in the vicinity of the pipeline corridor. In addition, the white-tailed prairie dog, currently in review for federal listing, is also of concern.

UDWR (2003b) reported an unconfirmed sighting of black-footed ferrets in the vicinity of the Klondike Flats site in 1989. All black-footed ferrets currently in the wild are believed to be the result of a federal reintroduction program. It is highly unlikely that the black-footed ferrets reintroduced in Uinta and Duchesne Counties in 1999 or their offspring could occur along the pipeline corridor between the Moab site and the Klondike Flats site. The black-footed ferret is of concern particularly along the northernmost sections of the pipeline route. However, the route's proximity to US-191 and its limited potential for suitable habitat for more than 80 percent of the area likely limit the potential for the ferret's presence. An environmental assessment conducted for the Grand County Landfill (BLM 1995), which is located within 3 miles of the Klondike Flats site, concluded that there is no present or historical evidence of black-footed ferrets.

However, white-tailed prairie dog colonies, upon which the ferret depends, may be located in the vicinity of this segment of the proposed pipeline corridor just south of the Klondike Flats site. Surveys for white-tailed prairie dogs have been conducted at the Klondike Flats site (BLM 1995). At that time, it was determined that all the colonies were relatively small and isolated, such that they would not support black-footed ferrets.

Data provided by UDWR (2003a) indicated that there were no occurrences of the Mexican spotted owl in any of the project areas. However, habitat models (BLM 2003b) indicate that potential habitat areas may exist in the canyons near US-191 over the first 7 miles north from the Moab site. Nonetheless, these models are primarily based on physical and topographic features and do not consider vegetation requirements. Mexican spotted owls nest, roost, and forage in an array of different community types, but mixed-conifer forests dominated by Douglas fir and/or white fir are most common (USF&WS 2001). However, they may also nest, but less frequently so, in arid, rocky, mostly unvegetated canyons (Romin 2004). Although there are no forested areas in the vicinity of US-191 north of Moab, there are arid canyons that largely or altogether lack forest-type vegetation. Thus, it is unlikely but possible that spotted owls occur in the canyons near US-191 over the first 7 miles north of the Moab site.

The Utah Gap Analysis (UDWR 1999) indicates that potential high-quality bald eagle wintering habitat exists throughout many of the project areas. However, it is not known to nest or night roost nor is it known to have been observed in the vicinity of the proposed pipeline corridor between the Moab site and the Klondike Flats site.

There is no designated or proposed critical habitat for any of the above federally protected species in the vicinity of the proposed pipeline corridor between the Moab site and the Klondike Flats site.

DOE, in consultation with USF&WS and BLM, would determine the need for additional habitat evaluations and surveys for species that may be affected by the proposed action should this transportation mode be selected.

The burrowing owl (Cresto 2003), ferruginous hawk, peregrine falcon, and Swainson’s hawk are not federally listed species, but they are included on the state list of sensitive species and are also protected under the MBTA. On the basis of previous sightings, it can be assumed that the peregrine falcon and ferruginous hawk may be present. Studies conducted for the Grand County landfill (BLM 1995) identified ferruginous hawk sightings in the vicinity of the pipeline corridor.

3.2.18.7 Land Use

The slurry line route from the Moab site to the Klondike Flats site is approximately 18 miles. Where possible, the pipeline would be located in an existing right-of-way permitted across federal lands administered by BLM, which constitutes approximately 37 percent of the entire route. Approximately 7 percent of the route would be located on national park lands, 16 percent on private lands, and the remaining 40 percent on state and sovereign lands. If co-location of the proposed slurry line is not feasible or practical, DOE would obtain a new permit from BLM, and the pipeline would parallel the existing right-of-way. Proposed pipeline corridors are shown on Maps 2 through 4 in Appendix C.

3.2.18.8 Cultural Resources

The cultural history of the proposed Klondike Flats pipeline route is discussed in the more general cultural history of southeastern Utah described in Section 3.1.13.1; the Class I cultural resource inventory that was conducted for this corridor is described in Section 3.1.13.2.

Results of the Class I inventory indicate that a number of linear Class III cultural resource surveys associated with existing pipelines and US-191 have been conducted along the proposed pipeline corridor between the Moab and Klondike Flats sites. On the basis of these surveys, 25 sites have been identified that are either eligible for inclusion in the National Register of Historic Places or have been recommended as eligible. An additional site, the Dalton Wells Civilian Conservation Corps/Japanese-American Internment Camp (Map 3, Appendix C), is listed on the National Register. The 25 sites include historic sites associated with transportation, mining, ranching, and agriculture; prehistoric lithic scatters of unknown affiliation; a small number of Formative and Archaic period sites; small rock art sites; and possibly protohistoric (immediately preceding recorded history) sites. No Paleoindian sites have been recorded along the corridor, and it is not likely that they would occur.

No data exist concerning the presence of potential traditional cultural properties along the proposed Klondike Flats pipeline route. On the basis of Class I cultural resource inventory results, tribal interviews, and published and unpublished literature, the likelihood of their occurrence and estimated density on the site are low (on a scale of low-medium-high-extremely high) for traditional cultural properties associated with the Navajo Nation and medium for properties associated with the Ute Mountain Ute Tribe, White Mesa Ute Tribe, Southern Ute Tribe, and Hopi Tribe. The likelihood of their occurrence and estimated density are medium to high for properties associated with the Uintah-Ouray Ute Tribe (Fritz 2004).

3.2.18.9 Visual Resources

The proposed pipeline route between the Moab and Klondike Flats sites passes through narrow Moab Canyon, just north of the Moab site (Map 4, Appendix C), and the gently rolling desert plains north of Moab Canyon to the Klondike Flats site (Maps 2 and 3, Appendix C). Moab Canyon, characterized by steep, rugged, red sandstone cliffs, has a visual resource designation of Class II (BLM 2003b) (see Section 3.1.15 for an explanation of visual resource classes). The natural environment in the canyon has been altered somewhat by a number of cultural modifications, such as US-191, the Cane Creek Branch rail line, an overhead transmission line, and several buried pipelines. For the most part, however, the dominant features within the canyon are not the cultural modifications but the imposing sandstone cliffs. North of the canyon, the rolling desert plains are designated Class III (approximately 70 percent of the route) and Class IV (approximately 10 percent of the route) (Map 4, Appendix C).

The desert plains are characterized by undulating topography that is scattered with small desert shrubs and grasses. The background scenery along the pipeline corridor in these Class III and IV areas is composed of moderately rugged red and beige sandstone mesas and cliffs containing predominantly horizontal and diagonal features. Near the Klondike Flats site, background scenery changes to the smooth, rounded, buff-colored bluffs of the Mancos Shale.

The route proposed for the pipeline is visible to travelers on US-191 for most of its length. An approximately 4-mile stretch of the route is not entirely visible from the highway but is visible to recreationists and other travelers on the county road (historic US-160) that parallels US-191 along Moab Canyon. The proposed south access portion of the pipeline route is visible to recreationists and other travelers on Blue Hills Road (CR-138).

3.3 Crescent Junction Site

The proposed Crescent Junction disposal site (Crescent Junction site) is located about 2 miles north of the Crescent Junction interchange on I-70 and US-191. The site is about 31 miles north of the Moab site and covers several square miles of largely desert terrain that is bordered on the north by the prominent Book Cliffs. All drainage to the Green River, which ultimately flows to the Colorado River, is located several miles west of the site. Because no perennial streams or rivers are on the Crescent Junction site, aquatic ecology and surface water contamination and use are not discussed.

The Crescent Junction area is within the service territory of Utah Power, a subsidiary of PacifiCorp. The corporation maintains an existing three-phase distribution line that parallels CR-175, a frontage road between Crescent Junction and Cisco.

3.3.1 Geology

The Crescent Junction site is along the south edge of the Uinta Basin, and rocks dip gently to the north toward the basin axis. The site also overlies the northwestern part of the ancestral Paradox Basin (Figure 3–1). Nearby to the north is an erosional escarpment that rises about 600 ft; this escarpment is known as the Book Cliffs.

3.3.1.1 Stratigraphy

Mancos Shale bedrock is exposed in several places at the site. The site is underlain by 3,000 ft of Mancos Shale; the remaining 1,000 ft was removed by erosion. The Ferron Sandstone Member is about 60 ft thick and occurs in the lower 300 to 350 ft of Mancos Shale. Below the Ferron is the lowermost member of the Mancos, the Tununk Shale (see Figure 3–25).

The Dakota Sandstone underlies the Mancos Shale and is less than 100 ft thick in the Crescent Junction site area. It is likely the shallowest bedrock unit containing ground water. The Cedar Mountain Formation underlies the Dakota Sandstone.

Mancos Shale bedrock exposures are covered over much of the Crescent Junction site area by alluvial mud (Doelling 2001). This unconsolidated gray material, less than 20 ft thick, fills swales in the softest parts of the Mancos Shale and consists of silt, clay, sand, and minor fragments of sandstone. Along the west side of the site area, Quaternary stream alluvium, up to 20 ft thick deriving from Crescent Wash, covers the Mancos Shale (Doelling 2001). This material consists of sand, silt, clay, pebbles, and sparse cobbles adjacent to the Crescent Wash stream course, which heads in the Book Cliffs just to the north.

3.3.1.2 Structure

The site is in the Paradox fold and fault belt of the ancestral Paradox Basin (see Figure 3–1). The geologic structure of the Paradox Basin is discussed in Section 3.1.1. The Book Cliffs, less than 1 mile north of the site, is an erosional escarpment on the south flank of the Uinta Basin. Mancos Shale at the site dips gently (less than 10 degrees) northward (from north-northeast to north-northwest) toward the axis of the subtle, northwest-striking Whipsaw Flat syncline. Northwest-striking normal faults defining a graben of the northwest extension of the Salt Valley salt-cored anticline are about 1 to 2 miles southwest of the Crescent Junction site. These faults are not exposed on the surface and reportedly have as much as 1,000 ft of displacement, as determined by oil test wells drilled in the area in the 1920s and 1930s (Fisher 1936).

A fault mapped in 1924 during oil exploration (Harrison 1927; Fischer 1936) is believed to extend into the southwest quarter of Section 27 in the Crescent Junction site area. More recent studies do not show this fault as having surface expression (Woodward-Clyde Consultants 1984; Doelling 2001). It is unclear what geologic features were used as evidence of the fault. Surface fieldwork and an additional search for well data in the area would be necessary to confirm the existence of the fault. No other lineaments or geologic structures were noted in the Crescent Junction site area from northern Paradox Basin mapping by Friedman and Simpson (1980).

3.3.1.3 Geologic Resources

No oil and gas resources have been found in the Crescent Junction site area. The nearest known petroleum accumulation is in the Morrison Formation about 3 miles south-southwest of the Crescent Junction site. Exploratory drilling for gas is currently under way 1 to 2 miles west of the Crescent Junction site; results of this exploration are unknown. Historical drilling in the vicinity of the site indicates that the potential for oil and gas accumulations at the site is low.

Although potash resources are associated with the Paradox Formation about 3 miles south of the Crescent Junction site, the site is northeast of the Salt Valley salt-cored anticline, and thick saline deposits are not present.

Uranium and vanadium deposits, which are associated with the Morrison and Chinle Formations, have been found in scattered locations in the region. However, because of the depth of these formations (3,000 to 4,000 ft) in the Crescent Junction site area, exploration for such deposits is not economical. Copper and silver mineralization is known to occur in a few locations in the region in fault-related deposits in the Morrison Formation (Woodward-Clyde Consultants 1984). Exploration for these deposits would be uneconomical because of their great depth. Coal resources occur in the Book Cliffs just north of the site; however, they are in stratigraphically younger rocks (Mesaverde Group of Late Cretaceous age) than are present at the Crescent Junction site.

Black shales, such as the Mancos, are naturally enriched to above background concentrations in metals such as uranium, copper, silver, vanadium, mercury, arsenic, and gold. These metals likely originated in volcanic ash material that was deposited (and became bentonite) during deposition of the Mancos Shale. In a study by Marlatt (1991), sampling of Mancos Shale generally in the area between Salt Valley and the Book Cliffs found that gold content ranged from 30 to 100 micrograms per kilogram (parts per billion). These values are about 10 times the background levels but are much too low for economic extraction.

No sand and gravel deposits are present in the Crescent Junction site area. Potential deposits of such material are present just south of the Crescent Junction site area and also about 0.5 mile west of Crescent Wash (McDonald 1999). This material occurs as pediment-mantle deposits that cover Mancos Shale bedrock surfaces.

3.3.1.4 Geologic Hazards

Montmorillonite clay is found in the Mancos Shale underlying the Crescent Junction site area. Changes in water content cause the clay to shrink and swell, which can lead to subsidence (Mulvey 1992). An example of current problems associated with this clay may be seen along I-70, just south of the Crescent Junction site. Portions of the highway that cross Mancos Shale require constant maintenance because of heaving of the concrete slab structures.

The low angle of slopes and homogeneity of the Mancos Shale bedrock preclude hazardous landslides, slumping, or rock falls. The site is sufficiently distant from the Book Cliffs that hazards from rock falls are not an issue.

Earthquake risk and seismic activity in the site area are low. The nearest faults with Quaternary movement that also have surface expression are about 2 to 4 miles southwest of the site and are related to the northwest extension of the Salt Valley salt-cored anticline (Hecker 1993). These faults are associated with salt structures in the northern part of the Paradox Basin and salt-dissolution collapse that has occurred (Wong et al. 1996). The faults are considered to be unrelated to earthquake-generating tectonic forces and not seismogenic. Seismicity in this part of the northern Paradox Basin has a low rate of occurrence, with small- to moderate-magnitude earthquakes (Wong and Humphrey 1989). The site area is in Uniform Building Code 1, indicating lowest potential for earthquake damage (Olig 1991).

The site area has a moderate-to-high radon-hazard potential for occurrence of naturally occurring indoor radon based on the geologic factors of uranium concentration, soil permeability, and ground water depth (Black 1993). The moderate-to-high rating stems from the relatively high concentration of naturally occurring uranium in Mancos Shale, the relatively high soil permeability caused by shrinking and swelling of the Mancos-derived soil, and the relatively deep depth to ground water (shallow water retards radon migration).

3.3.2 Soils

The soils at the Crescent Junction site are on the alluvial valley flats immediately south of the Book Cliffs. The area is dominated by the Toddler-Ravola-Glenton complex of soils. Because the Book Cliffs are composed mainly of shale and topped by sandstone, the Ravola family soils, which are strongly influenced by shale sediment, are probably the predominant family in the area. Table 3–30 provides characteristics of these soils.

The Ravola family is derived from shale from the Book Cliffs and is therefore moderately to strongly saline. These soils are typically very deep and well-drained. The hazard of water erosion is moderate; however, the soils are subject to gully formation and piping where runoff is concentrated.

Also occurring within the soil complex is the Toddler family of soils, which formed from a mixture of marine shale and sandstone and is also very deep and well-drained. They are moderately to strongly saline. Runoff is slow, and the erosion hazard is moderate.

Formation of the Glenton soils is strongly influenced by sandstone sediment. These soils are very deep, are well-drained, and exhibit fairly rapid permeability. Runoff is moderate to slow and erosion hazard is relatively low; however, deep gullies have formed in areas where runoff is concentrated.

Mack loam soils, associated with 2- to 6-percent slopes, are formed similarly to Toddler-Ravola-Glenton soils from alluvium derived from sandstone and shale from the Book Cliffs. They are also similar in that they are very deep and well-drained. However, these soils are composed of more loam-textured soils and therefore support a different plant community. They also have a slight, rather than moderate, water erosion hazard.

Soil materials consist of more than 60 inches of the Toddler-Rovola-Glenton family soil. This series consists of low plasticity sandy clay and silts with good infiltration characteristics. These soils are grouped into the Hydrological Group B characterized by moderately high infiltration rate with a low erosion potential (SCS 1989).

Table 3–30. Soil Types and Properties at the Crescent Junction Site

Soil Name	Taxonomy	Depth (inches)	pH	Salinity (mmho/cm)	Permeability (inches per hour)	Available Water (percent)	Textural Class	Clay (percent)	Erodibility Factors[a]
Ravola	Fine-silty, mixed (calcareous), mesic Typic Torrifluvents	> 60	7.9–9.0	4–16	0.2–6.0	10–18	Silt loam	15–35	K = 0.43 T = 5 Wind = 4
Toddler	Fine-silty, mixed (calcareous), mesic Typic Torrifluvents	> 60	7.9–9.0	2–8	0.6–2.0	10–18	Silt loam to fine sandy loam	18–35	K = 0.32 T = 5 Wind = 4
Glenton	Coarse-loamy, mixed (calcareous), mesic Typic Torrifluvents	> 60	7.9–8.4	< 8	2.0–6.0	8–18	Silt loam to fine sandy loam	5–18	K = 0.24 T = 5 Wind = 3
Mack loam	Fine-loamy, mixed, mesic typic Haplargids	> 60	7.4–9.0	<2–4	0.2 – 6.0	12 – 19	Silt loam to fine sandy loam	5 – 19	K = 0.32 T = 5 Wind = 4L

[a]Erodibility factors:
K, used in the Universal Soil Loss Equation, is an indicator of the susceptibility of a soil to sheet and rill erosion by water. Values range from 0.02 to 0.69; the higher the value, the more susceptible the soil is to sheet and rill erosion.
T is an estimate of the maximum average annual rate of water or wind erosion in tons per acre per year.
Wind erosion factors range from 1 to 8; the lower the value, the more susceptible the soil is to wind erosion.
mmho/cm = millimhos per centimeter.
Source: SCS 1989.

Hydrocollapse potential for these soils is low, and no subsidence areas are known to exist in the area. Conditions for liquefaction (that is, loose soils, soils with a high moisture content, and a source of vibration) do not occur, so liquefaction potential is considered low.

3.3.3 Air Quality

3.3.3.1 Ambient Air Quality

Air quality information specific to the Crescent Junction site is unavailable; however, it is expected to be similar to, or better than, that described for the Moab site because of its more remote location and lack of area development. Limited air quality data are available for the Green River, Utah, area approximately 20 miles west of the Crescent Junction site. Air quality data collected from this site are considered to be representative of the Crescent Junction site because of geologic and physiographic similarities.

Criteria pollutants (Table 3–4 and Table 3–5 in Section 3.1.4) routinely measured at the Green River station include total suspended particulates, sulfur dioxide, and nitrogen dioxide; pollutants not monitored are carbon monoxide, ozone, and lead. Measurements of pollutants at the Green River station from 1980 through 1985 were below applicable standards except for total suspended particulates, which exceeded state secondary standards (DOE 1985). There are no major sources of pollutants at the Crescent Junction site; therefore, pollutant concentrations are likely similar to those recorded at the Green River station.

The Green River area is classified as an attainment area under the NAAQS. No site-specific information is available for the Crescent Junction site. However, based on its proximity to Green River, the Crescent Junction site is also considered to be an attainment area according to these same standards.

3.3.3.2 Visibility

Visibility information specific to the Crescent Junction site is unavailable; however, it is expected to be similar to that described for the Moab site. Because the Crescent Junction site is on a plateau, the range of visibility is expected to be greater in most locations than at the Moab site where visibility is impeded by natural geologic features. However, low areas and hills are present and could impede visibility.

3.3.4 Climate and Meteorology

Climate statistics for the Crescent Junction site were obtained from Thompson Springs, Utah (5 miles east). This arid area is characterized by maximum average temperatures that range from 88 ºF in summer (the maximum recorded summer temperature is 105 ºF) to 46 ºF in winter. Minimum average temperatures range from 60 ºF in summer to 22 ºF in winter (the minimum recorded winter temperature is –23 ºF). The overall mean annual temperature is 52.8 ºF, the annual average maximum temperature is 66 ºF, and the annual average minimum is 39.7 ºF (Ashcroft et al. 1992).

Mean annual precipitation is 9.2 inches, and the frequency of precipitation events greater than 0.125 inch is less than 10 percent. Most of the precipitation occurs as rainfall during the southwest monsoon season, July through September. Maximum daily precipitation of 2.00 inches and maximum monthly precipitation of 3.99 inches have occurred in August. The potential annual evaporation is approximately 55 inches, which greatly exceeds annual precipitation (Robson and Banta 1995).

Wind speed and direction data are currently unavailable for this site. For the purposes of this EIS, the data compiled from the Canyonlands Field Airport for the Klondike Flats site have been used (see Section 3.2.3).

3.3.5 Ground Water

3.3.5.1 Hydrostratigraphy

Unconsolidated alluvial material that is less than 20 ft thick along Crescent Wash consists of silt, clay, and minor fragments of sandstone. This material occurs just west of the site and overlies the Mancos Shale bedrock.

Bedrock at the Crescent Junction site is the upper part of the Mancos Shale; approximately 3,000 ft of the formation underlies the site. The Mancos Shale in the area consists of thin siltstone, fine-grained sandstone, and bentonitic interbeds widely spaced in the thick calcareous mudstone (Chitwood 1994). The Ferron Sandstone Member is about 60 ft thick and occurs in the lower 300 to 350 ft of the Mancos Shale (Blanchard 1990).

The Dakota Sandstone of the Late Cretaceous age underlies the Mancos Shale and consists of less than 100 ft of sandstone, conglomeratic sandstone, and shale. The Dakota Sandstone is deeper than 3,000 ft beneath the surface. The Cedar Mountain Formation of Early Cretaceous age underlies the Dakota Sandstone and consists of several sandstone and conglomeratic sandstone beds along with thick mudstone layers.

3.3.5.2 Ground Water Occurrence

No usable ground water is available in the thin alluvial deposits of Crescent Wash just west of the Crescent Junction site area.

The Ferron Sandstone Member of the Mancos Shale is not a water-bearing unit. The Mancos Shale overall does not yield ground water and forms an aquitard that inhibits ground water migration to deeper stratigraphic units (Blanchard 1990).

The Dakota Sandstone likely represents the shallowest bedrock unit containing ground water beneath the Crescent Junction site. Ground water is also present in the sandstone and conglomeratic sandstone beds of the Cedar Mountain Formation. Water in the Dakota Sandstone and Cedar Mountain Formation may be under slight artesian head from recharge to the north along the north edge of the Uinta Basin. Additional studies may be necessary to identify quantity yields from these formations.

3.3.5.3 Ground Water Quality

Inferred ground water quality for the Dakota Sandstone in this area is based on information from a well approximately 5 miles northeast of the proposed site, which had a TDS content of 1,800 mg/L (Blanchard 1990). This represents drinking water quality based on the Utah Ground Water Quality Protection program (Class II aquifer) (UAC 2003a).

3.3.5.4 Ground Water Use

The current known source of water used by residents in the Crescent Junction area is from Thompson Spring, near the town of Thompson Springs. Additional studies may be necessary to confirm uses.

3.3.6 Surface Water

3.3.6.1 Surface Water Resources

No perennial water bodies are present within the Crescent Junction site area. Surface water resources within this area are limited to storm water runoff flows within the various ephemeral washes that transect the area. The courses of the ephemeral water bodies in this area are well-established and are unlikely to migrate in a different direction or pattern. Two washes just west of the site are Crooked Wash and Crescent Wash. Several smaller washes are present in the east part of the site that are tributaries of Thompson Wash. All of these washes flow south to southwest and are tributaries of the Green River. The ephemeral washes located on the Crescent Junction site are ungaged. Extreme floodwater surface elevations or the effects of extreme storm events are not currently known.

3.3.6.2 Surface Water Quality

Soils associated with the Mancos Shale are alkaline and may have high concentrations of selenium. As a result, surface water in these ephemeral washes likely has high salinity, high turbidity, considerable hardness, and elevated levels of sulfate and selenium.

3.3.6.3 Relevant Water Quality Standards

All ephemeral water bodies within the Crescent Junction site area are tributaries of the Green River; therefore, they are subject to the water quality classifications specified in Utah Administrative Code R317-2, “Standards of Quality for Waters of the State” (UAC 2003b) (see Chapter 7.0).

3.3.7 Floodplains

Crescent Wash, an ephemeral stream, runs east of the Crescent Junction site and drains an area of 18 square miles. No floodplains exist at the Crescent Junction site, but it is prone to extreme surface flooding during precipitation events. The disposal cell would be located outside flood-prone areas of Crescent Wash.

3.3.8 Wetlands

No known wetlands exist in or near the Crescent Junction site, but because riparian vegetation is present in places, the area would be investigated for any small, isolated wetlands prior to construction. Appendix F includes a further description of floodplains and wetlands at the Crescent Junction site.

3.3.9 Terrestrial Ecology

This section describes the vegetation and wildlife aspects, including protected and sensitive species, for the Crescent Junction site. Although natural habitat is limited, it does exist for wildlife adapted to a desert environment, including some species of birds, mammals, and reptiles. The site topography is relatively flat, although steep rock mesas dominate the area to the north of the site, which also influences available habitat.

3.3.9.1 Terrestrial Vegetation and Wildlife

In most areas of the site, vegetation is indicative of a disturbed site and varies from the potential native vegetation. About 50 percent of the Crescent Junction site area is covered by low-growing vegetation. The northern part of the site is covered with a gray veneer of debris from a recent outwash originating in the nearby Mancos Shale hills. The outwash area is mostly bare with some prickly pear cactus, cheatgrass, and Russian thistle. Vegetation in the south-central and southeast areas of the site also consists primarily of species such as Russian thistle, cheatgrass, and prickly pear with a few native shrubs and perennial grasses, including Gardner saltbush, galleta, and Indian ricegrass. The range condition of this area would probably rate as poor to fair.

Shrubs include black greasewood, shadscale, and Gardner saltbush; an understory consists primarily of annual weeds such as cheatgrass and Russian thistle with a few perennial grasses (galleta and Indian ricegrass). Table 3–31 lists characteristics of the potential natural vegetation.

Black greasewood, an obligate phreatophyte, dominates the plant community in this area and accounts for the relatively high productivity. Occasional saltcedar (tamarisk) occurs in the drainages. Toddler family soils provide the structure to support Gardner and mat saltbush vegetation.

Wildlife population diversity and densities are limited in the Crescent Junction site area by the vegetation and habitat types present. However, large mammals such as the coyote and pronghorn antelope, adapted to a desert environment, likely occur in the vicinity of the Crescent Junction site. Smaller wildlife species adapted to a desert environment, including mammal, bird, and reptile, are also present. Coyote, mule deer, and bobcat may use the deep gullies as protection while traveling. Crescent Wash is near the site and may provide enough water near the surface to support low-density cottonwood trees that can serve as nesting and roosting sites for raptors, horned lark, sparrows, and other birds. The deep gullies are used as nesting sites for swallows. Coyote, white-tailed prairie dog, desert cottontail, and black-tailed jackrabbit may also use this habitat for food and cover. Raptors such as red-tailed hawks, golden eagles, and harriers use the area as a hunting ground. The presence of human activities close to I-70 may serve as a limiting factor in the density of wildlife species in this area. No critical habitat has been identified for wildlife at this site.

3.3.9.2 Species Listed Under the Endangered Species Act

This section describes federally listed terrestrial threatened and endangered, proposed, or candidate species that are or may be present in the Crescent Junction disposal site area. In March 2003, DOE requested an updated list of such species from USF&WS that may be present or affected by DOE's proposed alternatives. USF&WS responded in April 2003 with a list for Grand County. Table 3–32 lists a subset of those species that may occur in the vicinity of the Crescent Junction site.

Table 3–31. Vegetation Characteristics on the Various Soil Types at the Crescent Junction Site

Soil Name	Range Site	Characteristic Potential Vegetation[a]	Percent	Productivity (pounds/acre)	Rooting Depth (inches)
Ravola	Alkali flat	Black greasewood *(Sarcobatus vermiculatus)*	30	500–1,000	>60
		Shadscale *(Atriplex confertifolia)*	10		
		Bottlebrush squirreltail (*Elymus elymoides)*	10		
		Alkali sacaton *(Sporobolus airoides)*	10		
		Galleta (*Pleuraphis jamesii)*	5		
		Indian ricegrass (*Achnatherum hymenoides)*	5		
		Seepweed *(Suaeda* spp.*)*	5		
Toddler	Alkali fan	Gardner saltbush *(Atriplex gardneri)*	20	200–500	>60
		Bud sagebrush *(Picrothamnus desertorum)*	5		
		Winterfat *(Ceratoides arborescens)*	5		
		Galleta (*Pleuraphis jamesii)*	20		
		Indian ricegrass (*Achnatherum hymenoides)*	15		
		Globemallow (*Sphaeralcea* spp.*)*	5		
Glenton	Alkali fan	Gardner saltbush *(Atriplex gardneri)*	20	200–500	>60
		Bud sagebrush *(Picrothamnus desertorum)*	5		
		Winterfat *(Ceratoides arborescens)*	5		
		Galleta (*Pleuraphis jamesii)*	20		
		Indian ricegrass (*Achnatherum hymenoides)*	15		
		Globemallow (*Sphaeralcea* spp.*)*	5		
Mack loam	Desert loam	Shadscale *(Atriplex confertifolia)*	20	300–700	>60
		Indian ricegrass (*Achnatherum hymenoides)*	20		
		Galleta (*Pleuraphis jamesii)*	10		
		Globemallow (*Sphaeralcea* spp.*)*	5		
		Bud sagebrush *(Picrothamnus desertorum)*	5		
		Winterfat *(Ceratoides arborescens)*	5		

[a]Source: NRCS 2002; SCS 1989.

Table 3–32. Federally Listed Threatened or Endangered Species Potentially Occurring in the Vicinity of the Crescent Junction Site

Common Name	Scientific Name	Habitat Present and Affected	Species Present	Status	Comments
Jones' cycladenia	*Cycladenia humilis* var. *jonesii*	Possible	Possible	Threatened	
Black-footed ferret	*Mustela nigripes*	No	No	Endangered	
Bald eagle	*Haliaeetus leucocephalus*	Possible	Possible	Threatened	Proposed for Delisting
Mexican spotted owl	*Strix occidentalis lucida*	No	No	Threatened	

Spatial data for the species listed in Table 3–32 were obtained from the Utah Conservation Data Center (UCDC). This data set was compiled by the Utah Natural Heritage Program (UNHP) of UDWR, in which species occurrences are depicted as points at a scale of 1:24,000 on 7.5-minute topographic quad maps. Spatial data depicting the Crescent Junction site were overlaid on the species of concern spatial data to evaluate known species occurrences in the area.

The status of each of these species in the vicinity of the Crescent Junction site is briefly discussed below. Appendix A1, "Biological Assessment," provides more detailed information concerning these federally listed species that may be in the vicinity of the Crescent Junction site or could be affected by activities at the site.

There is a cluster of known populations of Jones' cycladenia on BLM land in Grand County approximately 11 to 17 miles northeast of Moab (UDWR 2003b). However, there are no known occurrences of the species on the Crescent Junction site.

UDWR (2003b) reported an unconfirmed ferret sighting in the vicinity of the Crescent Junction site in 1989. All black-footed ferrets currently in the wild are believed to be the result of a federal reintroduction program. It is highly unlikely that the black-footed ferrets reintroduced in Uinta and Duchesne Counties in 1999 or their offspring could occur on or in the vicinity of the Crescent Junction site.

Numerous white-tailed prairie dog (currently under review for federal listing) colonies ranging in size from 10 acres to 2,445 acres occur around the Crescent Junction area (Seglund 2004). It is unknown to what extent individual colonies or a combination of colonies could support black-footed ferrets.

The Utah Gap Analysis (UDWR 1999) indicates that potential high-quality bald eagle wintering habitat exists throughout many of the project areas. However, it is not known to nest or night roost nor is it known to have been observed in the vicinity of the Crescent Junction site.

Mexican spotted owls were historically reported to occupy the Book Cliffs to the north of the Crescent Junction site but have not been observed in the vicinity recently (USF&WS 2001).

There is no designated or proposed critical habitat for any of the above federally protected species in the vicinity of the Crescent Junction site.

DOE, in consultation with USF&WS and BLM, would determine the need for additional habitat evaluations and surveys for species that may be affected by the proposed action should this alternative be selected.

3.3.9.3 Other Special Status Species

Special status species are those that are protected under federal and state regulations other than the ESA; these regulations include the MBTA, Executive Order 13186, and Birds of Conservation Concern (USF&WS 2002f). UDWR provided a list of species that DOE should consider in this EIS (UDWR 2003b). Table 3–33 lists sensitive plant species that may occur in the site region. Table 3–34 describes state-listed animal species. Table 3–35 lists bird species protected under the MBTA and species listed as Birds of Conservation Concern.

Table 3–33. Sensitive Plant Species Potentially Occurring in the Vicinity of the Crescent Junction Site

Common Name	Scientific Name	Habitat Present and Affected	Federal Status	State Status
Clay verbena	*Abronia argillosa*	Possible	None	Watch
Cutler's milkweed	*Asclepias cutleri*	Possible	None	Rare
Fisher Towers milkvetch	*Astragalus piscator*	Possible	None	Rare
Cisco milkvetch	*Astragalus sabulosus*	Possible	BLM	Rare
Ben's buckbrush	*Ceanothus greggii*	Possible	None	Rare
Ruin Park winterfat	*Ceratoides lanata* var. *ruinina*	Possible	None	Rare
Tall cryptantha	*Cryptantha elata*	Possible	None	Rare
La Sal Mt daisy	*Erigeron mancus*	No	FS	Rare
Canyonlands desert parsley	*Lomatium latilobum*	No	BLM	Rare
Entrada skeletonweed	*Lygodesmia grandiflora* var. *entrada*	Possible	BLM	Rare
Shultz's blazing star	*Mentzelia shultziorum*	Possible	BLM	Rare
Paradox breadroot	*Pediomelum aromaticum* var. *aromaticum*	Possible	None	Rare
La Sal Mt beardtongue	*Penstemon crandallii* var. *atratus*	No	None	Watch
Jones indigobush	*Psorothamnus polydenius*	Possible	BLM	Rare
La Sal Mts butterweed	*Senecio fremontii* var. *inexpectatus*	No	BLM	Rare
Jane's globemallow	*Spharalcea leptophylla* var. *janeae*	Possible	BLM	Rare
San Rafael globemallow	*Spharalcea psoraloides*	Possible	BLM	Rare
Canyonlands woody aster	*Xylorhiza glabriuscula*	Possible	None	Rare

Habitat Present and Affected: Possible—habitat for the species is present in the vicinity of the site, transportation routes, or borrow areas; No—species is listed for this county, but habitat is not close to the site.
Federal Status: BLM—plants on the interim sensitive list adopted by the BLM Utah State Office. FS—U.S. Forest Service listed.
State Status: Watch—plants regionally endemic but without rangewide viability concern; Rare—plants with known or suspected rangewide viability concern.

Table 3–34. State-Listed Animal Species That May Occur In the Vicinity of the Crescent Junction Site

Common Name	Scientific Name	Habitat Present and Affected	State Status[a]			Species Present	Actions/ Comments
			T	E	C		
Mammals							
Allen's big-eared bat	*Idionycteris phyllotis*	No			x	No	
Big free-tailed bat	*Nyctinomops macrotis*	No			x	No	
Spotted bat	*Euderma maculatum*	No			x	No	
Townsend's big-eared bat	*Corynorhinus townsendii*	No			x	No	
Kit fox	*Vulpes macrotis*	Unknown			x	Unknown	
Dwarf shrew	*Sorex Nanus*	No			x	No	
Birds							
Peregrine falcon	*Falco peregrinus*	Yes		x		Yes	Federally delisted
Common yellowthroat	*Geothlypis trichas*	No			x	No	
Burrowing owl	*Athene Cunicularia*	Possible			x	Possible	
Swainson's hawk	*Buteo swainsoni*	Possible			x	Unknown	
Greater sage grouse	*Centrocercus urophasianus*	No			x	No	
Blue grosbeak	*Guiraca caerulea*	No			x	No	
Northern goshawk	*Accipiter gentiles*	No			x	No	
Amphibians and Reptiles							
Elaphe guttata	cornsnake	Yes			x	Unknown	
Lampropeltis traingulum	milksnake	Possible			x	Unknown	
Cnemidophorus (Aspidoscelis) velox	Plateau striped whiptail	Unknown			x	Unknown	
Tantilla hobartsmithii	Smith's black-headed snake	Unknown			x	Unknown	

[a]Federal or State Status: T—Threatened, E—Endangered, C—Candidate.

Table 3–35. Sensitive Bird Species Protected Under the Fish and Wildlife Conservation Act and the Migratory Bird Treaty Act That May Occur Near the Crescent Junction Site

Species	Potential to Occur in Project Area
Order Galliformes—Ground dwellers	
Gunnison sage grouse *(Centrocerus urophasianus)*	Moderate
Order Falconiformes—Birds of prey	
American peregrine falcon (*Falco peregrinus)*	High
Ferruginous hawk (*Buteo regalis*)	High
Golden eagle *(Aquila chrysaetos)*	Moderate
Northern harrier *(Circus cyaneous)*	Moderate
Prairie falcon *(Falco mexicanus)*	Moderate
Swainson's hawk *(Buteo swainsoni)*	Moderate
Red-tailed hawk (*Buteo jamaicensis*)	High
Turkey Vulture (*Cathartes aura)*	High
Order Gruiformes—Marsh and open country birds	
Black rail *(Laterallus jamaicensis)*	Low
Yellow rail *(Coturnicops noveboracensis)*	Low
Order Strigiformes—Nocturnal birds of prey	
Barn owl *(Tyto alba)*	Low
Burrowing owl *(Athena cunicularia)*	High
Flammulated owl *(Otus flammeolus)*	Low
Short-eared owl *(Asio flammeus)*	Low
Order Apodiformes—Small swallowlike birds	
Black swift *(Cypseloides niger)*	Low
Vaux's swift *(Chaetura vauxi)*	Low
Order Passeriformes—Perching birds	
Olive-sided flycatcher *(Contopus borealis)*	Low
Gray flycatcher *(Empidonax wrightii)*	Moderate
Pinyon jay *(Gymnorhinus cyaneocephalus)*	Low
Bendire's thrasher *(Toxostoma bendirei)*	High
Crissal thrasher *(Toxostoma dorsale)*	High
Bewick's wren *(Thryomanes bewickii)*	Moderate
Sedge wren *(Cistothorus platensis)*	Low
Verry *(Catharus fuscenscens)*	Moderate
Sprague's pipit *(Anthus spragueii)*	Low
Loggerhead shrike *(Lanius ludovicianus)*	Moderate
Gray vireo *(Vireo vicinior)*	Moderate
Virginia's warbler *(Vermivora virginiae)*	Moderate
Black-throated warbler *(Dendroica nigrescens)*	Low
Grace's warbler *(Dendroica graciae)*	Low
Blackpoll warbler *(Dendroica striata)*	Low
Dickcissell *(Spiza americana)*	Low
Sage sparrow *(Amphispiza belli)*	Low
Cassin's sparrow *(Aimophila cassinii)*	Low
Brewer's sparrow (*Spizella breweri)*	Moderate
Lark bunting *(Calamospiza melanocorys)*	High
Baird's sparrow *(Ammodramus bairdii)*	Low
Grasshopper sparrow *(Ammodramus savannarum)*	Low
McCown's longspur *(Calcarius mccownii)*	Low
Chestnut-collared longspur *(Calcarius ornatus)*	Low

Note: Birds listed in the table are protected under the Fish and Wildlife Conservation Act (Birds of Conservation Concern [2000] [USF&WS 2002f] and the MBTA [50 CFR 10], Executive Order 13186). Species listed as threatened or endangered under the ESA or considered endangered, threatened, or rare by the State of Utah are not included here.

Birds of primary concern are the peregrine falcon, red-tailed hawk, turkey vulture, burrowing owl, Swainson's hawk, and ferruginous hawk. Burrowing owl habitat may exist in the vicinity of white-tailed prairie dog colonies. Although burrowing owls have not been documented as occurring in the vicinity of this site, prairie dog burrows may provide suitable habitat for nesting.

3.3.10 Land Use

The Crescent Junction site is located in Grand County on lands administered by BLM approximately 31 miles north of the Moab site. The area under consideration encompasses 2,400 acres of undeveloped land near the base of the Book Cliffs on a low-lying plateau named Crescent Flats. It is north and northeast of the I-70 junction with US-191 at Crescent Junction. Area land uses are shown on Figure 3–18.

Although not designated by BLM as a recreational area, the site has no access controls, and the area's hiking, biking, and camping uses are low. BLM has designated the Crescent Junction area as access-limited to existing roads. Favorable weather allows recreational access in virtually all seasons. Although no recreational use numbers are available for this area, hiking, biking, and camping use has been observed to be low. The southern boundary of the Floy Canyon Wilderness Study Area is approximately 2 miles north and northwest of the site.

Existing land uses include grazing, oil and gas leasing, and mining claims. The site is part of the Crescent Canyon grazing allotment, which is currently under a grazing permit until 2010. There are no mining claims on the proposed disposal cell location. Currently, all sections of interest for the potential Crescent Junction site are held by oil and gas leases. None of the leases are held by production. The existing oil and gas leases expire between 2008 and 2011. BLM has temporarily suspended further mineral, oil, and gas leasing at this site, pending completion of this EIS.

The proposed location of the Williams Crescent Junction Petroleum Products terminal and pumping station is adjacent to the southern boundary of the site. The terminal would consist of a 50-acre fenced site that includes storage tanks, a truck-loading rack, a vapor combustion system, an electrical substation, offices, and warehouse buildings. This facility would be served largely by truck traffic. Williams estimates the average daily throughput from the trucks to be approximately 10,000 barrels per day.

The nearest commercial property is a gas station and convenience store at the Crescent Junction interchange (approximately 1.5 miles south) located between I-70 and the Union Pacific Railroad tracks. This property has at least one full-time resident and may have as many as five residents during the busy summer season. Much of the property on the east and west side of US-191 is owned by the State of Utah SITLA. These State lands are currently up for sale and are subject to future commercial development.

The northern boundary of Arches National Park is approximately 9 miles southeast of the Crescent Junction site.

3.3.11 Cultural Resources

The cultural history of the Crescent Junction site is discussed in the more general cultural history of southeastern Utah described in Section 3.1.13.1; the Class I cultural resource inventory that was conducted for this site is described in Section 3.1.13.2.

Results of the Class I inventory indicate that one linear Class III cultural resource survey, associated with a transmission line, has been conducted within the Crescent Junction site. On the basis of this survey, one prehistoric cultural site eligible for inclusion in the National Register of Historic Places has been identified within the boundaries of the site. The potential for cultural resources to occur on unsurveyed portions of the site is low. One predictive model based on soil type and landform (Berry 2003) indicates that an estimated 1.9 cultural sites per square mile could be expected to occur on the site.

No data exist concerning the presence of potential traditional cultural properties on the Crescent Junction site. On the basis of Class I cultural resource inventory results, tribal interviews, and published and unpublished literature, the likelihood of occurrence and their estimated density on the site are low (on a scale of low-medium-high-extremely high) for traditional cultural properties associated with the Ute Mountain Ute Tribe, White Mesa Ute Tribe, Southern Ute Tribe, Navajo Nation, and Hopi Tribe. The likelihood of occurrence and their estimated density on the site are medium for traditional cultural properties associated with the Uintah-Ouray Ute Tribe (Fritz 2004).

3.3.12 Noise and Vibration

The Crescent Junction site is located in a quiet desert environment where natural phenomena such as wind, rain, and wildlife account for most natural background noise. At times, insect activity and birds may account for significant portions of environmental noise. Sources of man-made background noise may include traffic on I-70, Union Pacific Railroad, aircraft flying overhead, and off-road recreation. Average L_{dn} would likely range from 22 dB on calm days to 38 dB on windy days (Brattstrom and Bondello 1983).

Neither background noise nor ground vibration data are available for the Crescent Junction site. Traffic noise from I-70 could raise the 1-hour L_{eq} to 55 dBA at the southern edge of the site. However, the background noise level from natural and man-made noise would average less than 50 dBA across the site.

3.3.13 Visual Resources

The Crescent Junction site is located between I-70 and the towering Book Cliffs, a linear geologic feature that runs east-west on the north side of I-70 from Grand Junction, Colorado, to Price, Utah. The proposed disposal cell location is on flat to gently undulating, buff-colored ground that is sparsely vegetated with bunchgrasses and small shrubs. The steep, dissected cliffs of the Book Cliffs provide a dramatic backdrop to the north. Westbound and eastbound travelers on I-70, travelers stopping at a scenic overlook on eastbound I-70 (Figure 3–33), and patrons of the Crescent Junction gas station have a clear view of the proposed disposal cell location. The site is also visible from several residences, currently unoccupied, in the Crescent Junction area and from several residences on the west end of Thompson Springs, a small town 6 miles east of Crescent Junction. Visual resources are classified as Class III in this area (BLM 2003b) (see Section 3.1.15 for an explanation of visual resource classes).

3.3.14 Infrastructure

The infrastructure supporting the Crescent Junction site is essentially identical to that described in Section 3.2.13 for Klondike Flats, except that the Utah Power three-phase distribution line that would supply the site runs along CR-175.

Figure 3–33. View of the Crescent Junction Site from the I-70 Scenic Overlook

3.3.15 Transportation

Section 3.1.17 provides details of area federal, state, and county road and railroad use. Table 3–15 in Section 3.1.17 provides AADT, level of congestion, truck percent, and accident rates for US-191 from Moab to Crescent Junction and for I-70 in this area. Figure 3–21 shows the location of area roads and railroad lines. US-191 terminates at Crescent Junction and the I-70 interchange. Accident rates on US-191 are low, and it is not considered congested at this junction; however, accident rates on I-70 in the area are considered moderate. Both US-191 and I-70 are considered not congested in this area.

Several local county roads provide informal access to I-70 and area attractions or towns. These are also described in Section 3.1.17. CR-175 is a paved frontage road that connects Crescent Junction to Thompson Springs and other areas to the east. Two county roads, CR-233 and CR-234, begin just east of Crescent Junction and trend north into backcountry areas. They are dirt tracks and are not passable after heavy rains.

3.3.16 Socioeconomics

Crescent Junction is approximately 31 miles north of the Moab site in Grand County, Utah (discussed in Section 3.1.18). It consists of a combination gas station and convenience store with several unoccupied former residences. The nearest town is Thompson Springs, which is 6 miles east of Crescent Junction, where temporary housing is limited to a few trailers and a campground.

3.3.17 Human Health

3.3.17.1 Background Radon and Natural Radiation

The greatest hazard from natural radiation sources is inhaled radioactivity, mostly from radon-222 and its radioactive decay products in homes and buildings, which accounts for about 200 mrem/yr. Additional natural sources include radioactive material in the earth (primarily external radiation from the uranium and thorium decay series), radioactive material in the body (primarily potassium-40), and cosmic rays from space filtered by the atmosphere.

Section 3.2.16.1 discusses natural sources of radiation. The actual radiation dose from natural background radiation varies with location. On the basis of data from the Blanding, Utah, area, the radiation dose from cosmic and cosmogenic radioactivity would be about 68 mrem/yr at the Crescent Junction site. The radiation dose from external terrestrial radioactivity would be about 74 mrem/yr, and the radiation dose from radon-222 and its radioactive decay products would be about 260 mrem/yr (IUC 2003). The total natural background radiation dose at the Crescent Junction site would be about 440 mrem/yr, considerably higher than the national average of 300 mrem/yr (Table 3–36).

No one currently resides at the Crescent Junction site. Currently, one full-time resident lives near the gas station and convenience store (approximately 1.5 miles to the south), which is located immediately north of I-70 and east of US-191. As many as five residents have lived in the area during past summer seasons. According to 2000 census data, the population within 50 miles of the Crescent Junction site was about 10,200 (Figure 3–34). Assuming that all these people were exposed to 440 mrem/yr, the population dose would be about 4,500 person-rem per year.

Table 3–36. U.S. and the Crescent Junction Site Natural Background Radiation Doses

Source	U.S. Average Natural Background Radiation Dose (millirem per year)	Crescent Junction Natural Background Radiation Dose (millirem per year)
Cosmic and cosmogenic radioactivity	28	68
Terrestrial radioactivity	28	74
Internal radioactivity	40	40
Inhaled radioactivity	200	260
Rounded Total	**300**	**440**

3.3.18 Environmental Justice

Section 3.1.20 describes the legal basis for evaluating environmental justice and general census characteristics in Grand County. One census block within 50 miles of the Crescent Junction site is reported to have greater than 50 percent minority population; this census block is approximately 20 miles north of the Crescent Junction site (Figure 3–35). One census block group north of the Crescent Junction site shows a reported income of less than $18,244 (poverty level for a family of four). It is located about 25 miles north of the Crescent Junction site (Figure 3–36). As discussed in Section 3.1.20, approximately 94 percent of Grand County was identified in the 2000 census as white, non-Hispanic.

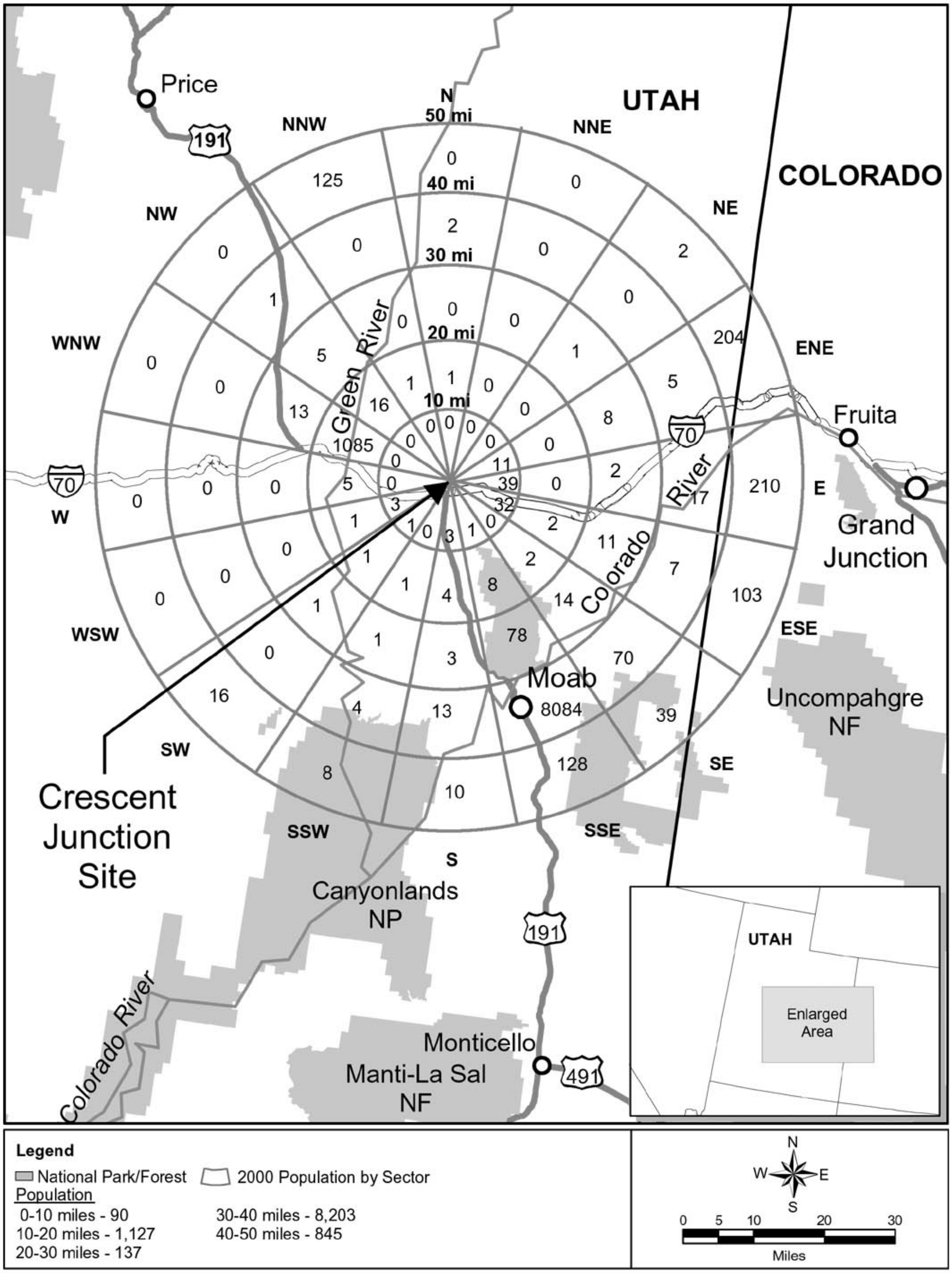
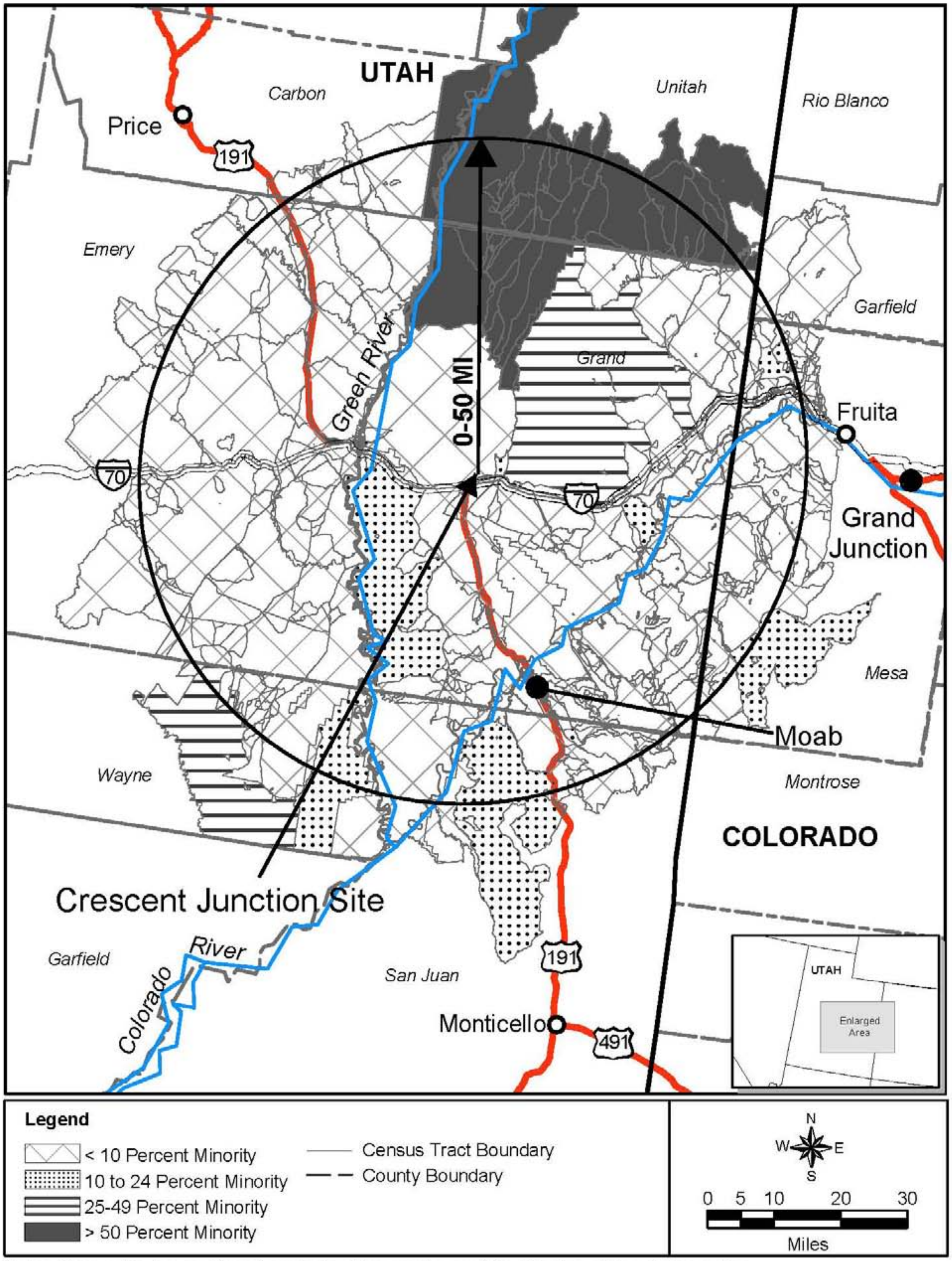
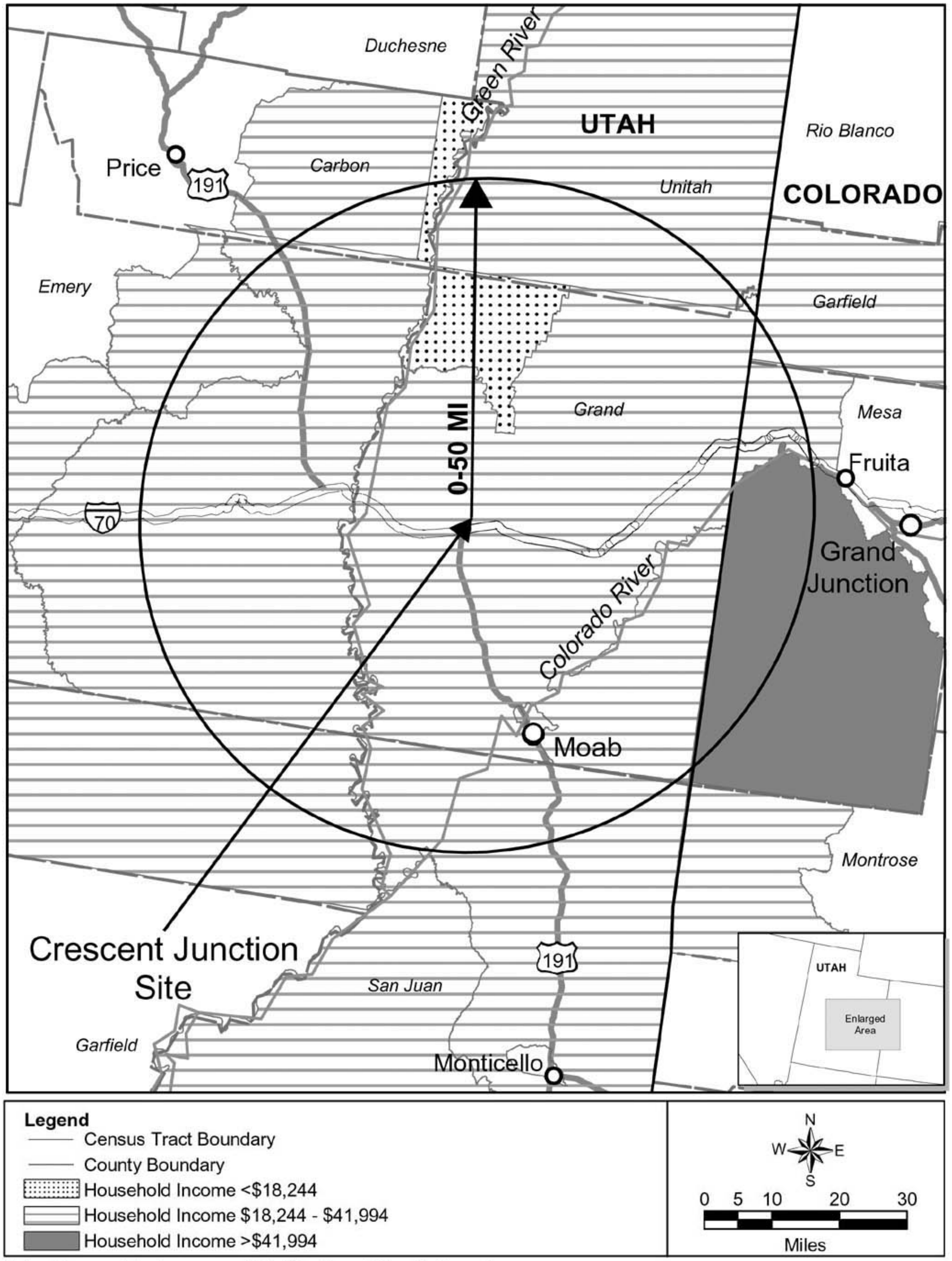


Figure 3–34. Population Within 50 Miles of the Crescent Junction Site



Note: Census blocks and American Indian Reservations within 50 miles of the site boundary.

Figure 3–35. Minority Population Distribution Within a 50-Mile Radius of Crescent Junction, Utah



Note: Census block groups within 50 miles of the site boundary.

Figure 3–36. Household Income Distribution Within a 50-Mile Radius of the Crescent Junction Site

3.3.19 Pipeline Corridor

This section describes the proposed pipeline corridor between the Klondike Flats site and the Crescent Junction site. It does not repeat information from the Moab site to the Klondike Flats site (Section 3.2.18), unless the information is necessary to provide context for this discussion.

3.3.19.1 Geology

Between the Klondike Flats site and Crescent Junction site, the proposed pipeline corridor passes over the lower and middle parts of the Mancos Shale for about 10 miles. The Mancos Shale contains expansive clay (montmorillonite) that shrinks and swells with changes in water content. No active faults or subsidence potential exists in the corridor.

3.3.19.2 Soils

Soils within the proposed pipeline corridor are formed primarily on marine shale uplands and pediments and on alluvial fans and drainages consisting of sediments derived from nearby shale and sandstone uplands. Three general soil map units occur along this segment of the pipeline corridor from south to north: rock outcrop-Nakai-Moenkopi, Chipeta-Killpack-Blueflat, and Toddler-Ravola-Glenton (SCS 1989).

The potential natural vegetation on Nakai-Moenkopi soils include (1) the shrubs fourwing saltbush, shadscale, blackbrush, and winterfat and (2) the common grasses Indian ricegrass and galleta. Plant abundance and diversity on Chipeta-Killpack-Blueflat soils are very low, even for arid rangeland, because the low-permeability soils promote rapid runoff, have low available water capacity, and are often highly saline (SCS 1989). Potential vegetation consists primarily of low shrubs, including mat saltbush and Gardner saltbush with occasional shadscale and bud sagebrush. The potential natural vegetation of the Ravola-Toddler-Glenton soils is described in Section 3.2.8. Detailed descriptions of soil types and potential natural vegetation for this pipeline corridor are available in the SOWP (DOE 2003).

3.3.19.3 Ground Water

North of the Klondike Flats site, the pipeline corridor passes generally over the lowermost part of the Mancos Shale, and ground water in the underlying Dakota Sandstone and Cedar Mountain Formations is at depths of 100 to 300 ft. For the last 3 to 4 miles to the proposed disposal site, the pipeline corridor passes over an increasing thickness of Mancos Shale, and the depth to ground water in the Dakota/Cedar Mountain increases gradually to about 3,000 ft at the Crescent Junction site.

3.3.19.4 Surface Water

The proposed slurry pipeline corridor extending north from the Klondike Flats site to the Crescent Junction site would cross several washes (e.g., Klondike Wash and Thompson Wash) and a number of other smaller, unnamed drainage features, all of which are ephemeral. No perennial surface waters are present within this proposed pipeline corridor.

Storm water runoff in the local ephemeral streams is characterized by a rapid rise in flow rates, followed by rapid recession, primarily because of the small storage capacity of the surface soils in the area. The flows in these drainage features occur primarily in response to local heavy rainfall and, occasionally, snowmelt runoff.

Water Quality and Existing Surface Water Contamination

Because there are no perennial surface waters, no data are available regarding contamination of existing surface water resources. When storm water flows through the washes within this pipeline corridor, the water is laden with sediment, and water quality is anticipated to be poor. These ephemeral washes collect surface water runoff primarily from areas composed predominantly of the Mancos Shale. Soils associated with the Mancos Shale are alkaline and may have high concentrations of selenium. As a result, surface water quality from these drainage features would likely be characterized as having high salinity, turbidity, and hardness and having elevated levels of sulfate and selenium.

Relevant Water Quality Standards

All ephemeral water bodies in this pipeline corridor are eventually tributaries to either the Green River or the Colorado River; therefore, they are subject to the water quality classifications specified in Utah Administrative Code R317-2-13 (see Chapter 7.0).

3.3.19.5 Floodplains and Wetlands

No floodplains or wetlands are known to exist along the proposed pipeline route. However, because the route may cross intermittent washes with riparian vegetation, such washes would be investigated for any small, isolated wetlands prior to construction.

3.3.19.6 Terrestrial Ecology

Section 3.3.9 describes the affected environment for terrestrial ecology on a regional basis in the Crescent Junction site area (Maps 1 and 2, Appendix C). This section addresses only the areas, wildlife, and habitat that would be affected by the proposed pipeline corridor between the Klondike Flats and Crescent Junction sites. General information applicable to the species and site descriptions as described in Section 3.3.9 are not repeated in this section.

Approximately 10 miles of the route is aligned in relatively undisturbed areas. As was the case with the segment from Moab to the Klondike Flats site, habitat for mammals is limited by sparse vegetation along the segment from the Klondike Flats site to the Crescent Junction site. Large mammals adapted to a desert environment, such as the pronghorn antelope, are likely to be present intermittently in the proposed pipeline corridor.

Table 3–25 in Section 3.2.8 presents a list of federally listed threatened and endangered species that may occur in the vicinity of the Crescent Junction site. Appendix A1, "Biological Assessment," provides more detailed information concerning these species. Of these species, the black-footed ferret and bald eagle, as described in Section 3.2.8.2 are the primary federally listed species of concern in the vicinity of the pipeline corridor between the Crescent Junction and Klondike Flats sites. In addition, the white-tailed prairie dog, currently in review for federal listing, is also of concern.

UDWR (2003b) reported an unconfirmed sighting in the vicinity of the Crescent Junction site in 1989. All black-footed ferrets currently in the wild are believed to be the result of a federal reintroduction program. It is highly unlikely that the black-footed ferrets reintroduced in Uinta and Duchesne Counties in 1999 or their offspring could occur along the pipeline corridor between the Crescent Junction and Klondike Flats sites. The environmental assessment conducted for the Grand County landfill (BLM 1995), which is located within 3 miles of the Klondike Flats site, concluded that there is no present or historical evidence of black-footed ferrets. Nevertheless, the black-footed ferret is of primary concern where potentially suitable habitat (i.e., prairie dog colonies) may exist along the northernmost sections of the route.

Numerous white-tailed prairie dog (currently under review for federal listing) colonies ranging in size from 10 acres to 2,445 acres occur around the Crescent Junction area (Seglund 2004). It is unknown to what extent individual colonies or a combination of these colonies could support black-footed ferrets.

The Utah Gap Analysis (UDWR 1999) indicates that potential high-quality bald eagle wintering habitat exists throughout many of the project areas. However, it is not known to nest or night roost nor is it known to have been observed in the vicinity of the proposed pipeline corridor between the Moab site and the Crescent Junction site.

There is no designated or proposed critical habitat for any of the above federally protected species in the vicinity of the proposed pipeline corridor between the Klondike Flats site and the Crescent Junction site.

DOE, in consultation with USF&WS and BLM, would determine the need for additional habitat evaluations and surveys for threatened and endangered species that may be affected by the proposed action should this transportation mode be selected.

The burrowing owl (Cresto 2003), ferruginous hawk, peregrine falcon, and Swainson’s hawk are not federally listed species, but they are included on the state list of sensitive species and are also protected under the MBTA. Because of previous sightings to the south of this site, it can be assumed that the peregrine falcon and ferruginous hawk may be present in the vicinity of the pipeline corridor.

3.3.19.7 Land Use

The proposed pipeline route from the Klondike Flats site to the Crescent Junction site is approximately 13 miles. Approximately 33 percent of the route would be located on federal lands administered by BLM, approximately 15 percent would be on private lands, and the remaining 52 percent would be on lands under the jurisdiction of the State of Utah.

3.3.19.8 Cultural Resources

The cultural history of this segment of the pipeline corridor is discussed in the more general cultural history of southeastern Utah described in Section 3.1.13.1; the Class I cultural resource inventory that was conducted for the proposed corridors is described in Section 3.1.13.2.

Results of the Class I inventory indicate that the segment of the pipeline corridor between the Klondike Flats site and Crescent Junction site contains approximately 20 known cultural sites that are either eligible for inclusion in the National Register of Historic Places or have been recommended as eligible. However, approximately 5 miles of the proposed route near the town of Crescent Junction have not been surveyed. The 20 sites include historic sites associated with transportation, mining, ranching, and agriculture; prehistoric lithic scatters of unknown affiliation; a small number of Formative and Archaic period sites; small rock art sites; and possibly protohistoric sites. No Paleoindian sites have been recorded along the corridor, and it is not likely that they would occur.

No data exist concerning the presence of potential traditional cultural properties along the pipeline corridor between the Klondike Flats site and Crescent Junction site. On the basis of Class I cultural resource inventory results, tribal interviews, and published and unpublished literature, the likelihood of occurrence and their estimated density on the site are low (on a scale of low-medium-high-extremely high) for traditional cultural properties associated with the Southern Ute Tribe, Navajo Nation, and Hopi Tribe. The likelihood of occurrence and their estimated density are medium for traditional cultural properties associated with the Ute Mountain Ute Tribe and White Mesa Ute Tribe and medium to high for properties associated with the Uintah-Ouray Ute Tribe (Fritz 2004).

3.3.19.9 Visual Resources

Visual resources along the Klondike Flats portion of the Crescent Junction pipeline route are described in Section 3.2.18.9. Visual resources along the remainder of the route, between the Klondike Flats and Crescent Junction sites, consist primarily of flat to gently rolling, light beige and light gray desert plains that are sparsely vegetated by saltbush and bunchgrass. The background scenery along this portion of the route varies. Along the east side of the corridor lie the rugged red and beige rocks of Arches National Park; along the west side of the corridor near the Klondike Flats site lie the smooth, rounded, buff-colored bluffs of Mancos Shale.

Approximately 3 miles north of the Klondike Flats site, the bluffs on the west side of the corridor come to an end and are replaced by the wide, flat expanse of the gray Mancos Shale desert. Visual resource designations along the entire route from the Moab site to the Crescent Junction site include Class III areas (approximately 80 percent of the route), Class IV areas (approximately 10 percent of the route), and the Class II area within Moab Canyon (approximately 10 percent of the route). Section 3.1.15 presents descriptions of the various visual resource classes.

The portion of the pipeline route from Klondike Flats to Crescent Junction is visible to travelers on US-191 for approximately 3 miles north of the Klondike Flats site. At that point, the route veers off to the northeast along an existing pipeline route and is not visible to the general public until it crosses I-70 near the town of Crescent Junction.

3.4 White Mesa Mill Site

The proposed White Mesa Mill disposal site (White Mesa Mill site) is located in San Juan County, Utah, approximately 5 miles south of Blanding, Utah. Facilities consist of a uranium-ore processing mill, ore storage pad, and four lined tailings cells with leak-detection systems and ground water monitor wells. The facilities are situated within a 5,415-acre area of private property owned primarily by IUC. The mill itself occupies approximately 50 acres, and the tailings disposal ponds occupy approximately 450 acres. The site is accessible from a half-mile-long private road connected to US-191.

Since early 1997, the mill has processed more than 100,000 tons from several additional feed stocks. Since its inception, the mill has processed a total of 4,083,144 tons of materials. This total is for all processing periods combined. Annual production of yellowcake has been as high as 3.75 million pounds per year in the 1985–1990 period. In comparison, the Moab contaminated materials are estimated at 11.8 million tons and have an in situ dry density between 90 (slimes) and 97 pounds per cubic foot. A more detailed summary of White Mesa Mill operations is provided in Appendix G.

3.4.1 Geology

The existing White Mesa Mill site is in the central part of the Colorado Plateau physiographic province known as the Canyonlands section. The site is located mostly on White Mesa, which slopes gently southward with elevations decreasing from about 5,700 to 5,400 ft. The southernmost part of the site is in a canyon that drops down to about 5,000 ft in elevation and contains an unnamed drainage that is a tributary to the Right Hand Fork of Cottonwood Wash. IUC (2003) provides a detailed description of the site geology.

3.4.1.1 Stratigraphy

Bedrock at the site is covered by up to 25 ft of unconsolidated silt and very fine-grained sand. Some alluvial material (sand and gravel) may also be present in the eastern part of the area. A generalized stratigraphic column of the White Mesa Mill site is shown on Figure 3–37.

In the north part of the millsite, the first bedrock formation present is a few feet of Mancos Shale. Below the Mancos Shale is the Dakota Sandstone, with an average thickness of 39 ft consisting mainly of sandstone and shale. Below the Dakota is the Burro Canyon Formation, which is approximately 75 ft thick.

Beneath the Burro Canyon is the thick Morrison Formation, which is composed of four members in this area. In descending order (from youngest to oldest) from the surface, the members and their respective thicknesses in the site area are: Brushy Basin, 275 ft; Westwater Canyon, 60 ft; Recapture, 120 ft; and Salt Wash, 100 ft.

The Summerville Formation, consisting mainly of siltstones, is below the Morrison. Below the Summerville are the thick Entrada and Navajo Sandstones. These sandstones were deposited mainly in eolian environments, are highly permeable, and form the principal aquifer in the region.

3.4.1.2 Structure

The White Mesa Mill site is in the south part of the ancestral Paradox Basin, in the west part of the Blanding Basin subprovince (see Figure 3–1). Rock formations in the immediate area are nearly flat lying. At the millsite, bedrock dips generally 0.5 to 1 degree to the south (IUC 2003). No faults are known in the site area or within at least a 5-mile radius.

3.4.1.3 Geologic Resources

No oil and gas resources are known to occur beneath the site. Evaporite deposits such as salt (halite) and magnesium salts (carnallite) occur in the Paradox Formation at the site; potash occurs farther north in the Paradox Basin. Recovery of these deposits would be uneconomical because of their great depth and the relative thinness of the deposits compared to other areas in the Paradox Basin.

Although uranium and vanadium deposits are known to exist 5 miles to the west and northwest of the millsite, the potential for these deposits on the site is low. Sand and gravel deposits may underlie the surface of the eastern part of the site (Gloyn et al. 1995). However, these deposits are probably scattered and insignificant (IUC 2003).

Age	Formation and Members	Thickness (ft)
Late Cretaceous	Mancos Shale	Up to 50 preserved
Early Cretaceous	Dakota Sandstone	30–50
	Burro Canyon Formation	60–90
Jurassic	Morrison Formation, Brushy Basin Member	275
	Morrison Formation, Westwater Canyon Member	60
	Morrison Formation, Recapture Member	120
	Morrison Formation, Salt Wash Member	100
	Summerville Formation	50–100
	Entrada Sandstone	300–500
	Navajo Sandstone	500–700
	Kayenta Formation	200
	Wingate Sandstone	300–400
Pennsylvanian to Triassic	Various formations from Pennsylvanian to Triassic age	2,000–3,000
	Paradox Formation	1,000–3,000

Figure 3–37. Generalized Stratigraphic Column for the White Mesa Mill Site

3.4.1.4 Geologic Hazards

Montmorillonite is present in the Brushy Basin Member of the Morrison Formation. As described in Section 3.2.1.4 and Section 3.3.1.4, changes in water content cause swelling and shrinking that can lead to subsidence. This hazard is a problem only at the edges of and on the slopes of White Mesa where the member is exposed. The Brushy Basin Member is 100 to 150 ft below the surface over most of the site and in the area being considered for a disposal cell; therefore, overburden pressures from the overlying formations and lack of exposure would prevent shrinking and swelling from becoming a problem.

The hazard exists for landslides and slumps in the canyons bordering the site where the Brushy Basin Member of the Morrison Formation forms unstable slopes (Harty 1991). Here, mudstones of the Brushy Basin Member offer little support to competent, thick sandstones of the overlying Burro Canyon Formation, especially in areas of seepage.

Earthquake risk and seismic hazard in the site area are low (Wong and Humphrey 1989). The site area is in Uniform Building Code 1, indicating the lowest potential for earthquake damage (Olig 1991).

The site area has a moderate-to-high radon-hazard potential for occurrence of indoor radon based on the geologic factors of uranium concentrations, soil permeability, and ground water depth (Black 1993). The high rating stems from the relatively high concentration of uranium in the Salt Wash Member of the Morrison Formation, the relatively high soil permeability caused by shrinking and swelling of the soils derived from the Brushy Basin Member of the Morrison Formation, and the relatively deep depth to ground water (shallow depth to water retards radon migration).

3.4.2 Soils

The soil type in this area is primarily Blanding very fine sandy loam (USDA 1962), which is deep, well-drained, and of medium texture. The soil is moderately permeable and has slow surface runoff, so water can move through the profile readily and roots can penetrate easily. Because of the moderate infiltration characteristics, erosion potential is low. However, the flows resulting from thunderstorms are nearly instantaneous. When these soils are barren, they are considered to have a high potential for wind erosion.

Also occurring in small areas near the site is the soil type Mellenthin, a very rocky fine sandy loam (USDA 1962). This soil type is very similar to Blanding very fine sandy loam but is much shallower, often only 15 inches deep. The shallow depth influences the current and potential vegetation communities and, consequently, the wildlife habitat. It is also less suitable for reseeding because it has only moderate permeability, medium runoff, and low moisture-holding capacity. Table 3–37 lists characteristics of the soil at the White Mesa Mill site.

3.4.3 Air Quality

3.4.3.1 Ambient Quality

Prior to construction of the White Mesa Mill, comprehensive evaluations of ambient air quality conditions at the millsite were conducted in the late 1970s and documented in the *Environmental Report, White Mesa Uranium Project, San Juan County, Utah* (Dames & Moore 1978), and also in the *Final Environmental Statement Related to Operation of White Mesa Uranium Project* (NRC 1979). This section summarizes these past investigations.

The State of Utah has adopted EPA standards for gaseous emissions and particulates as applicable throughout the state. Federal and state primary and secondary air quality standards are presented in Table 3–4. Primary ambient air quality standards define the relative air quality levels judged necessary, with an adequate safety margin, to protect the public *health*. Secondary ambient air quality standards define levels of air quality that are judged necessary to protect the public *welfare* from any known or anticipated adverse effects of a pollutant.

Table 3–37. Soil Types and Properties at the White Mesa Mill Site

Soil Name	Taxonomy[a]	Depth (inches)	pH	Salinity (mmho/cm)	Permeability (inches per hour)[b]	Available Water (percent)[b]	Textural Class[a]	Clay (percent)	Erodibility Factors[b,c]
Blanding very fine sandy loam, 2 to 10 percent slopes	Fine-silty, mixed mesic, Ustolic Haplargid	>60	7.7–8.3	0.40–1.07	0.6–6.0	12–18	Silty clay loam to silty loam	16–22	K = 0.37–0.43 T = 5 Wind = 3–4
Mellenthin very rocky fine sandy loam, 4 to 25 percent slopes	Loamy-skeletal, mixed mesic, Lithic Ustolic Calciorthid	15–20	8.0–8.3	0.50–0.60				N/A	

[a]Information obtained from Dames and Moore (1978).
[b]Information obtained from USDA (1993), which classifies the Blanding soil type as the Ruinpoint-Cahona association. Information in table includes data from both Ruinpoint and Cahona soil information.
[c]Erodibility factors:

- K, used in the Universal Soil Loss Equation, is an indicator of the susceptibility of a soil to sheet and rill erosion by water. Values range from 0.02 to 0.69; the higher the value, the more susceptible the soil is to sheet and rill erosion.
- T is an estimate of the maximum average annual rate of water or wind erosion in tons/acre/year.
- Wind erosion factors range from 1 to 8; the lower the value, the more susceptible the soil is to wind erosion.

mmho/cm = millimhos per centimeter.
Source: USDA 1962, 1993.

The White Mesa Mill site is located within the Four Corners Interstate Air Quality Control Region, which encompasses parts of Colorado, Arizona, New Mexico, and Utah. Air quality for any given area is evaluated according to a classification system that was established for all air quality control regions in the United States. The classification system rates the five major air pollutants (particulate matter, sulfur dioxide, nitrogen oxides, carbon monoxide, and photochemical oxidants) as having a priority of I, II, or III. A priority I rating means that a portion of the region is significantly violating federal standards for a particular pollutant, and special emission controls are needed. If the emissions are predominantly from a single point source, then it is further classified as IA. A priority II indicates a better quality of air in the region; a priority III rating classifies the highest quality. The priority classifications for the Four Corners Air Quality Control Region, which includes the White Mesa Mill site, are as follows:

	Sulfur Dioxides	Particulate Matter	Nitrogen Oxides	Carbon Monoxide	Photochemical Oxidants
Priority Classification	IA	IA	III	III	III

Ambient pollutant concentrations that define the classification system are outlined in Table 3–38.

Table 3–38. Federal Regional Priority Classifications Based on Ambient Air Quality

Pollutant	Averaging Time	Air Quality for Each Priority Group[a,b]		
		I	II	III
Sulfur oxides	Annual 24 hour 3 hour	>100 µg/m^3 >455 µg/m^3	60–100 µg/m^3 260–455 µg/m^3 1,300 µg/m^3	<60 µg/m^3 <260 µg/m^3 <1,300 µg/m^3
Particulate matter	Annual 24 hour	>95 µg/m^3 >325 µg/m^3	60–95 µg/m^3 150–325 µg/m^3	<60 µg/m^3 <150 µg/m^3
Carbon monoxide	8 hour 1 hour	>14 mg/m^3 >55 mg/m^3	NA	<14 mg/m^3 <55 mg/m^3
Nitrogen dioxide	Annual	>110 µg/m^3	NA	<110 µg/m^3
Photochemical oxidants	1 hour	>195 µg/m^3	NA	<195 µg/m^3

[a]In the absence of measured data to the contrary, any given region containing an area whose 1970 "urban place" population exceeds 200,000 will be classified priority I. All others will be classified priority III. Hydrocarbon classifications will be same as for photochemical oxidants. There is no priority II classification for carbon monoxide, nitrogen dioxide, and photochemical oxidants. Hydrocarbon classifications will be the same as for photochemical oxidants.
[b]µg/m^3 = micrograms per cubic meter; mg/m^3 = milligrams per cubic meter.

Air quality at the White Mesa Mill site area has a priority rating of IA, which signifies a violation of federal air standards for particulate matter and sulfur dioxide, both of which are attributable to emissions from fossil-fueled power plants located within the region. However, none of the power plants lie within 31 miles of the millsite, which suggests that the air quality in the vicinity of the site may be better than the priority IA classification indicates.

The State of Utah monitors total suspended particulates and sulfur dioxide at a station located 66 miles west of the millsite at Bull Frog Marina (Lake Powell). Except for the short-term (24-hour) particulate measurement, all reported values were well below the federal and State of Utah air quality standards. The 24-hour particulate violations are believed to have been caused by dust blown by high winds.

On the basis of data collected from sampling locations at the White Mesa Mill site for 1 year, dust-fall averaged 33 grams per square meter (g/m^2) per month; the highest monthly average was 102 g/m^2 occurring in August. Total suspended particulates monitoring from October 1977 through February 1978 produced a geometric mean of 18 $\mu g/m^3$. This value is well below the federal and state air quality standard of 50 $\mu g/m^3$. The maximum 24-hour concentration was 79 $\mu g/m^3$, or approximately one-half of the federal and state standard of 150 $\mu g/m^3$. Sulfation-rate monitoring at the White Mesa Mill site indicates that sulfur dioxide concentrations at the site are less than 0.005 parts per million (ppm). The federal and state standard for the annual average of sulfur dioxide is 0.03 ppm.

At the time of the 1978 environmental report (Dames and Moore 1978) and final environmental statement (NRC 1979), the Four Corners Air Quality Control Region had an air quality priority IA rating. This was an important consideration at the time because there was significant concern that windblown dust from coal storage stockpiles and air emissions (i.e., sulfur dioxides, particulate matter, carbon monoxide, and nitrogen oxides resulting from combustion of coal to power the mill) associated with operation of the mill would further degrade air quality in the region. However, the use of coal to fire boilers at the mill was discontinued in 1990. By 1994, propane was used to fire all process and heating boilers. The mill is no longer required to perform sulfation rate monitoring. NRC's final environmental statement concluded that operation of the White Mesa Mill would not have any significant impact upon regional air quality.

Currently, nonradioactive air emissions from the White Mesa Mill are regulated by the State of Utah in accordance with an air quality permit (1997 Approval Order DAQE-884-97). This permit establishes annual emission limits for the mill's yellowcake dryers and the vanadium circuit scrubber. Requirements for controlling dust from roads and fugitive sources are also included in this permit. The permit also specifies that the mill must comply with National Emissions Standards for Hazardous Air Pollutants for radon emissions (40 CFR 61). The air quality permit requires that particulate emissions (PM_{10}) to the atmosphere shall not exceed 0.40 pound per hour for each yellowcake dryer and 2.50 pounds per hour for the vanadium circuit scrubber. Compliance testing of the scrubber and dryers must be performed within 180 days of the startup of a new emission point or the inclusion of an emission point in the permit and, thereafter, if and when directed by UDEQ. Monitoring for radionuclide emissions is conducted while the mill is operating.

To ensure compliance with applicable air quality standards and the requirements of the permit, restrictions are in place that control emissions from specific pieces of milling equipment and operations. These restrictions ensure compliance with emission levels specified in the permit by controlling ore processing rates and propane gas consumption rates. The mill is required to submit an annual emission inventory to UDEQ. Table 3–39 summarizes the annual emission inventory for the key criteria emissions for the last 6 years. The key criteria emissions are PM_{10}, sulfur oxides, nitrogen oxides, volatile organic compounds, and carbon monoxide.

The NRC license also requires the mill to monitor total particulate matter. The mill's environmental air monitoring program uses four high-volume continuous air sampling stations; filters from each station are changed approximately every 7 days. Data collected from the air monitoring program are reported to NRC in semiannual effluent monitoring reports as required by 10 CFR 40.65.

Table 3–39. Air Emission Inventory for Key Criteria Emissions (tons per year)

Year	PM_{10}	Sulfur Oxides	Nitrogen Oxides	Volatile Organic Compounds	Carbon Monoxide
1997	0.775	0.255	3.859	2.120	7.257
1998	-	-	-	-	-
1999	2.57	1.15	18.11	2.16	14.14
2000	1.9	1.47	14.61	2.76	11.78
2001	-	-	-	-	-
2002	0.68	0.98	9.04	1.80	11.49

Environmental air monitoring data collected to date indicate that concentrations of total suspended particulate matter resulting from mill emissions are in compliance with the applicable regulatory limit of 50 $\mu g/m^3$ and do not vary significantly from ambient concentrations of particulate matter measured at the mill. During a recent mill run (April–October 1999), average concentrations for particulate matter ranged from 20 to 40 $\mu g/m^3$. By comparison, concentrations of particulate matter were measured at 26 to 44 $\mu g/m^3$ during a period in 2001 when operations were suspended at the mill.

3.4.3.2 Visibility

Southeastern Utah is known for its scenic vistas and attracts many visitors each year. Stack emissions (primarily steam) from the mill are visible to the public traveling US-191 east of the White Mesa Mill site. These emissions are not visible from the major recreational areas in the vicinity of the mill.

In its 1979 final environmental statement, NRC concluded that there would be no significant impacts to air quality as a result of the White Mesa Mill operations. NRC concluded that, although the operation of the mill would result in a slight increase in concentrations of particulate matter and ambient gaseous emissions, the concentrations would be below federal and state air quality standards, and they would not significantly degrade the regional air quality (NRC 1979).

Beginning with the 1994/1995 mill run, propane was used to fire all process and heating boilers. As a result, impacts to visibility resulting from windblown dust (from coal storage stockpiles) and from air emissions associated with the combustion of coal were significantly reduced.

3.4.4 Climate and Meteorology

The climate of the site area in southeastern Utah is classified as semiarid continental. Data from the National Weather Service station in Blanding (approximately 5 miles north of the site) are considered representative of the site weather conditions. Weather data summarized by the Utah Climate Center for the town of Blanding are presented in the following discussion (Pope and Brough 1996).

Although varying somewhat with elevation and terrain, the climate in the White Mesa Mill area is also considered as semiarid, with normal annual precipitation of about 13.4 inches. Precipitation is characterized by wide variations in annual and seasonal rainfall punctuated by long periods of drought. Most precipitation is in the form of rain; the average annual snowfall of about 40 inches accounts for about 29 percent of the annual total precipitation. The region has two separate rainfall seasons; one is in late summer to early autumn (July to October) and corresponds to the southwest monsoon season, and one is during the winter months of December to March. The mean annual relative humidity is about 44 percent and is normally highest in January and lowest in July.

The average annual Class A pan evaporation rate is 68 inches; the largest evaporation rate typically occurs in July (IUC 2003). Warm summers and cold winters typify the weather in the Blanding area. The mean annual temperature in Blanding is about 50 °F; the mean annual maximum is 63.6 °F, and the mean annual minimum is 36.4 °F. The coldest temperature recorded was –23 °F in February 1933 and the hottest temperature was 110 °F in June 1905. January is the coldest month, with an average low temperature of 16 °F and an average high temperature of 38 °F. July is the hottest month, with an average high temperature of 89 °F and an average low temperature of 57 °F.

Winds are usually light to moderate in the area during all seasons, although occasional stronger winds may occur in the late winter and spring. Winds are from the north and northeast approximately 30 percent of the time and from the south and southwest about 25 percent of the time. Winds are generally less than 15 mph; wind speeds faster than 25 mph occur less than 1 percent of the time.

3.4.5 Ground Water

3.4.5.1 Hydrostratigraphy

The White Mesa Mill site is underlain by unconsolidated alluvium and indurated sedimentary rocks of Cretaceous and Jurassic age consisting primarily of sandstone and shale. Ground water in the vicinity of the site occurs primarily as perched water in the Burro Canyon Formation of Cretaceous age, and under confined conditions in the Entrada and Navajo Sandstones of Jurassic age. The Entrada and Navajo Sandstones constitute the primary aquifer in the area of the White Mesa Mill site. The Entrada and Navajo Sandstones are separated from the Burro Canyon Formation by approximately 1,000 ft of unsaturated materials of the Morrison and Summerville Formations of Jurassic age that have a low average vertical permeability and form a significant aquitard.

3.4.5.2 Ground Water Occurrence

Perched ground water beneath the site occurs primarily within the Burro Canyon Formation. The saturated thickness of the perched ground water zone generally increases to the north of the site. Perched ground water is supported within the Burro Canyon Formation by the underlying, fine-grained Brushy Basin Member of the Morrison Formation. The contact between these two units generally dips to the south-southwest beneath the site. The permeability of the Burro Canyon Formation is generally low; no significant joints or fractures are documented by cores from any wells or borings in the area. Any fractures in cores collected from site borings were typically cemented and had no open space. Some conglomeratic zones within the perched ground water system were observed east to northeast of the tailings cells at the site and may represent a relatively continuous zone of higher permeability. This zone is hydraulically cross gradient to upgradient of the tailings cells with respect to perched ground water flow. The higher permeability zone may extend beneath the southeastern margin of the cells but does not appear to exist downgradient (south-southwest) of the tailings cells based on current data.

Perched ground water was noted at depths of approximately 50 to 110 ft below land surface in the vicinity of the tailings cells at the site (IUC 2003). Information collected by the State of Utah Division of Radiation Control in September 2002 indicated that depth to ground water ranged from 17 to 110 ft and averaged 71 ft. The saturated thickness of the perched ground water zone ranges from approximately 82 ft in the northeast portion of the site to less than 5 ft in the southwest portion of the site (IUC 2003). Perched ground water flow at the site is generally to the south-southwest, and hydraulic gradients range from 0.04 ft/ft to less than 0.01 ft/ft downgradient of the tailings cells. The ground water gradient changes from generally southwesterly in the western portion of the site to generally southerly in the eastern portion of the site. In general, perched ground water levels have not changed significantly in most areas. An increase in water levels in the east and northeast portions of the site since 1994 are probably attributable to seepage from two wildlife ponds (IUC 2003). This activity may affect the ground water flow regime in the perched ground water system in this area.

Recharge to the perched ground water system is through percolation of rainfall and snowmelt through surface soils over the mesa top, along with infiltration of water from the wildlife ponds. Perched ground water at the millsite discharges where the Burro Canyon Formation crops out in springs and seeps along Westwater Creek Canyon and Cottonwood Canyon to the west-southwest of the site and along Corral Canyon to the east of the site. The primary discharge point for perched water flowing beneath the tailings cells is believed to be Ruin Spring in Cottonwood Canyon, approximately 2.5 miles south-southwest of the millsite. Ruin Spring is the only spring that flows consistently. The Ute Mountain Ute Tribe has indicated that it has performed extensive surveys of the seeps and springs on the perimeter of the geographic White Mesa, including tribal and BLM land, and that Ruin Springs is not the only consistently flowing spring on the mesa. DOE has requested these data from the tribe and will address the data once they are received.

The Entrada and Navajo Sandstones are prolific aquifers beneath and in the vicinity of the White Mesa Mill site. Because water wells at the site are screened through both of these units, they will be considered as a single aquifer. Ground water in the Entrada/Navajo aquifer is under artesian pressure, rising 800 to 900 ft above the top of the Entrada contact with the overlying Summerville Formation. Static ground water levels are 390 to 500 ft below ground surface. The site is located within a region that has a dry to arid continental climate and an average annual precipitation of 13.4 inches (IUC 2003). Recharge to regional aquifers occurs primarily along the mountain fronts (such as the Henry Mountains to the west and the Abajo Mountains to the north) and along the flanks of folds (such as Comb Ridge Monocline to the west).

3.4.5.3 Ground Water Quality

The quality of the Burro Canyon perched ground water beneath and downgradient from the site is poor and extremely variable. Concentrations of TDS measured in water sampled from upgradient and downgradient wells range between 1,200 and 5,000 mg/L (IUC 2003). Split sampling by the State of Utah Division of Radiation Control in September 2002 indicated a TDS concentration in perched ground water ranging from 608 to 5,390 mg/L. Approximately 55 percent of the wells sampled had a TDS concentration of less than 3,000 mg/L. Consequently, these wells appear to intercept drinking-water-quality ground water under the Utah Ground Water Quality Protection Regulations (Class II ground water) (UAC 2003a). Sulfate concentrations measured in samples from three upgradient wells varied between 670 and 1,740 mg/L. The spatial variability of the ground water quality makes the definition of background water quality a challenge over the large extent of the millsite. This definition of background water quality is currently being refined.

Ground water monitoring for the past 20 years at the site has shown no impact to perched ground water from the tailings cells (IUC 2003). However, during the May 1999 sampling event, the presence of chloroform and other man-made volatile organic compounds was detected in samples from the perched aquifer beneath the White Mesa Mill site. Subsequent aquifer characterization by IUC indicated that the chloroform plume was approximately 1,700 ft long and located across the eastern margin of the IUC facility. According to IUC, the chloroform was used in the laboratory of an earlier ore-buying station that operated at the site. The chloroform used for that operation was disposed of through a leach field. However, IUC has not yet completed its ground water contaminant investigation report required by an August 23, 1999, UDEQ ground water corrective action order. Therefore, it is not yet known how many sources of chloroform actually contributed to the contaminant plume along the eastern margin of the site.

Water quality from Ruin Spring (discharge from the perched ground water system), approximately 2.5 miles south-southwest of the mill, is generally good; TDS concentration is less than 1,000 mg/L (IUC 2003).

Ground water quality in the Entrada/Navajo aquifer is good; TDS content ranges from 216 to 1,110 mg/L (IUC 2003). Sampling of ground water in the Entrada/Navajo aquifer is not required under the mill's monitoring program because the aquifer is isolated from the perched ground water zone by approximately 1,000 ft of rock formations that have a low average vertical permeability.

UDEQ has identified potential elevated uranium concentrations in the shallow alluvial aquifer that exceed state ground water quality standards. If UDEQ determined that ground water corrective action or remediation was required, DOE would consult with UDEQ to determine the most feasible location for the “dry cell”.

3.4.5.4 Ground Water Use

Because of the generally low permeability of the perched ground water zone beneath the site, well yields are typically low (less than 0.5 gpm), although yields of about 2 gpm or greater may be possible in wells intercepting the higher permeability zones on the east side of the site (IUC 2003). Sufficient productivity can, in general, only be obtained in areas where the saturated thickness is greater, which is the primary reason that the perched ground water zone has been used on a limited basis as a water supply to the north (upgradient) of the site. The perched ground water is used primarily for stock watering and irrigation.

The Entrada/Navajo aquifer is capable of yielding domestic quality water at rates of 150 to 225 gpm and is used as a secondary source of potable water for the White Mesa Mill. Five deep water supply wells constructed by IUC at the White Mesa Mill facility (WW-1 through WW-5) are used for industrial and domestic needs. These wells are completed in the Entrada/Navajo aquifer. Also, two domestic water supply wells located 4.5 miles southeast of the millsite on the Ute Mountain Ute Indian Reservation draw water from this aquifer. Although the water quality and productivity of the Entrada/Navajo aquifer are generally good, the depth of the aquifer (approximately 1,200 ft below land surface) makes access difficult.

3.4.6 Surface Water

3.4.6.1 Surface Water Resources

No perennial surface water is present on the White Mesa Mill site. This lack of surface water results from the gentle slope of the mesa on which the site is located, the low average annual rainfall of 13.4 inches (measured at Blanding), local soil characteristics, and the porous bed material of local stream channels. The millsite is drained almost equally by Corral Creek on the east and by Westwater Creek and Cottonwood Wash on the west. White Mesa is defined by these two adjacent main drainages that have cut deeply into the regional sandstone formations. Storm water runoff in the local ephemeral streams is characterized by a rapid rise in flow rates followed by rapid recession, primarily because of the small storage capacity of the surface soils in the area. Monthly water flow is monitored on the larger drainage features (Cottonwood Wash, Recapture Creek, and Spring Creek); however, the smaller water courses closest to the millsite are not monitored because of their infrequent flows. Water flows through these drainages primarily during local heavy rainfall (occurring mostly during the months of August through October) and snowmelt (occurring mostly in April). Flow typically ceases in Corral and Westwater Creeks within 6 to 48 hours following significant storm events.

The U.S. Geological Survey (USGS) maintains two stream gages on watercourses in the region. One gaging station (No. 09378630) is located on Recapture Creek in the upper portion of the watershed at an elevation of 7,200 ft above mean sea level; the second gaging station (No. 098378700) is located on Cottonwood Wash approximately 7 miles southwest of Blanding at an elevation of 5,138 ft. Corral Creek has a drainage area of approximately 5.8 square miles adjacent to the site and is a tributary of Recapture Creek. Westwater Creek on the western edge of the site has a drainage area of nearly 27 square miles and is a tributary of Cottonwood Wash. Both Cottonwood Wash and Recapture Creek flow in a southerly direction and are tributaries of the major drainage artery of the region, the San Juan River. The San Juan River is a major tributary of the Colorado River and drains approximately 23,000 square miles above Bluff, Utah, which is located at the mouth of Cottonwood Wash. The San Juan River flows in a westerly direction toward its confluence with the Colorado River at Lake Powell, which is about 114 river miles west of Bluff. The major drainages in the vicinity of the White Mesa Mill site are summarized in Table 3–40. Total runoff from the site is estimated to be less than 0.5 inch annually.

Table 3–40. Drainage Basins Near the White Mesa Mill Site

Basin Description	Drainage Area (square miles)
Corral Creek at confluence with Recapture Creek	5.8
Westwater Creek at confluence with Cottonwood Wash	26.6
Cottonwood Wash at USGS gage west of millsite	<205
Cottonwood Wash at confluence with San Juan River	<332
Recapture Creek at USGS gage station	3.8
Recapture Creek at confluence with San Juan River	<200
San Juan River at USGS gage downstream at Bluff, Utah	<23,000

Source: *Description of the Affected Environment, White Mesa Mill, Blanding, Utah, for Transport by Slurry Pipeline and Disposal of the Moab Tailings* (IUC 2003)

Two small, ephemeral catch basins are located near the millsite; these ponds are filled by the mill to provide water and habitat for local wildlife. Springs and seeps at the edge of White Mesa are fed by the perched aquifer system and support wildlife and livestock in the area. These springs and seeps may constitute future points of exposure for mill tailings contaminants.

3.4.6.2 Surface Water Quality

Sampling of surface water quality in the mill vicinity began in July 1977 and continued through March 1978. Baseline data show conditions existing at the millsite and vicinity at that time. No samples were collected from the two catch basins at that time because they were dry. Sampling of ephemeral surface waters in the vicinity was possible only during major precipitation events; these streams are normally dry at other times.

Previous investigations (IUC 2003) concluded that surface water quality in the vicinity of the millsite is generally poor. Water samples collected from Westwater Creek were characterized as having high TDS (averaging 674 mg/L) and sulfate (averaging 117 mg/L). The waters were typically hard (total hardness measured as calcium carbonate averaged 223 mg/L) and had an average pH of 8.25; however, according to Utah ground-water classification and water-quality standards, TDS concentrations for a drinking water class II aquifer range from 500 to 3,000 mg/L. Estimated water velocities for Westwater Creek averaged 0.3 ft per second at the time of sampling. Samples from Cottonwood Creek were similar in quality to those from Westwater Creek, although TDS and sulfate levels were lower (TDS averaged 264 mg/L; sulfate averaged 40 mg/L) during heavy spring flow conditions (80 ft per second water velocity). During heavy runoff, the concentration of TDS in these streams increased to more than 1,500 mg/L. Concentrations of mercury and iron above background were measured in some samples. These values appear to reflect surface water quality in the area and are probably because of evaporative concentration and not because of human disturbance of the environment (NRC 1979).

In 1997, NRC prepared an environmental assessment (NRC 1997) to address renewal of the White Mesa Mill source material license (No. SUA-1358). NRC specified that surface water monitoring would be conducted at two sampling locations, Westwater Creek and Cottonwood Creek, adjacent to the mill. Grab samples were collected annually from Westwater Creek and quarterly from Cottonwood Creek.

These surface water samples were analyzed for TDS, total suspended solids, gross alpha, and total and dissolved concentrations of natural uranium, thorium-230, and radium-226. Field measurements included pH, specific conductivity, and temperature. Since the mill began operations in 1980, the measured values for these constituents have been consistently low.

Table 3–41 summarizes the results from monitoring conducted at Cottonwood Creek and Westwater Creek. In 2000 and 2002, Westwater Creek was dry, so no data are available for those years. Data from the mill's monitoring program indicate that concentrations of all analytes in samples collected from the Cottonwood and Westwater Creeks are within the range of background (NRC 1979).

Table 3–41. Monitoring Results for Surface Water Samples Collected from Cottonwood Creek and Westwater Creek near the White Mesa Mill Site

Sample Date Status	Dissolved Uranium (pCi/L)	Total Uranium (pCi/L)	Dissolved Th-230 (pCi/L)	Total Th-230 (pCi/L)	Dissolved Ra-226 (pCi/L)	Total Ra-226 (pCi/L)	Gross Alpha (pCi/L)	TDS (mg/L)	Total Suspended Solids (mg/L)
Cottonwood Creek									
3/17/98	6.11×10^{-3}	$<2.0 \times 10^{5}$	$<2.0 \times 10^{5}$	$<2.0 \times 10^{4}$	$<2.0 \times 10^{5}$	$<2.0 \times 10^{5}$	N/A[d]	N/A	N/A
11/02/98	3.25×10^{-3}	1.22×10^{-3}	$<2.0 \times 10^{5}$	$<2.0 \times 10^{4}$	5.0×10^{-4}	N/A	N/A	N/A	N/A
7/17/99	6.67×10^{-3}	0.0243	$<2.0 \times 10^{5}$	3.25×10^{-3}	$<2.0 \times 10^{5}$	0.0962	N/A	N/A	N/A
08/03/99	6.67×10^{-3}	0.0243	$<2.0 \times 10^{5}$	3.25×10^{-3}	$<2.0 \times 10^{5}$	0.0962	N/A	N/A	N/A
06/30/00	0.0684	<200	<0.135	<0.135	8.0×10^{-4}	$<2.0 \times 10^{-4}$	N/A	N/A	N/A
12/31/00	7.04×10^{-3}	4.06×10^{-4}	<0.135	<0.135	2.3×10^{-3}	$<2.0 \times 10^{-4}$	4.10	N/A	N/A
04/06/01	0.44	<0.203	<0.135	<0.135	$<2.0 \times 10^{-4}$	$<2.0 \times 10^{-4}$	N/A	N/A	N/A
12/06/01	57.6	3.93	<0.20	<0.20	1.20	0.10	3.0	646	6
04/24/02	6.84	<0.203	4.41	<0.20	<0.20	<0.20	<1.00	360	57
Westwater Creek									
11/21/98	2.98	3.18	<0.20	<0.20	<0.20	<0.20	<1.00	637	26
08/03/99	2.78	1.40	<0.20	6.80	<0.20	3.80	12.3	152	8,230
04/06/01	2.37	<0.203	<0.20	<0.20	<0.20	<0.20	2.0	608	3.3

pCi/L = picocuries per liter.
mg/L = milligrams per liter.
N/A = not available.
Source: IUC 2003.

3.4.6.3 Relevant Water Quality Standards

All ephemeral water bodies near the White Mesa Mill site area are tributaries of the San Juan River, which flows into the Colorado River; therefore, they are subject to the water quality classifications specified in Utah Administrative Code R317-2-13 (see Chapter 7.0).

3.4.7 Floodplains

Several streams exist near the White Mesa Mill site, but the site lies outside any potential floodplains. A more detailed description of these streams is available in Appendix F.

3.4.8 Wetlands

Topographic maps of the region potentially indicate 10 areas with riparian or wetland potential within the site boundary. Water resources in and near the White Mesa Mill site have not been assessed in detail, but several resources are known to exist. Appendix F includes more detailed descriptions and the locations of these known resources.

3.4.9 Terrestrial Ecology

This section describes the vegetation and wildlife, including protected and sensitive species, for the White Mesa Mill site. The region north of the millsite has the greatest diversity of vegetation compared to the other alternative sites. This diversity is primarily because of variation in life zones, elevations, and precipitation between the Moab site and the White Mesa Mill. However, sparsely vegetated desert-shrub communities dominate the immediate millsite area.

3.4.9.1 Terrestrial Vegetation and Wildlife

At the White Mesa Mill site, several areas were chained (i.e., trees and vegetation were removed) to support an active cattle ranch prior to mill operations. These areas were reseeded but are now mostly void of vegetation because of overgrazing, which has resulted in limited habitat. Current vegetation consists primarily of crested wheatgrass and invasive weeds. Surrounding areas of abandoned dry farms are dominated by annual weeds, rabbitbrush, snakeweed, sagebrush, and cheatgrass. Areas that were neither cultivated nor chained support sagebrush communities with a sparse understory of grasses, including galleta and crested wheatgrass. The potential vegetation consists of more than 50 percent palatable grasses such as western wheatgrass, Indian ricegrass, needle-and-thread, and squirreltail; 15 to 20 percent increaser grasses, including galleta and blue grama; 25 percent decreaser browse plants, including winterfat; and 5 to 10 percent big sagebrush, ephedra, and other shrubs. Forbs are rare.

On a visit to the site on January 29, 2003, the north and south sides of the entrance road to the White Mesa Mill were surveyed, and plant composition was documented. Three different areas similar to those described by the U.S. Department of Agriculture (USDA 1993) were observed. One area, northeast of the entrance road, is dominated by basin big sagebrush, which accounts for approximately 30 percent of the relative cover. The understory consists of galleta (20 to 30 percent), Indian ricegrass (5 percent), and cheatgrass (10 percent). Rubber rabbitbrush is growing along the disturbed soil next to the road. The area south of the entrance road is dominated by Wyoming big sagebrush (50 percent relative cover), and galleta and cheatgrass each account for approximately 10 percent of the relative cover. The northwest area of the entrance road has been previously seeded with crested wheatgrass (20 percent relative cover);

rubber rabbitbrush (30 percent) is the dominant shrub. Other grasses include galleta (5 percent) and cheatgrass (5 percent). Table 3–42 shows the vegetation characteristics of the site, and Table 3–43 presents detailed vegetative structure at the site.

The millsite is somewhat comparable to the Moab site in terms of wildlife diversity and abundance. Pronghorn antelope, mule deer, and bobcat may occur in the vicinity of the site, depending upon habitat type. The red fox, gray fox, badger, longtail weasel, desert cottontail, and black jackrabbit are known to occur on the site.

Table 3–42. Vegetation Characteristics on the Various Soil Types at the White Mesa Site

Soil Name	Range Site	Characteristic Potential Vegetation	Percent	Productivity (pounds/acre)	Rooting Depth (inches)
Blanding very fine sandy loam, 2 to 10 percent slopes	Semidesert loam	Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis)*	20	400–800	>60
		Indian ricegrass (*Achnatherum hymenoides)*	15		
		Galleta (*Pleuraphis jamesii)*	10		
		Bottlebrush squirreltail (*Elymus elymoides)*	10		
		Winterfat *(Ceratoides arborescens)*	10		
		Globemallow (*Sphaeralcea* spp.*)*	5		
		Needle-and-thread *(Hesperostipa comata)*	5		
		Douglas rabbitbrush (*Chrysothamnous viscidiflorus)*	5		

Notes: USDA (1993)**,** Mellenthin soil type not found.
Source: NRCS 2002; SCS 1989.

Table 3–43. Community Structure Parameters of the White Mesa Mill Site Plant Communities

Community Group/Species	Relative Density	Percent Cover	Relative Cover	Relative Frequency
Reseeded Grassland I				
Grasses and grasslike plants				
Crested wheatgrass (*Agropyron cristatum)*	92.0	12.0	78.2	66.4
Sixweeks fescue (*Vulpia octoflora)*	1.0	0.1	0.5	5.6
Galleta (*Pleuraphis jamesii)*	2.0	0.3	2.4	2.4
Squirreltail (*Elymus elymoides)*	1.0	0.1	0.5	2.4
Forbs				
Chicory *(Cichorium intybus)*	0.3	0.2	1.2	2.4
Scarlet globemallow (*Sphaeralcea coccinea)*	0.3	0.1	0.5	2.4
Shrubs				
Broom snakeweed (*Gutierrezia sarothrae)*	4.0	1.9	13.3	16.0
Pale desert-thorn (*Lycium pallidum)*	0.3	0.5	3.6	2.4
Total vegetative cover		15.2		
Bare Ground Litter		61.0 24.2		
Reseeded Grassland II				
Grasses and grasslike plants				
Crested wheatgrass (*Agropyron cristatum)*	96.0	8.9	82.7	75.0
Forbs				
Russian thistle (*Salsola kali)*	0.6	0.1	1.2	5.0
Scarlet globemallow (*Sphaeralcea coccinea)*	3.0	1.4	13.0	15.0

Table 3−43. Community Structure Parameters of the White Mesa Mill Site Plant Communities (continued)

Community Group/Species	Relative Density	Percent Cover	Relative Cover	Relative Frequency
Shrubs				
Broom snakeweed (*Gutierrezia sarothrae)*	0.6	0.3	3.1	5.0
Total vegetative cover		10.7		
Bare Ground Litter		79.7 9.5		
Controlled Big Sagebrush				
Grasses and grasslike plants				
Crested wheatgrass (*Agropyron cristatum)*	19.0	3.4	19.3	15.0
Galleta (*Pleuraphis jamesii)*	16.0	2.8	15.9	18.0
Indian ricegrass (*Achnatherum hymenoides)*	3.0	0.5	3.0	2.0
Squirreltail (*Elymus elymoides)*	10.0	1.7	9.8	24.0
Forbs				
Lesser rushy milkvetch (*Astragalus convallarius)*	3.0	0.5	3.0	5.0
Russian thistle (*Salsola kali)*	11.0	1.9	11.2	15.0
Scarlet globemallow (*Sphaeralcea coccinea)*	0.2	0.1	0.2	2.0
Shrubs				
Big sagebrush (*Artemisia tridentata)*	27.0	4.7	27.0	7.0
Broom snakeweed (*Gutierrezia sarothrae)*	10.0	1.8	10.4	12.0
Total vegetative cover		17.3		
Bare Ground Litter		67.4 15.3		
Big Sagebrush				
Grasses and grasslike plants				
Galleta (*Pleuraphis jamesii)*	72.8	12.7	38.1	35.9
Squirreltail (*Elymus elymoides)*	19.0	1.1	3.3	23.4
Shrubs				
Big sagebrush (*Artemisia tridentata)*	4.6	18.9	56.8	20.3
Broom snakeweed (*Gutierrezia sarothrae)*	3.6	0.5	1.5	10.9
Total vegetative cover		33.3		
Bare Ground Litter		49.9 16.9		
Pinon-Juniper				
Grasses and grasslike plants				
Fendler threeawn (*Aristida purpurea)*	13.1	2.1	8.1	9.7
Cheatgrass (*Bromus tectorum)*	1.2	0.1	0.4	4.8
Galleta (*Pleuraphis jamesii)*	26.2	0.8	3.1	9.7
Indian ricegrass (*Achnatherum hymenoides)*	1.2	0.6	2.3	1.6
Squirreltail (*Elymus elymoides)*	4.8	0.1	0.4	3.2
Cushion buckwheat (*Eriogonum ovalifolium)*	3.6	0.1	0.4	5.6
Forbs				
Sand gilia (*Gilia leptomeria)*	8.3	0.04	0.1	1.6
Stickseed (*Lappula occidentalis)*	1.2	2.4	9.3	1.6
Shrubs				
Big sagebrush (*Artemisia tridentata)*	5.9	4.0	15.4	30.3
Yellow rabbitbrush (*Chrysothamnous viscidiflorus* var *stenophyllus)*	1.2	0.3	1.1	5.6
Mexican cliffrose (*Purshia mexicana)*	3.6	4.0	15.4	23.0
Broom snakeweed (*Gutierrezia sarothrae)*	14.3	1.3	5.0	30.4
Plains pricklypear (*Opuntia polyacantha)*	2.4	0.2	0.8	6.3
Trees				
Utah juniper (*Juniperus osteosperma)*	4.8	7.2	27.8	37.6
Pinon pine (*Pinus edulis)*	1.2	0.8	3.1	5.7
Lichen		1.0	3.9	29.5
Moss		0.8	3.1	6.3
Total vegetative cover		25.9		
Bare Ground Litter Rock		55.6 15.6 4.4		

Notes: Table from Dames and Moore (1978); indicates plant communities at time of survey.
Source: NRCS 2002; SCS 1989.

Seven species of amphibians are thought to occur in the area, but none are believed to inhabit the site. Up to 11 species of reptiles are believed to be in the vicinity of the millsite. No critical habitat exists in the millsite area.

3.4.9.2 Threatened and Endangered Species

This section describes federally listed terrestrial threatened and endangered, proposed, or candidate species that are or may be present in the White Mesa Mill site area. In March 2003, DOE requested an updated list of such species from USF&WS that may be present or affected by DOE's proposed alternatives. USF&WS responded in April 2003 with a list for San Juan County. Table 3–44 lists a subset of those species that may occur in the vicinity of the White Mesa Mill site.

Table 3–44. Federally Listed Threatened or Endangered Species Potentially Occurring in the Vicinity of the White Mesa Mill Site

Common Name	Scientific Name	Habitat Present and Affected	Species Present	Status	Comments
Navajo sedge	*Carex specuicola*	Possible	Possible	Threatened	
Southwestern willow flycatcher	*Empidonax traillii extimus*	Possible	Possible	Endangered	
Black-footed ferret	*Mustela nigripes*	No	No	Endangered	
Bald eagle	*Haliaeetus leucocephalus*	Possible	Possible	Threatened	Proposed for Delisting
Mexican spotted owl	*Strix occidentalis lucida*	Possible	Possible	Threatened	
Gunnison sage grouse	*Centrocercus minimus*	Possible	Possible	Candidate	

Spatial data for the species listed in Table 3–44 were obtained from the Utah Conservation Data Center (UCDC). This data set was compiled by the Utah Natural Heritage Program (UNHP) of UDWR, in which species occurrences are depicted as points at a scale of 1:24,000 on 7.5-minute topographic quad maps. Spatial data depicting the White Mesa Mill site were overlaid on the species of concern spatial data to evaluate known species occurrences in the area.

The status of each of these species in the vicinity of the White Mesa Mill site is briefly discussed below. Appendix A1, "Biological Assessment," provides more detailed information concerning these federally listed species that may be in the vicinity of the White Mesa Mill site or could be affected by activities at the site.

All of the known populations of Navajo sedge in Utah are located at least 20 miles southwest of the White Mesa Mill site and associated borrow areas (UDWR 2003b). The Navajo sedge also is unlikely to occur at the White Mesa Mill site because the species requires wetland areas that do not occur within the area to be disturbed by development of the disposal cell.

There was a reported southwestern willow flycatcher sighting in San Juan County in the vicinity of the slurry pipeline corridor (UDWR 2003b). However, there is no information on the date of the reported sighting or on whether the sighting was confirmed. There is no suitable habitat for flycatchers known to occur on the White Mesa Mill site because wetland areas do not occur within the area to be disturbed by development of the disposal cell.

UDWR (2003b) reported a confirmed ferret sighting in the vicinity of the White Mesa Mill site in 1937. However, all black-footed ferrets currently in the wild are believed to be the result of a federal reintroduction program. It is highly unlikely that the black-footed ferrets reintroduced in Uinta and Duchesne Counties in 1999 or their offspring could occur on or in the vicinity of the White Mesa Mill site. Black-footed ferrets depend almost exclusively on prairie dog colonies for food, shelter, and denning. Although the area from Moab south along US-191 toward the White Mesa Mill site supports colonies of Gunnison's prairie dog (*Cynomys gunnisoni*) (Seglund 2004), no colonies are currently known to occur at or close to the White Mesa Mill site.

The Utah Gap Analysis (UDWR 1999) indicates that potential high-quality bald eagle wintering habitat exists throughout many of the project areas, and they are known to frequent the area between Monticello and Blanding. However, bald eagles are not known to nest or night roost nor is it known to have been observed in the vicinity of the White Mesa Mill site.

Designated critical habitat for the Mexican spotted owl occurs within 2 miles of the transportation corridor just south (within 25 miles) of the Moab site. However, the southern tip of this section of critical habitat that lies within 2 miles of the transportation corridor is located at least 50 miles from the White Mesa Mill site. Further, data provided by UDWR (2003a) indicated that there were no occurrences of the Mexican spotted owl in any of the project areas. Thus, it is unlikely that spotted owls occur in the vicinity of the White Mesa Mill site.

Although the White Mesa Mill site is within a Gunnison sage grouse conservation area (Sage Grouse Working Group 2000), this species is not known to occur at the White Mesa Mill site (IUC 2003).

There is no designated or proposed critical habitat for any of the above federally protected species in the vicinity of the White Mesa Mill site.

On the White Mesa Mill site, there is no recorded presence of any threatened and endangered species (IUC 2003), including amphibians or reptiles (Dames and Moore 1978; UDWR 2003b).

3.4.9.3 Other Special Status Species

As previously discussed, special status species are those that are protected under federal and state regulations other than the ESA, which include the MBTA, Executive Order 13186, and Birds of Conservation Concern (USF&WS 2002f). The State of Utah and federal land management agencies maintain a list of species that they consider threatened, endangered, or sensitive or otherwise of concern. UDWR identified several species of state concern (UDWR 2003b), which included BLM- and USFS-identified species. However, only those listed by the USF&WS under the ESA are included in Section 7 consultations or in the Biological Assessment. Although the special status species are not covered by the ESA, USF&WS encourages protection of these species.

Table 3–45 lists plant species considered by state and federal resource agencies to be endangered, threatened, or otherwise of concern that may occur in the site region. A number of the species listed by the State of Utah or considered sensitive by BLM are potentially present in the vicinity of the White Mesa Mill site.

Table 3–46 includes animal species listed by the State of Utah as endangered, threatened, or otherwise of concern that may be present in the project region. The list includes all species identified by UDWR as potentially occurring in San Juan County; in some cases, the known population locations or suitable habitats may not be close to the site. The species listed as endangered or threatened by UDWR are discussed below.

Table 3–45. Sensitive Plant Species Potentially Occurring in the White Mesa Mill Site Vicinity

Common Name	Scientific Name	Habitat Present and Affected[a]	Federal Status[b]	State Status[c]
Chatterley's onion	*Allium geyeri* var. *chatterleyi*	No	BLM	Rare
Cutler's milkweed	*Asclepias cutleri*	Possible	None	Rare
Cronquist's milkvetch	*Astragalus cronquistii*	Possible	BLM	Rare
Cutler's milkvetch	*Astragalus cutleri*	No	Unknown	Rare
Fisher Towers milkvetch	*Astragalus piscator*	Possible	None	Rare
Ben's buckbrush	*Ceanothus greggii*	Possible	None	Rare
Ruin Park winterfat	*Ceratoides lanata* var. *ruinina*	Possible	None	Rare
Beck's springparsley	*Cymopterus beckii*	Possible	BLM	Rare
Hole-in-the-Rock prairie clover	*Dalea flavescens* var.*epica*	Possible	BLM	Uncertain
Kachina daisy	*Erigeron kachinensis*	Possible	BLM	Rare
Cataract Canyon gilia	*Gilia latifolia* var. *imperialis*	No	BLM	Rare
Tuhy's breadroot	*Pediomelum aromaticum* var. *tuhyi*	Possible	BLM	Rare
La Sal Mt beardtongue	*Penstemon crandallii* var. *atratus*	No	Unknown	Watch
Navajo Mt beardtongue	Penstemon navajoa	No	Unknown	Rare
Alcove rock-daisy	*Perityle specuicola*	Possible	BLM	Rare
Alcove bog orcid	*Platanthera zothecina*	Possible	BLM	Rare
Wupatki indigobush	*Psorothamnus thompsoniae*	No	Unknown	Rare
La Sal Mts butterweed	*Senecio fremontii* var. *inexpectatus*	No	BLM	Rare
Jane's globemallow	*Spharalcea leptophylla* var. *janeae*	Possible	BLM	Rare
Canyonlands woody aster	*Xylorhiza glabriuscula*	Possible	None	Rare

[a]Habitat Present and Affected: No—species is listed for this county, but habitat is not close to the site; Possible—habitat for the species is present in the vicinity of the site, transportation routes, or borrow areas.
[b]Federal status: BLM—plants are on the interim sensitive list adopted by the BLM Utah State Office.
[c]State status: Rare—plants with known or suspected rangewide viability concern; Uncertain—plants for which viability as a species or subspecies has been questioned by one or more experts; Watch—plants are regionally endemic but without rangewide viability concern.

Table 3–46. State-Listed Wildlife Species That May Occur In the Vicinity of the White Mesa Site

Common Name	Scientific Name	Habitat Present and Affected	State Status[a] T	E	C	Species Present	Actions/Comments
Mammals							
Ringtail (cat)	*Bassariscus astutus*	Possible			x	Possible	
Kit fox	*Vulpes macrotis*	Possible			x	Possible	
Spotted ground squirrel	*Spermophilus spilosoma*	Possible			x	Unknown	
Gunnison's prairie dog	*Cynomys gunnisoni*	Possible			x	Unknown	
Allen's big-eared bat	*Idionycteris phyllotis*	Possible			x	Unknown	
Big free-tailed bat	*Nyctinomops macrotis*	Possible			x	Unknown	
Spotted bat	*Euderma maculatum*	Possible			x	Unknown	
Townsend's big-eared bat	*Corynorhinus townsendii*	Possible			x	Unknown	
Mogollon vole	*Microtus mongollonensis*	Possible			x	Unknown	
Dwarf shrew	*Sorex Nanus*	Possible			x	Unknown	
Northern rock mouse	*Peromyscus nasutus*	Possible			x	Unknown	
Stephen's wood rat	*Neotoma stephensi*	Possible			x	Unknown	
Rock pocket mouse	*Chaetodipus intermedius*	Possible			x	Unknown	
Birds							
Peregrine falcon	*Falco peregrinus*	Possible			x	No	Delisted
Ferruginous hawk	*Buteo regalis*	Possible		x		No	
Short-eared owl	*Asio flammeus*	No			x	No	
Common yellowthroat	*Geothlypis trichas*	Possible			x	Unknown	
American white pelican	*Pelecanus erythrorhynchos*	No			x	No	
Burrowing owl	*Athene Cunicularia*	Yes			x	Yes	
Swainson's hawk	*Buteo swainsoni*	No			x	No	
Lewis's woodpecker	*Melanerpes lewis*	No			x	No	
Three-toed woodpecker	*Picoides tridactylus*	No			x	No	
Greater sage grouse	*Centrocercus urophasianus*	No			x	No	
Bobolink	*Dolichonyx oryzivorus*	No			x	No	
Blue grosbeak	*Guiraca caerulea*	No			x	No	
Williamson's sapsucker	*Sphyapicus thyroideus*	No			x	No	
Northern goshawk	*Accipiter gentiles*	No			x	No	
Reptiles							
Common chuckwalla	*Sauromalus ater*	Possible			x	Unknown	
Common kingsnake	*Lampropeltis getula*	Possible			x	Unknown	
Desert night lizard	*Xantusia vigilis*	Possible			x	Unknown	
Plateau striped whiptail	*Cnemidophorus velox*	Possible			x	Unknown	
Glossy snake	*Arizona elegans*	Possible			x	Unknown	
Smooth greensnake	*Opheodrys vernalis*	Possible			x	Unknown	
Western patch-nosed snake	*Slavadora hexalepis*	Possible			x	Unknown	
Many-lined skink	*Eumeces multivirgatus*	Possible			x	Unknown	

[a]State Status: T—Threatened, E—Endangered, C—Candidate.

Raptors are of primary concern, including the burrowing owl, golden eagle, red-tailed hawk, and osprey. The Raptor Protection Act requires that surveys be conducted before disturbances, depending upon season and proximity to nesting areas. Other birds of concern in the area include the long-billed curlew, loggerhead shrike, gray vireo, virginia's warbler, cassin's sparrow, and brewer's sparrow. Species previously described are not discussed in this section.

The long-billed curlew, although typically associated with aquatic environments, is also found in a variety of habitats, including plains, prairies, and open rangeland. In discussions with the BLM Monticello office, it was discovered that this species is commonly found in habitats frequented by burrowing owls in the vicinity of the White Mesa Mill site. The loggerhead shrike is typically found in open country, low scrub, and desert environments characteristic of the northern and southernmost segments of the transportation corridor. The gray vireo and virginia's warbler are commonly found in the foothills zone characterized by piñon-juniper forest, scrub oak, and open chaparral. The cassin's and brewer's sparrows are found in habitat characterized by low brush (e.g., sagebrush) and arid to semiarid regions.

Table 3–47 lists bird species, including migratory birds, that may occur in the vicinity of the site, although on-site habitat limits typical nesting and breeding activities. Most of these species are protected under the MBTA, which prohibits take or destruction of birds, nests, or eggs of listed migratory birds.

3.4.10 Land Use

Of the more than 4.9 million acres in San Juan County, approximately 60 percent of the land is administered by federal agencies. There are several national parks in the county. The entire western boundary of the county is adjacent to Canyonlands National Park, Glen Canyon National Recreation Area, the Colorado and Green Rivers, and Lake Powell. Approximately 28 miles due west of the White Mesa Mill site is Natural Bridges National Monument. Hovenweep National Monument is about 25 miles to the east-southeast. San Juan County has a total of 15 national, state, and tribal parks and recreation areas. Most of these resources are within a 50-mile radius of the site, but none are in the immediate vicinity of the site.

Approximately 30 percent of San Juan County lands are in Indian reservations. The White Mesa Ute Indian Reservation totals more than 8,300 acres and is located 3.4 miles south of the site along both sides of US-191. Several small, isolated, and uninhabited Ute Reservation parcels are west of Blanding. The Navajo Reservation occupies the entire southern portion of the county and constitutes 28 percent of county lands.

Much of the land in San Juan County is public domain and open to recreational use. Tourism is increasingly becoming the mainstay of the local economy. Favorable weather allows off-road access for hikers, bikers, and off-highway vehicles in virtually all seasons. The Colorado River, which runs along the western border of the county, is a source of extensive recreational use for summer water sports. BLM administers most of the federal lands and makes the lands available for grazing, oil and gas leasing, and mining claims. As late as 1977, San Juan County was the largest processor of uranium ore in Utah. The Aneth Oil Field in southern Utah is the second largest field in Utah and is still producing. While oil production has been steadily declining, natural gas production is expanding. The USFS lands are also available for multiple uses such as recreational, agricultural, and timber and mining production.

Table 3–47. Sensitive Bird Species Protected Under the Fish and Wildlife Conservation Act and Migratory Bird Treaty Act That May Occur Near the White Mesa Mill Site

Species	Potential to Occur in Project Area
Order Falconiformes—Birds of prey	
Golden eagle *(Aquila chrysaetos)*	High
Northern harrier *(Circus cyaneous)*	Moderate
Prairie falcon *(Falco mexicanus)*	Moderate
Red-tailed hawk (*Buteo jamaicensis*)	High
Turkey vulture (*Cathartes aura)*	High
Order Gruiformes—Marsh and open country birds	
Black rail *(Laterallus jamaicensis)*	Moderate
Yellow rail *(Coturnicops noveboracensis)*	Low
Order Strigiformes—Nocturnal birds of prey	
Barn owl *(Tyto alba)*	Low
Flammulated owl *(Otus flammeolus)*	Low
Short-eared owl *(Asio flammeus)*	Low
Order Apodiformes—Small swallowlike birds	
Black swift *(Cypseloides niger)*	Low
Vaux's swift *(Chaetura vauxi)*	Low
Order Piciformes—Wood-boring birds	
Red-headed woodpecker *(Melanerpes erythrocephalus)*	Low
Williamson's sapsucker *(Sphyrapicus thyroideus)*	Low
Order Passeriformes—Perching birds	
Olive-sided flycatcher *(Contopus borealis)*	Low
Gray flycatcher *(Empidonax wrightii)*	Moderate
Pinyon jay *(Gymnorhinus cyaneocephalus)*	Low
Bendire's thrasher *(Toxostoma bendirei)*	High
Crissal thrasher *(Toxostoma dorsale)*	High
Bewick's wren *(Thryomanes bewickii)*	Moderate
Sedge wren *(Cistothorus platensis)*	Low
Verry *(Catharus fuscenscens)*	Moderate
Sprague's pipit *(Anthus spragueii)*	Low
Loggerhead shrike *(Lanius ludovicianus)*	Moderate
Gray vireo *(Vireo vicinior)*	Moderate
Virginia's warbler *(Vermivora virginiae)*	Moderate
Black-throated warbler *(Dendroica nigrescens)*	Low
Grace's warbler *(Dendroica graciae)*	Low
Blackpoll warbler *(Dendroica striata)*	Low
Dickcissell *(Spiza americana)*	Low
Sage sparrow *(Amphispiza belli)*	Low
Cassin's sparrow *(Aimophila cassinii)*	Low
Brewer's sparrow (*Spizella breweri)*	Moderate
Lark bunting *(Calamospiza melanocorys)*	High
Baird's sparrow *(Ammodramus bairdii)*	Low
Grasshopper sparrow *(Ammodramus savannarum)*	Low
McCown's longspur *(Calcarius mccownii)*	Low
Chestnut-collared longspur *(Calcarius ornatus)*	Low

Note: Birds listed in the table are protected under the Fish and Wildlife Conservation Act (Birds of Conservation Concern [2000] [USF&WS 2002f] and the MBTA [50 CFR 10], Executive Order 13186). Species listed as threatened or endangered under the ESA or considered endangered, threatened, or rare by the State of Utah are not included here.

Private land in San Juan County is dedicated almost entirely to agriculture. The areas most amenable to farming are in the east-central portion of the county. The principal crops are wheat and beans. There are no prime or unique farmlands in San Juan County. The arid climate, lack of irrigation, and the rugged landforms dictate grazing as the primary agricultural use. However, low rainfall and lack of sufficient vegetation limit livestock numbers. Except where irrigation is present, livestock herds are widely spaced, and federal grazing allotments cover large areas.

In the past, dry farming has been largely unsuccessful on soil types characteristic of this area. However, the Blanding soils are deep and easy to plow, have high moisture-holding capacity, and are high in inherent fertility if irrigated.

The White Mesa Mill site is a 5,415-acre parcel that is privately owned by IUC. Land use in the vicinity of the site and directly outside the property boundary is zoned agricultural by San Juan County. Land within 5 miles of the site is privately owned agricultural land. A parcel of land comprising the site is a six-section area that is zoned as an industrial controlled district. Blanding is expanding its commercial district to the south along US-191 in the direction of the site. It is currently 4.7 miles from the northern edge of the site to the southern expansion of Blanding development. A National Guard Armory is 3.7 miles north of the site.

The largest communities in San Juan County are Monticello and Blanding. Very few residents live near the site. The nearest full-time residence is a farm/ranch located 1.6 miles north of the site. A residence associated with a convenience store and gas station is located at the intersection of US-191 and SR-95 approximately 3 miles north of the site. In addition, there is a residence at the Blanding airport about 3.5 miles north of the site. The Ute Mountain Reservation is 3.4 miles south of the site, and the community of White Mesa is approximately 5 miles to the south. Figure 3–38 presents a land use map of the White Mesa Mill site area.

Ongoing consultations with White Mesa Mill elders have identified burial sites near the White Mesa Mill site entrance.

3.4.11 Cultural Resources

The cultural history of the White Mesa Mill site area is discussed in the more general cultural history of southeastern Utah described in Section 3.1.13.1; the Class I cultural resource inventory that was conducted for the White Mesa Mill site is described in Section 3.1.13.2.

Results of the Class I inventory (Davis et al. 2003) indicate that a number of Class III cultural resource surveys have been conducted at the White Mesa Mill site, primarily between 1976 and 1981. The areas of the White Mesa Mill site encompassed by the Class I inventory include Sections 28, 29, 32, and 33 of T. 37 S., R. 22 E. and Sections 4 and 5 and the north half of Section 9 of T. 38 S., R. 22 E. Within this area, the Class I inventory documented 231 cultural sites. Of these 231 sites, 196 (85 percent) have been determined eligible for inclusion in the National Register of Historic Places. Table 3–48 summarizes the types of sites documented for each section.

The probable time periods represented by the 231 sites are summarized, by section, in Table 3–49. Most of the sites are associated with Anasazi habitation between A.D. 450 and A.D. 1150. From an initial low frequency of Archaic and Basketmaker II sites (see Table 3–49 footnotes), there is a pronounced increase in Basketmaker III sites, followed by a steady increase in sites through the Pueblo I and Pueblo II periods. The population of prehistoric inhabitants appears to have peaked during early Pueblo II and remained fairly stable into the early Pueblo III period, after which it declined sharply. In contrast to the high number of prehistoric sites, only seven sites are attributed to the historic period. Of this total, one is a Navajo camp and one is a Ute camp; the other five lacked diagnostic artifacts or other attributes to determine cultural affiliation.

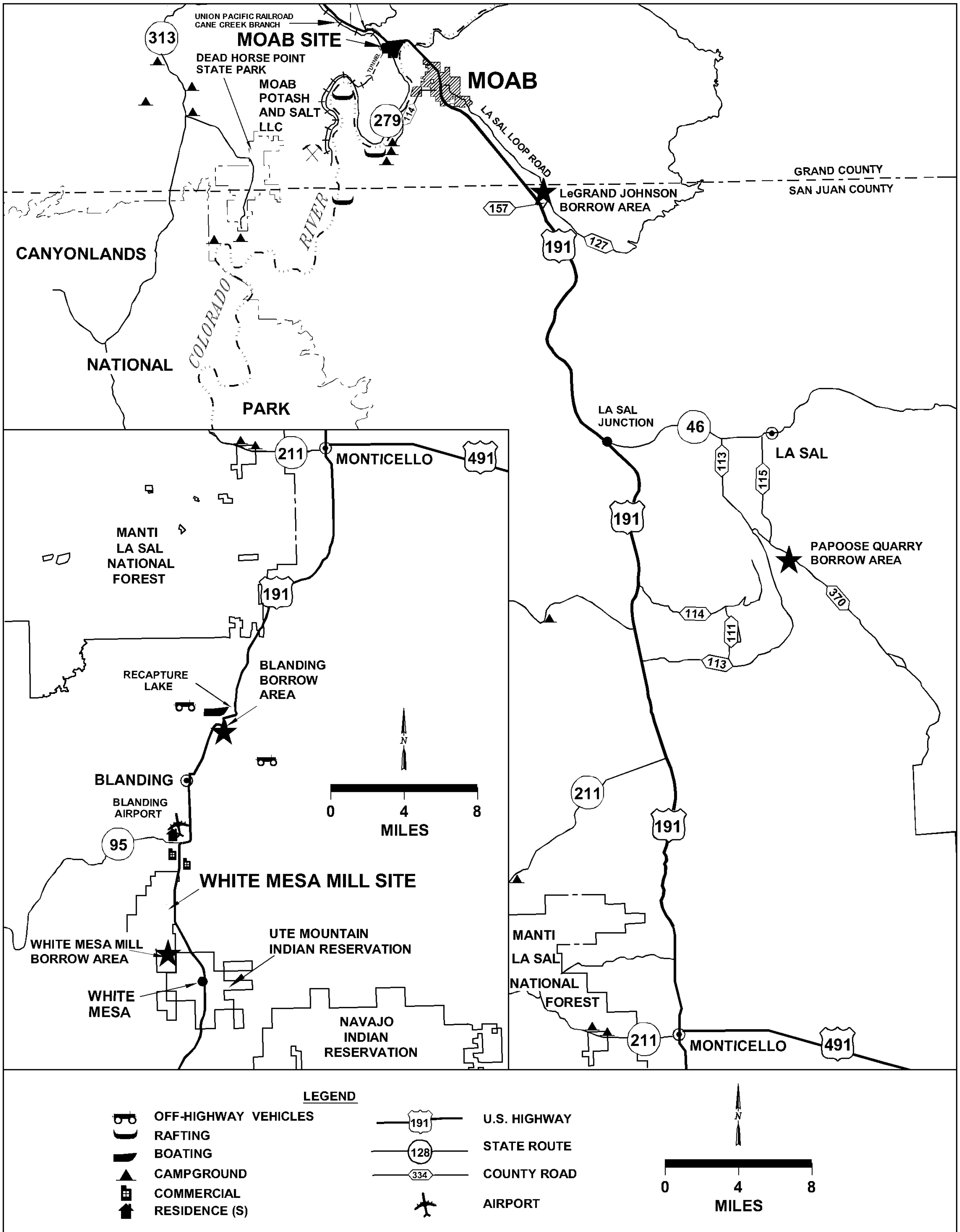


Figure 3–38. Land Use in the Moab to White Mesa Mill Site Area

Table 3–48. White Mesa Mill Site—Summary of Cultural Sites by Type

Section	Habitation Site	Temporary Habitation Site	Limited Activity Site	Granary	Quarry	Unknown	Total	NRHP Eligible Yes/No
Sec. 28	17		11				28	21/7
Sec. 29	7	2	3	6		2	20	18/2
Sec. 32	15	2	12		2	7	38	31/7
Sec. 33	22		13			1	36	21/15
Sec. 4	38		5				43	43/0
Sec. 5	32	4	11				47	45/2
Sec. 9, N1/2	12	2	5				19	17/2
Total	143 (62%)	10 (4%)	60 (26%)	6 (3%)	2 (1%)	10 (4%)	231	196/35 (85%/15%)

NRHP = National Register of Historic Places

Within the 6.5-section area encompassed by the Class I inventory, a notable site distribution pattern—from northeast to southwest—is present. The more northerly Sections 28 and 29 average 24 sites per square mile; the middle Sections 32 and 33 average 37 sites per square mile; and the southerly Sections 4 and 5 average 45 sites per square mile. This increasing site density from northeast to southwest is likely a function of specific environmental factors—mainly, nearness to a water source. The more southerly sites are closer to the canyon edges where the water sources are located.

Recent interviews (Fritz 2004) with tribal members indicate that at least five potential traditional cultural properties associated with the White Mesa Ute Tribe exist on or near the White Mesa Mill site. These are “potential” traditional cultural properties because their eligibility for National Register status has yet to be determined; this determination would be made during the Section 106 consultation process. Interviews conducted with tribal members before the current mill was constructed indicate that sacred areas existed within the IUC site boundaries at that time as well (Fritz 2004). In the White Mesa Mill area, the likelihood of occurrence of traditional cultural properties and their estimated density are extremely high (on a scale of low-medium-high-extremely high) and are likely associated with the Ute Tribe, Navajo Nation, and Hopi Tribe (Fritz 2004). Traditional cultural properties in this area may include sacred gathering areas, sacred healing areas, sacred springs, and burial areas.

3.4.12 Noise and Vibration

The White Mesa Mill site is within the boundaries of the IUC site. Background noise levels are expected to be comparable to noise levels associated with open desert areas, with some influence from the existing IUC operation. These noise levels could approach 50 to 60 dBA at the White Mesa Mill site area as a result of operations at the IUC mill. US-191 passes about 1 mile to the east of the White Mesa Mill site area and does not significantly contribute to background noise (less than 50 dBA).

Neither background noise nor ground vibration data are available for the White Mesa Mill site. No residences are in the surrounding areas, although the land adjacent to IUC property may be used for outdoor recreation.

Table 3–49. White Mesa Mill Site—Summary of Cultural Sites by Time Period

Section	Archaic[a]	Basketmaker II[b]	Basketmaker III[b]	Pueblo I[b]	Pueblo II[b]	Pueblo III[b]	General Pueblo	Historic[c]	Unknown	Total[d]
Sec. 28	1		6	14	15	8	1	1	2	48
Sec. 29			1	4	9	6		1	9	30
Sec. 32	2	2	7	4	12	6		4	16	53
Sec. 33		1	16	18	19	7			4	65
Sec. 4			9	23	29	15			1	77
Sec. 5	1		13	22	25	12		1	8	82
Sec. 9, N1/2			4	6	13	4			3	30
Total	4 (1%)	3 (0.7%)	56 (14%)	91 (24%)	122 (32%)	58 (15%)	1 (0.3%)	7 (2%)	43 (11%)	385

[a] Archaic (7000 B.C.–1000 B.C.).

[b] Anasazi (1000 B.C.–A.D. 1300). The Anasazi cultural period is divided into temporal segments identified as Basketmaker II (1000 B.C.–A.D. 450); Basketmaker III (A.D. 450–750); Pueblo I (A.D. 750– 900); Pueblo II (A.D. 900–1150); and Pueblo III (A.D. 1150–1300).

[c] Historic (A.D. 1850–present).

[d] The total number of sites is greater than the 231 sites identified by the Class I inventory because many of the sites are multicomponent (e.g., many of the sites exhibit temporal occupations from the Basketmaker III, Pueblo I, and Pueblo II periods).

3.4.13 Visual Resources

The White Mesa Mill site is located immediately west of US-191 in a rural area approximately 5 miles south of the town of Blanding and 5 miles north of the community of White Mesa. Gently rolling rangelands dotted with sagebrush, piñon-pine, and juniper surround this commercial facility. Most of the facility consists of several large metal structures, a yellow-brick office building, and numerous earthen piles. The taller structures and piles are visible from US-191 but do not dominate the view because of their distance (approximately 0.5 mile) from the highway. The existing disposal cells are not visible from the highway (Figure 3–39).

Figure 3–39. View of the White Mesa Mill Site from the Entrance Road on US-191

Approximately 1.6 miles north of the facility is the nearest residence, from which the taller facility structures are barely visible. The areas proposed to be disturbed by the new disposal cells are not visible from US-191 or from the nearest residence. BLM places the area surrounding the facility in the Class III visual resources category (Sweeten 2003). Section 3.1.15 describes the visual resource classes.

3.4.14 Infrastructure

3.4.14.1 Waste Management

Mill-generated sewage is disposed of in an on-site state-approved leach field system. This system manages sanitary wastes generated by the 70 to 100 full-time workers that are typically employed when the mill is in production mode; the maximum capacity of the system is unknown. Mill-generated solid waste is disposed of in the on-site tailings cells.

3.4.14.2 Electric Power Supplies

An existing three-phase overhead power line runs adjacent to US-191; an existing substation that supplies the White Mesa Mill site is approximately 0.25 mile from the site. The existing power line ends approximately 4 miles north of where the booster pump station would be located.

3.4.14.3 Water Supplies

Potable and nonpotable water needs at the White Mesa Mill site are supplied from existing deep wells and the Recapture Reservoir, respectively. The Entrada/Navajo aquifer is capable of yielding domestic quality water at rates of 150 to 225 gpm (216,000 to 324,000 gallons per day) and is used as a secondary source of potable water for the White Mesa Mill site. There are five deep water supply wells constructed by IUC at the White Mesa facility.

3.4.15 Transportation

Table 3–15 in Section 3.1.17 describes AADT, congestion, truck percent, and accident rates on US-191 between Moab and Blanding. US-191 south of Moab is generally not congested; it carries AADT volumes that vary from 2,861 at the junction of US-191 and the White Mesa Mill site to 7,450 at the south Blanding city limits. At the San Juan County/Grand County line, traffic increases to an AADT of 8,510. The road is two-lane until it reaches downtown Moab. Two road segments are noted as having actual accident rates that exceed the expected accident rate; other reported segments are considered not congested and have low accident rates. The two segments that have high accident rates occur at the junction of US-191 and US-491 (formerly US-666) in Monticello, and at the junction of US-191 and SR-95 south of Blanding (see Figure 3–40).

Although road congestion and accident rates are considered low, south of Moab, US-191 follows rolling hills with often poor sight lines around curves.

No rail transportation is available between the Moab site and the White Mesa Mill site.

3.4.16 Socioeconomics

3.4.16.1 Demography of the Area

The 2000 census reported the population density of San Juan County as 1.8 individuals per square mile. By comparison, the statewide density is greater than 27.2 persons per square mile.

Blanding, approximately 5 miles north of the mill, is the largest population center near the millsite and had a 2000 census population of 3,162. Approximately 5 miles southeast of the White Mesa Mill site is the White Mesa community of approximately 277 Ute Mountain Ute tribal members. An estimated 60 to 75 individuals live within 5 miles of the site (IUC 2003) (Figure 3–41). The nearest resident to the millsite is approximately 1.6 miles north of the mill.

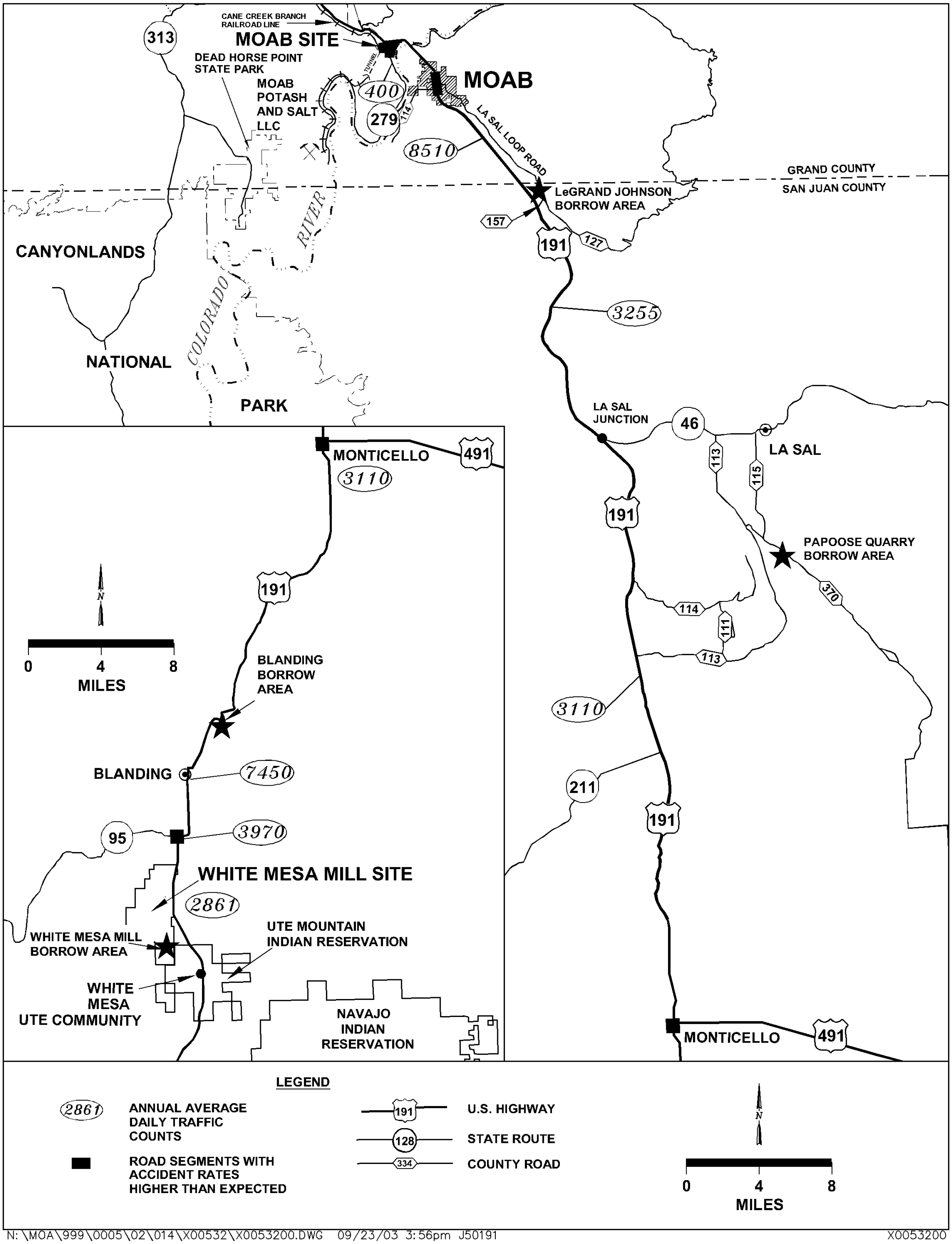


Figure 3–40. Transportation Routes From Moab to the White Mesa Mill Site

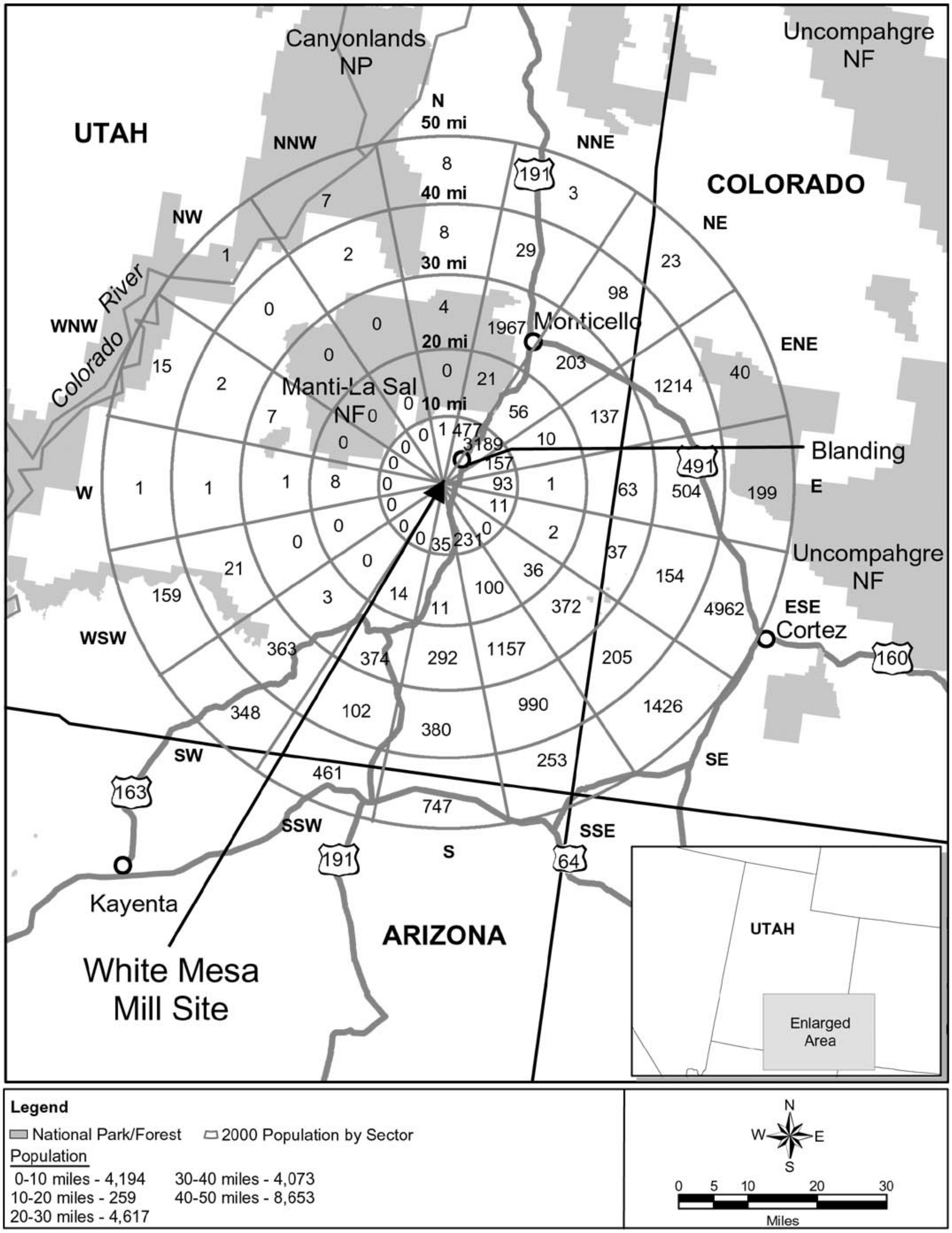


Figure 3–41. Census Population Within 50 Miles of the White Mesa Mill Site

The Navajo Reservation is approximately 19 miles southeast of the mill. The nearest community on the Navajo Reservation is Montezuma Creek, with a population of about 507. Figure 3–41 provides population centers located within 50 miles of the millsite.

3.4.16.2 Socioeconomic Profiles

San Juan County is the largest and poorest county in Utah. As of October 2002, the unemployment rate in the county was 7.8 percent, compared to 5.2 percent in the state of Utah, and 5.6 percent for the nation. When operating, the White Mesa Mill is the largest private employer in San Juan County, employing 70 to 100 full-time workers. Typically, the mill employs a high percentage of minority workers. During the mill operation that began in June 2002, mill employment ranged from 45 to 75 percent Native Americans.

Since its inception in 1980, the mill has run on a campaign basis, in each case remaining on standby pending accumulation of sufficient ore stockpiles to justify a milling campaign. Currently, mill employees are predominantly residents of San Juan County or residents of neighboring counties who commute to the mill daily. Historically, the mill has drawn from residents of San Juan County and neighboring counties for each milling campaign, rather than relying upon an influx of workers to the area.

3.4.17 Human Health

Nationwide, on average, people are exposed to approximately 300 mrem/yr from natural background radiation (NCRP 1987). Table 3–50 summarizes the radiation doses from natural background, assuming residential exposure is occurring at the White Mesa Mill site.

Table 3–50. United States and the White Mesa Mill Site Natural Background Radiation Doses

Source	U.S. Average Natural Background Radiation Dose (millirem/yr)	White Mesa Mill Natural Background Radiation Dose (millirem/yr)
Cosmic and cosmogenic radioactivity	28	68
Terrestrial radioactivity	28	74
Internal radioactivity	40	40
Inhaled radioactivity	200	260
Rounded Total	300	440

The largest natural source is inhaled radioactivity, mostly from radon-222 and its radioactive decay products in homes and buildings, which accounts for about 200 mrem/yr. Additional natural sources include radioactive material in the earth (primarily external radiation from the uranium and thorium decay series), radioactive material in the body (primarily potassium-40), and cosmic rays from space filtered by the atmosphere.

The actual radiation dose from natural background radiation varies with location. On the basis of data for Blanding, the radiation dose from cosmic and cosmogenic radioactivity would be about 69 mrem/yr at the White Mesa Mill site, the radiation dose from external terrestrial radioactivity would be about 74 mrem/yr, and the radiation dose from radon-222 and its radioactive decay products would be about 260 mrem/yr (IUC 2003). The total natural background radiation dose at the White Mesa Mill site would be about 440 mrem/yr, considerably higher than the national average.

According to the 2000 census, the population within 50 miles of the White Mesa Mill site was about 21,800 (Figure 3–41). Assuming that all residents were exposed to 440 mrem/yr, the population dose would be about 9,600 person-rem per year.

Existing Operations at the White Mesa Mill

The individual radiation dose for members of the public from existing operations at the White Mesa Mill was estimated to be 10 mrem per year (IUC 2003). The population dose to the 50-mile population surrounding the White Mesa Mill site was estimated to be 4 person-rem per year (IUC 2003).

For workers at the White Mesa Mill, the average individual radiation dose was 0.11 rem in 1999. The population dose to these workers was 10 person-rem.

3.4.18 Environmental Justice

Section 3.1.20 describes the legal basis for evaluating environmental justice and general census characteristics in San Juan County. Figure 3–42 and Figure 3–43 provide the minority population distribution within 50 miles of the site and income by household, respectively. The Navajo Reservation occupies a significant portion (28 percent) of San Juan County. Figure 3–42 shows greater than 50 percent of the total population as minority occurring within 20 miles of the White Mesa Mill site. The Ute Mountain Reservation is adjacent to the White Mesa Mill site. Reported household incomes of less than $18,244 per year (poverty level for a family of four) are found in census group blocks within about one-half of the minority-populated areas south of the site.

The closest low-income block group is about 15 miles from the site. Areas west of US-191 that are considered to have greater than 50 percent minority population had reported incomes between $18,244 and $41,994.

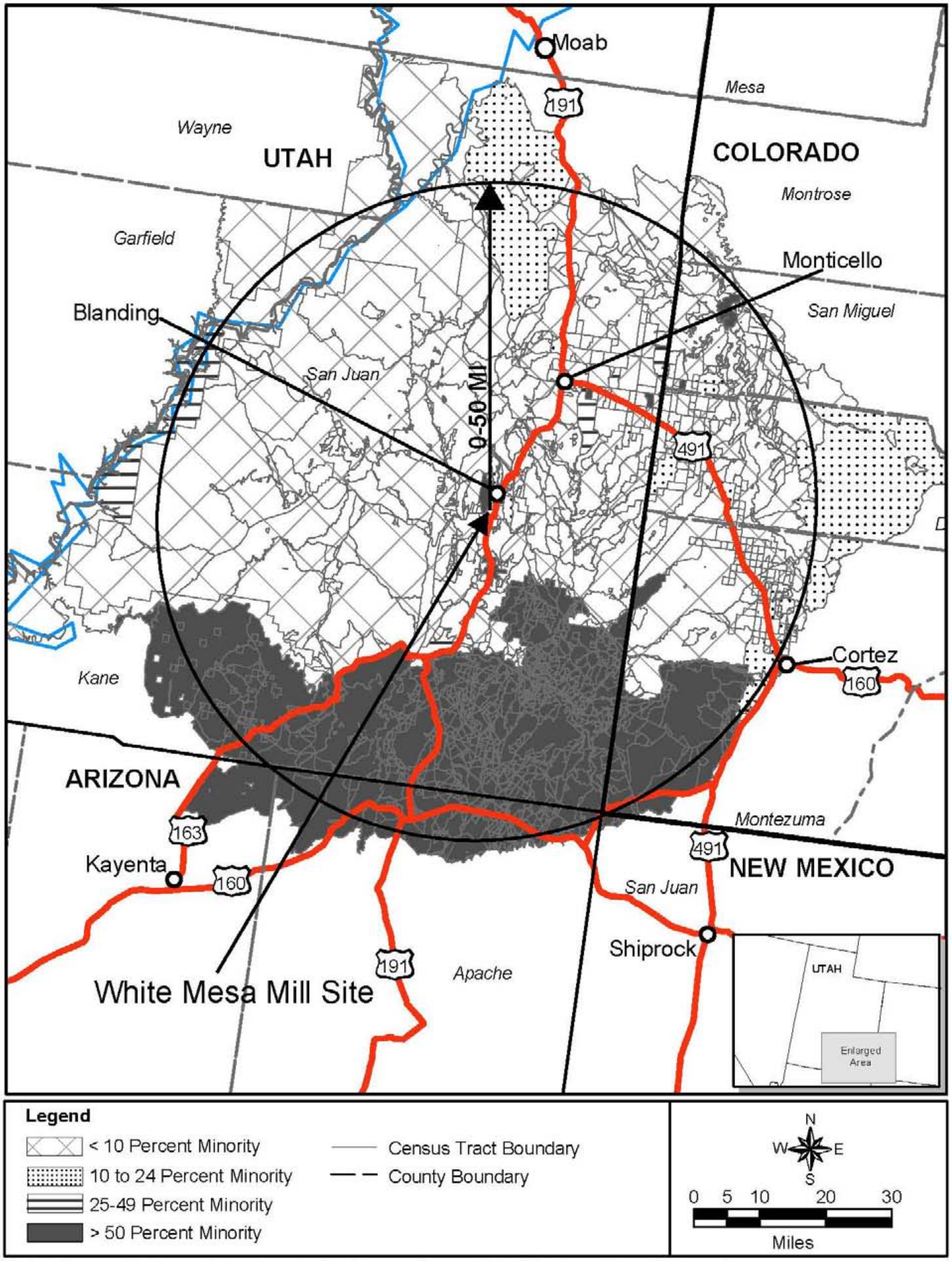
3.4.19 Pipeline Corridor

3.4.19.1 Geology

This section describes the level of seismic risk, possibility for subsidence, landslide potential, and occurrence of expansive clay evaluated from a geologic perspective for the proposed pipeline route from the Moab site to the White Mesa Mill site.

Seismicity (and seismic risk) is low in this part of the central Paradox Basin, and has a low rate of occurrence with small- to moderate-magnitude earthquakes (Wong and Humphrey 1989). The pipeline route is in Uniform Building Code 1, indicating lowest potential for earthquake damage (Olig 1991).

Quaternary displacement is evident along the Shay Graben Faults (Wong and Humphrey 1989), and small earthquakes have possibly been associated with these faults (Wong et al. 1996), the eastern ends of which cross the pipeline route about 3 miles south of Church Rock. The similar east-striking Verdure Graben Fault system may also have had Quaternary displacement; the proposed pipeline corridor would cross this fault system about 5 to 6 miles south of Monticello.



Note: Census blocks and American Indian Reservations within 50 miles of the site boundary.

Figure 3–42. Minority Population Distribution Within a 50-mile Radius of the White Mesa Mill Site

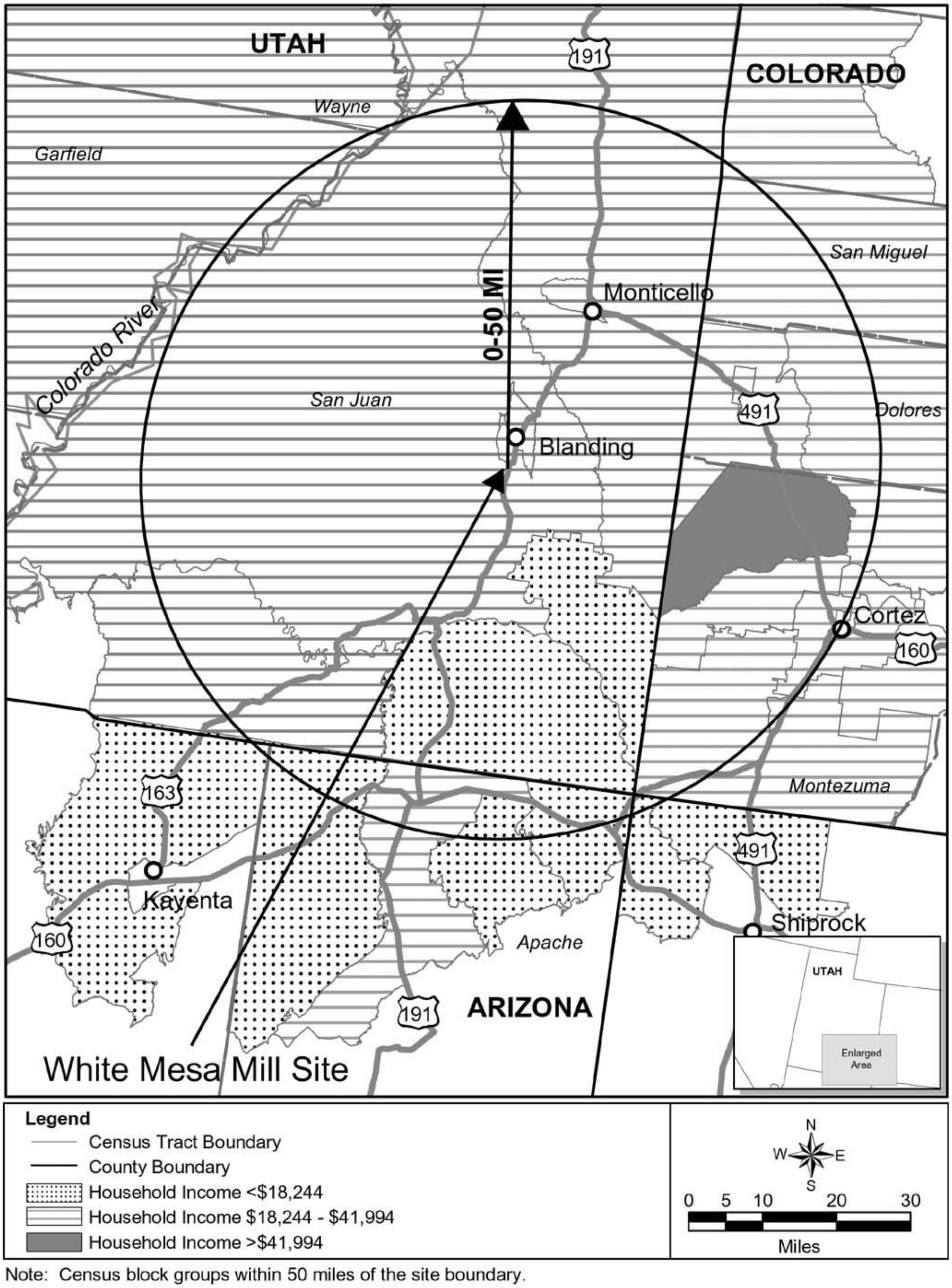


Figure 3–43. Household Income Distribution Within a 50-Mile Radius of the White Mesa Mill Site

Geologic conditions for subsidence and landslides were evaluated in the EIS for the Queston, Williams, and Kern River pipeline route (DOI 2001), which closely follows the proposed pipeline corridor from the Moab site to White Mesa Mill site south to near Wilson Arch. In that EIS, no risks for landslides, soil liquefaction, or collapsible soils were noted for the shared areas of these pipelines. Farther south on the proposed pipeline corridor, landslides are present in the Brushy Basin Member of the Morrison Formation on the north slope of the Sage Plain about 4 to 6 miles south of Church Rock (Harty 1991). Also, landslides occur in the Brushy Basin Member in the Recapture Wash area along the proposed pipeline (Harty 1991, 1993).

Expansive clay (montmorillonite), which can potentially cause engineering geologic problems when a change in water content causes shrinking and swelling, occurs in mudstones of the Brushy Basin Member of the Morrison Formation. The two main areas along the proposed pipeline corridor on this member, as noted by Mulvey (1992), are the Recapture Wash area and the area between Spanish Valley and Kane Springs.

3.4.19.2 Soils

For the purpose of soils discussion, this proposed pipeline corridor can be divided into two segments: Moab site to Peters Canyon, approximately 9 miles north of the city of Monticello (Maps 5 through 11, Appendix C), and Peters Canyon to the White Mesa Mill site (Maps 12 through 16, Appendix C). Peters Canyon marks a physiographic boundary between the lower-elevation canyon country of northern San Juan County and the rolling tableland of central San Juan County known as the Sage Plain. The head of Peters Canyon also marks a boundary between soils formed in semiarid and in subhumid climates (USDA 1962).

Four general soil map units or soil associations occur between the Moab and Peters Canyon segment of the pipeline corridor: Thoroughfare-Sheppard-Nakai, Begay-Moab-Redbank, Rizno Dry-Rock Outcrop, and Ustic Torriorthent-Ustic Calciorthids-Ustollic Haplargids (USDA 1991). The segment of the proposed pipeline corridor from Peters Canyon to the White Mesa Mill site crosses five general soil map units or soil associations in the higher, subhumid region of the Sage Plain, then drops into semiarid upland soil map units just south of the town of Blanding. The San Juan Area Soil Survey (USDA 1962) groups the soil series and soil map units as range sites based on land use and management. The soil types and potential natural vegetation for both of these pipeline corridor segments are described in the SOWP (DOE 2003).

3.4.19.3 Ground Water

Depth to ground water varies widely between Moab and the White Mesa Mill site. For the first 2 to 3 miles of the pipeline corridor southeast from the Moab site, ground water is shallow (within a few feet of the ground surface) in the Matheson Wetlands Preserve area of the Moab Valley. For the next approximately 10 miles, the pipeline corridor runs along the southwest flank of Spanish Valley in Quaternary alluvial fill and fan material, in which the depth to ground water is generally between 50 and 100 ft. In the approximately 3 miles between Spanish Valley and Kane Springs, the pipeline corridor crosses a higher elevation area that is underlain by the Salt Wash Member of the Morrison Formation, where depth to ground water is less than 100 ft. Except for a small area where shallow ground water is present in alluvium around the Hatch Wash crossing, ground water from Kane Springs south to about 2 miles south of Church Rock is in Entrada, Navajo, and Wingate Sandstones. As the pipeline corridor climbs southward up to the Sage Plain, ground water is in the Burro Canyon Formation and Dakota Sandstone. Ground water on the Sage Plain, which extends south generally to Recapture Wash and in alluvium where the pipeline corridor crosses Verdure Creek and Devil Canyon, is less than 50 ft deep. From the shallow alluvial water at Recapture Wash south to the White Mesa Mill site, the pipeline corridor is underlain by shallow (less than 50 ft deep), perched ground water in alluvial Quaternary terrace gravels and ground water in the immediately underlying bedrock (Gloyn et al. 1995).

3.4.19.4 Surface Water

The perennial waters that this pipeline corridor would either cross or affect include the Colorado River, Matheson Wetlands Preserve, Mill Creek, Pack Creek, Kane Springs Creek, Vega Creek, Montezuma Creek, Verdure Creek, Devil Canyon, Long Canyon, and Recapture Creek (these are shown on the segment reference maps in Appendix C).

The ephemeral/intermittent drainages that this pipeline corridor would either cross or affect are Muleshoe Canyon, West Coyote Creek, Joe Wilson Canyon, Hook and Ladder Gulch, Hatch Wash, Lightning Draw, Big Indian Wash, Sandstone Draw, Tank Wash, East Canyon, Peter's Canyon, South Canyon, Spring Creek, Halfway Hollow, Bull Hollow, Dodge Canyon, Whipstock Draw, Bullpup Canyon, Lem's Draw, Brown Canyon, and Corral Canyon. Numerous other smaller, unnamed drainages, all of which are intermittent, would also be affected (see the segment reference maps in Appendix C).

<u>Water Quality and Existing Surface Water Contamination</u>

None of the perennial water resources within the pipeline corridor are listed as "High Quality Waters" as defined by UDEQ regulations (UAC 2003b). However, water quality varies widely among many of the perennial surface-water resources identified within this pipeline corridor. As the pipeline corridor passes through higher elevations near the Verdure and Devil Canyon drainages south of Monticello, the water quality in these streams is higher than that observed in perennial water sources at lower elevations (e.g., the Colorado River at Moab, Recapture Creek at Blanding).

The seasonal washes located within this pipeline corridor are dry most of the year, and no water quality data are available. Flow occurs in these washes primarily after significant storm events. When storm water does flow through these washes, it is laden with sediments, and water quality is anticipated to be poor. Many of these ephemeral washes collect surface water runoff primarily from areas of Mancos Shale. Soils associated with the Mancos Shale are alkaline and may have high concentrations of selenium. As a result, surface water quality from these drainage features would likely be characterized as having high salinity, turbidity, hardness, and elevated levels of sulfate and selenium.

<u>Relevant Water Quality Standards</u>

All surface water bodies (both perennial and ephemeral) in this pipeline corridor are eventually tributaries to the Colorado River; therefore, they are subject to the water quality classifications specified in Utah Administrative Code R317-2-13 (see Chapter 7.0).

3.4.19.5 Floodplains and Wetlands

The White Mesa Mill pipeline would cross 11 perennial streams containing riparian vegetation and at least 21 intermittent drainages. The pipeline would also cross the Colorado River and the Matheson Wetlands Preserve. There have been previous utility crossings in the preserve, and the pipeline would follow these as closely as possible. Appendix F provides additional details relevant to the pipeline crossing.

3.4.19.6 Terrestrial Ecology

Section 3.4.9 describes the affected environment for terrestrial ecology for the White Mesa Mill site. This section addresses only the areas, wildlife, and habitat that may be affected by the proposed pipeline corridor (Maps 4 through 16, Appendix C). This transportation corridor is likely to support a greater diversity and abundance of vegetation and wildlife than the other pipeline routes. For example, the region near Monticello, north of the White Mesa Mill site, is dominated by the foothills life zone (transition zone), which ranges from 6,000 to 9,000 ft in elevation. Piñon-juniper forests and scattered ponderosa pine stands dominate this zone. General vegetation and wildlife information applicable to the regional descriptions as described in Section 3.4.9 is not repeated in this section.

Pronghorn antelope, mule deer, and bobcat occur along the proposed pipeline corridor and in the vicinity of the site, depending upon habitat type. The red fox, gray fox, badger, longtail weasel, desert cottontail, and black jackrabbit are known to occur along the southernmost segments of the corridor. Sagebrush communities along the route are home to many other species of small mammals, birds, and reptiles. Smaller mammals inhabiting the piñon-juniper woodland include raccoons, skunks, badgers, coyotes, woodrats, and deer mice. Bird species, including piñon jays and several species of raptors, also use the piñon-juniper habitat. Up to seven species of amphibians are thought to occur in riparian and wetland areas that may be within the pipeline corridor.

Critical habitat exists for several nonsensitive mammals and bird species along this segment of the pipeline corridor. The area that includes T. 30 S., R. 23 E. (Map 9, Appendix C) has been designated as critical habitat for the pronghorn antelope during fawning, and restrictions are in effect between May 15 and June 15 each year. Mule deer migration routes have been identified in T. 33 S. – T. 35 S., ranges to the east and west (Maps 11 through 14, Appendix C). Critical winter range is located in T. 35 S.–T. 37 S., (Maps 14 through 16, Appendix C) east of US-191, where restrictions are in effect from November 15 to April 30 each year.

The loggerhead shrike (*Lanius ludovicianus*) is typically found in open country, low scrub, and desert environments characteristic of the southernmost segments of the pipeline corridor. The gray vireo (*Vireo vicinior*) and virginia's warbler (*Vermivora virginiae*) may also exist in this area because they are commonly found in the foothills zone characterized by piñon-juniper forest, scrub oak, and open chaparral.

In March 2003, DOE requested an updated list of federally terrestrial threatened and endangered, proposed, or candidate species from USF&WS that may be present or affected by DOE's proposed alternatives. USF&WS responded in April 2003 with a list for San Juan County. Appendix A1, "Biological Assessment," provides more detailed information concerning these species. Table 3–51 lists a subset of those species that may occur in the vicinity of the pipeline corridor between the White Mesa Mill site and the Moab site.

Table 3–51. Federally Listed Threatened and Endangered Species Potentially Occurring in the Vicinity of the Proposed Pipeline Corridor

Common Name	Scientific Name	Habitat Present and Affected	Species Present	Status	Comments
Navajo sedge	*Carex specuicola*	Possible	Possible	Threatened	
Southwestern willow flycatcher	*Empidonax traillii extimus*	Possible	Possible	Endangered	
Black-footed ferret	*Mustela nigripes*	No	No	Endangered	
Yellow-billed cuckoo	*Coccyzus americanus*	No	No	Candidate	
Bald eagle	*Haliaeetus leucocephalus*	Possible	Possible	Threatened	Proposed for Delisting
Mexican spotted owl	*Strix occidentalis lucida*	Possible	Possible	Threatened	
Gunnison sage grouse	*Centrocercus minimus*	Possible	Possible	Candidate	

All of the known populations of Navajo sedge in Utah are located at least 20 miles southwest of the White Mesa Mill site and associated borrow areas (UDWR 2003b). However, because the Navajo sedge requires wetland areas, it could potentially occur within the pipeline corridor where it crosses seeps and springs.

There was a reported southwestern willow flycatcher sighting in San Juan County in the vicinity of the slurry pipeline corridor (UDWR 2003b). However, there is no information on the date of the reported sighting or on whether the sighting was confirmed. Flycatchers could potentially occur along wetland areas of the pipeline corridor. It is currently unknown whether or not these wetland areas constitute suitable nesting habitat and/or whether they could be used as stopover habitat during migration.

Like the southwestern willow flycatcher, the Western yellow-billed cuckoo is also a riparian obligate. However, the cuckoo most likely does not occur along wetland areas of the pipeline corridor because associated areas of riparian vegetation are likely to be much smaller than that required by the cuckoo for nesting (100 to 200 acres of contiguous large gallery-forming or developing trees).

UDWR (2003b) reported a confirmed ferret sighting in the vicinity of the White Mesa Mill site in 1937. However, all black-footed ferrets currently in the wild are believed to be the result of a federal reintroduction program. It is highly unlikely that the black-footed ferrets reintroduced in Uinta and Duchesne Counties in 1999 or their offspring could occur in the vicinity of the pipeline between the White Mesa Mill site and the Moab site. However, black-footed ferrets depend almost exclusively on prairie dog colonies for food, shelter, and denning. The area from Moab south along US-191 toward the White Mesa Mill site supports colonies of Gunnison’s prairie dog (Seglund 2004). It is unknown to what extent individual colonies or a combination of these colonies could support black-footed ferrets.

The Utah Gap Analysis (UDWR 1999) indicates that potential high-quality bald eagle wintering habitat exists throughout many of the project areas, and bald eagles are common between Monticello and Blanding (Maps 12 through 14, Appendix C) during winter months. However, bald eagles are not currently known to night roost (or nest) near the route proposed for the pipeline corridor between the White Mesa Mill site and the Moab site.

Designated critical habitat for the Mexican spotted owl occurs within 2 miles of the pipeline corridor just south (within 25 miles) of the Moab site. Data provided by UDWR (2003a) indicated that there were no occurrences of the Mexican spotted owl in any of the project areas. However, based on proximity to critical habitat, spotted owls could potentially occur within 2 miles of the pipeline corridor just south (within 25 miles) of the Moab site.

The pipeline corridor between the White Mesa Mill site and the Moab site is within a Gunnison sage grouse conservation area (Sage Grouse Working Group 2000). High quality habitat for the Gunnison sage grouse has been designated in T. 31 S.–T. 33 S., R. 24 E. (Maps 10 and 11, Appendix C).

Besides that noted above for the Mexican spotted owl, there is no designated or proposed critical habitat for any of the other federally protected species in the vicinity of the pipeline corridor between the White Mesa Mill site and the Moab site.

No threatened or endangered amphibians or reptiles are believed to be present within the area of the pipeline corridor (Dames and Moore 1978; UDWR 2003b).

DOE, in consultation with USF&WS and BLM, would determine the need for additional habitat evaluations and surveys for species that could be affected by the proposed action should this alternative be selected.

As previously discussed, special status species are those that are protected under federal and state regulations other than the ESA, which include the MBTA, Executive Order 13186, and Birds of Conservation Concern (USF&WS 2002f). The State of Utah and federal land management agencies maintain a list of species that they consider threatened, endangered, or sensitive or otherwise of concern. By letter dated May 30, 2003, UDWR identified several species of state concern, which included BLM- and USFS-identified species. However only those listed by USF&WS under the ESA are included in Section 7 consultations or in the Biological Assessment. Although the special status species are not covered by the ESA, the State of Utah, BLM, USFS, and USF&WS encourage protection of these species.

Table 3–52 lists sensitive plant species considered by state and federal resource management agencies to be of concern that may occur in the vicinity of the pipeline corridor. A number of the species listed are potentially present in the vicinity of the corridor; in some cases the known population locations or suitable habitat may not be close to the site.

Table 3–53 lists animal species considered by state and federal resource management agencies as endangered, threatened, or otherwise of concern that may be present in the vicinity of the pipeline corridor. A number of the species listed are potentially present in the vicinity of the corridor; in some cases the known population locations or suitable habitat may not be close to the site.

Table 3–54 lists bird species, including migratory birds, that may occur in the vicinity of the corridor, although on-site habitat limits typical nesting and breeding activities. Most of these species are protected under the MBTA, which prohibits take or destruction of birds, nests, or eggs of listed migratory birds.

Table 3–52. Sensitive Plant Species Potentially Occurring in Vicinity of the Pipeline Corridor

Common Name	Scientific Name	Habitat Present and Affected[a]	Federal Status[b]	State Status[c]
Chatterley's onion	*Allium geyeri* var. *chatterleyi*	No	BLM	Rare
Cutler's milkweed	*Asclepias cutleri*	Possible	None	Rare
Cronquist's milkvetch	*Astragalus cronquistii*	Possible	BLM	Rare
Cutler's milkvetch	*Astragalus cutleri*	No	BLM	Rare
Fisher Towers milkvetch	*Astragalus piscator*	Possible	None	Rare
Ben's buckbrush	*Ceanothus greggii*	Possible	None	Rare
Ruin Park winterfat	*Ceratoides lanata* var. *ruinina*	Possible	None	Rare
Beck's spring-parsley	*Cymopterus beckii*	Possible	BLM	Rare
Hole-in-the-Rock prairie clover	*Dalea flavescens* var.*epica*	Possible	BLM	Uncertain
Kachina daisy	*Erigeron kachinensis*	Possible	BLM	Rare
Cataract Canyon gilia	*Gilia latifolia* var. *imperialis*	No	BLM	Rare
Tuhy's breadroot	*Pediomelum aromaticum* var. *tuhyi*	Possible	BLM	Rare
La Sal Mt beardtongue	*Penstemon crandallii* var. *atratus*	No	BLM	Watch
Navajo Mt beardtongue	Penstemon navajoa	No	BLM	Rare
Alcove rockdaisy	*Perityle specuicola*	Possible	BLM	Rare
Alcove bog orchid	*Platanthera zothecina*	Possible	BLM	Rare
Wupatki indigobush	*Psorothamnus thompsoniae*	No	BLM	Rare
La Sal Mts butterweed	*Senecio fremontii* var. *inexpectatus*	No	BLM	Rare
Jane's globemallow	*Spharalcea leptophylla* var. *janeae*	Possible	BLM	Rare
Canyonlands woody aster	*Xylorhiza glabriuscula*	Possible	None	Rare

[a]Habitat Present and Affected: No—species is listed for this county, but habitat is not close to the site; Possible—habitat for the species is present in the vicinity of the site, transportation routes, or borrow areas.
[b]Federal status: BLM—plants are on the interim sensitive list adopted by the BLM Utah State Office.
[c]State status: Rare—plants with known or suspected rangewide viability concern; Uncertain—plants for which viability as a species or subspecies has been questioned by one or more experts; Watch—plants are regionally endemic but without rangewide viability concern.

Table 3–53. State-Listed Animal Species That May Occur in the Vicinity of the Pipeline Corridor

Common Name	Scientific Name	Habitat Present and Affected	State			Species Present	Actions/Comments
			E	T	SC		
Mammals							
American pika	*Ochotona princeps*	No			x	No	
Abert's squirrel	*Sciurus aberti*	No			x	No	
Allen's big-eared bat	*Idionycteris phyllotis*	Unknown			x	Unknown	
Big free-tailed bat	*Nyctinomops macrotis*	Unknown			x	Unknown	
Spotted bat	*Euderma maculatum*	Unknown			x	Unknown	
Brazilian free-tailed bat	*Tadarida brasiliensis*	Unknown			x	Unknown	
Fringed myotis	*Myotis thysanodes*	Unknown			x	Unknown	
Townsend's big-eared bat	*Corynorhinus townsendii*	Unknown			x	Unknown	
Northern flying squirrel	*Glaucomys sabrinus*	No			x	No	
Northern river otter	*Lontra Canadensis*	No			x	No	
Dwarf shrew	*Sorex Nanus*	No			x	No	
Birds							
Peregrine falcon	*Falco peregrinus*	Yes	x			Yes	Federally delisted
Ferruginous hawk	*Buteo regalis*	Possible		x		Yes	
Common yellowthroat	*Geothlypis trichas*	Unknown			x	Unknown	
Burrowing owl	*Athene Cunicularia*	No			x	No	
Swainson's hawk	*Buteo swainsoni*	Possible			x	Unknown	
American white pelican	*Pelecanus erythrorhynchos*	No			x	No	
Lewis's woodpecker	*Melanerpes lewis*	No			x	No	
Three-toed woodpecker	*Picoides tridactylus*	No			x	No	
Greater sage grouse	*Centrocercus urophasianus*	No			x	No	
Blue grosbeak	*Guiraca caerulea*	Unknown			x	Unknown	
Northern goshawk	*Accipiter gentiles*	Unknown			x	Unknown	
Amphibians and Reptiles							
Western toad	*Bufo boreas*	Possible			x	Unknown	
Arizona toad	Bufo microscaphus	Possible			x	No	
cornsnake	*Elaphe guttata*	Yes			x	Unknown	
milksnake	*Lampropeltis traingulum*	Possible			x	Unknown	
Plateau striped whiptail	*Cnemidophorus (Aspidoscelis) velox*	Unknown			x	Unknown	
Smith's black-headed snake	*Tantilla hobartsmithii*	Unknown			x	Unknown	
Snails							
Eureka mountainsnail	*Oreohelix eurekensis*	No			x	No	

Status: E—Endangered, T—Threatened, SC—State concern.

Table 3–54. Sensitive Bird Species Protected Under the Fish and Wildlife Conservation Act and Migratory Bird Treaty Act That May Occur Near the Pipeline Corridor

Species	Potential to Occur in Project Area
Order Falconiformes—Birds of prey	
Golden eagle *(Aquila chrysaetos)*	High
Northern harrier *(Circus cyaneous)*	Moderate
Prairie falcon *(Falco mexicanus)*	Moderate
Red-tailed hawk (*Buteo jamaicensis*)	High
Turkey vulture (*Cathartes aura)*	High
Order Gruiformes—Marsh and open country birds	
Black rail *(Laterallus jamaicensis)*	Moderate
Yellow rail *(Coturnicops noveboracensis)*	Low
Order Strigiformes—Nocturnal birds of prey	
Barn owl *(Tyto alba)*	Low
Flammulated owl *(Otus flammeolus)*	Low
Short-eared owl *(Asio flammeus)*	Low
Order Apodiformes—Small swallowlike birds	
Black swift *(Cypseloides niger)*	Low
Vaux's swift *(Chaetura vauxi)*	Low
Order Piciformes—Wood-boring birds	
Red-headed woodpecker *(Melanerpes erythrocephalus)*	Low
Williamson's sapsucker *(Sphyrapicus thyroideus)*	Low
Order Passeriformes—Perching birds	
Olive-sided flycatcher *(Contopus borealis)*	Low
Gray flycatcher *(Empidonax wrightii)*	Moderate
Pinyon jay *(Gymnorhinus cyaneocephalus)*	Low
Bendire's thrasher *(Toxostoma bendirei)*	High
Crissal thrasher *(Toxostoma dorsale)*	High
Bewick's wren *(Thryomanes bewickii)*	Moderate
Sedge wren *(Cistothorus platensis)*	Low
Verry *(Catharus fuscenscens)*	Moderate
Sprague's pipit *(Anthus spragueii)*	Low
Loggerhead shrike *(Lanius ludovicianus)*	Moderate
Gray vireo *(Vireo vicinior)*	Moderate
Virginia's warbler *(Vermivora virginiae)*	Moderate
Black-throated warbler *(Dendroica nigrescens)*	Low
Grace's warbler *(Dendroica graciae)*	Low
Blackpoll warbler *(Dendroica striata)*	Low
Dickcissell *(Spiza americana)*	Low
Sage sparrow *(Amphispiza belli)*	Low
Cassin's sparrow *(Aimophila cassinii)*	Low
Brewer's sparrow (*Spizella breweri)*	Moderate
Lark bunting *(Calamospiza melanocorys)*	High
Baird's sparrow *(Ammodramus bairdii)*	Low
Grasshopper sparrow *(Ammodramus savannarum)*	Low
McCown's longspur *(Calcarius mccownii)*	Low
Chestnut-collared longspur *(Calcarius ornatus)*	Low

Note: Birds listed in the table are protected under the Fish and Wildlife Conservation Act (Birds of Conservation Concern [2000] [USF&WS 2002f] and the MBTA [50 CFR 10], Executive Order 13186). Species listed as threatened or endangered under the ESA or considered endangered, threatened, or rare by the State of Utah are not included here.

The Abert's squirrel (*Sciurus aberti*) and burrowing owl are of primary concern along the pipeline corridor. Ponderosa pine stands in the vicinity of T. 35 S., R. 23 and R. 24 W. (Map 14, Appendix C) likely provide habitat for Abert's squirrel and many sensitive avian species. Burrowing owl habitat has been identified within T. 30 S., R. 23 and R. 24 E., (Map 9, Appendix C) and seasonal restrictions may apply; however, no critical habitat exists within the pipeline corridor.

3.4.19.7 Land Use

The proposed pipeline corridor south from the Moab site to the White Mesa Mill site is approximately 89 miles and would cross federal, State, and private land. Where possible, the pipeline would be constructed in the existing right-of-way. Where co-location was not possible or practical, the slurry pipeline would parallel existing rights-of-way. Approximately 27 percent of the corridor is administered by BLM and the USFS. Approximately 54 percent of the route is located on private and Nature Conservancy lands; the remaining 19 percent is under the jurisdiction of the State, including wildlife reserves.

3.4.19.8 Cultural Resources

The cultural history of the White Mesa Mill pipeline route is discussed in the more general cultural history of southeastern Utah described in Section 3.1.13.1; the Class I cultural resource inventory that was conducted for the corridor is described in Section 3.1.13.2.

The Class I inventory (Davis et al. 2003) indicates that Class III surveys have been conducted along most of the proposed pipeline route. An approximately1.5-mile section of the pipeline corridor north and south of the proposed pumping station (Map 8, Appendix C) has not been surveyed, and an approximately 8.5-mile section of the pipeline corridor from Dodge Point (Map 13, Appendix C) to Mustang Mesa (Map 15, Appendix C) has not been completely surveyed. Davis et al. (2003) estimate that, within these unsurveyed areas, approximately 127 sites per square mile could be expected to occur. Of the 127 sites, approximately 79 percent, or 100 sites, would be eligible for inclusion in the National Register of Historic Places.

Within the 1-mile-wide corridor along the entire pipeline corridor, approximately 203 cultural sites have been documented. Of this total, approximately 104 are considered eligible for inclusion in the National Register of Historic Places. Table 3–55 summarizes the types of cultural sites that are eligible for inclusion. The time periods represented by the sites range primarily from the prehistoric Archaic to the Pueblo III periods (7000 B.C.–A.D. 1300); however, the protohistoric and historic periods are represented by a number of sites.

A distinctive trend in cultural site densities occurs north to south along the length of the pipeline corridor. In the northern 10-mile section of the corridor, between Moab and the southern end of Spanish Valley (Map 6, Appendix C), typical site densities are 2.9 sites per linear mile. This area lacks the physical attributes that are deemed essential for long-term prehistoric habitation. Accordingly, the types of cultural sites documented in this section indicate a relatively transient use by prehistoric and protohistoric groups.

Table 3–55. White Mesa Mill Pipeline—Summary of Eligible Cultural Sites by Type

Site Type	Number of Sites
Temporary Camp	17
Long-Term Camp	1
Habitation Site	13
Limited Activity Site	21
Granary	7
Rock Art	1
Quarry	10
Road	5
Homestead	1
Unknown	28
Total	**104**

Along the middle section of the pipeline corridor, between the southern end of Spanish Valley and Peters Canyon (Map 10, Appendix C), cultural site densities average 8 sites per linear mile. This area contains a wide variety of bedrock exposures containing rock types that were exploited by prehistoric groups for the manufacturing of stone tools. The types of cultural sites documented in this area indicate that prehistoric groups used this area primarily for short-term activities such as lithic quarrying, tool manufacturing, and hunting and gathering of local natural resources.

The southern section of the pipeline corridor, between Peter's Canyon and the White Mesa Mill site, contains the highest density of cultural sites along the corridor. Within this section of the corridor, Class III surveys have been incomplete or nonexistent. As previously noted, Davis et al. (2003) estimated densities of approximately 127 sites per square mile in the Dodge Point/Mustang Mesa area. In the Recapture Wash area north of Blanding, archaeologists (Davis et al. 2003) documented an average of 56 cultural sites per square mile, and on White Mesa, Davis et al. (2003) documented an average of 34 cultural sites per square mile.

Recent interviews (Fritz 2004) with tribal members indicate that at least one potential traditional cultural property, a sacred ceremonial site, associated with the Ute Tribe exists along the proposed pipeline corridor. This is a "potential" traditional cultural property because its eligibility for National Register status has yet to be determined; this determination would be made during the Section 106 consultation process. The potential for the existence of additional traditional cultural properties and their estimated density are extremely high (on a scale of low-medium-high-extremely high); such properties would likely be associated with the Ute Tribe, Navajo Nation, and Hopi Tribe (Fritz 2004). Traditional cultural properties along the route may include sacred gathering areas, sacred healing areas, sacred springs, and burial areas.

3.4.19.9 Visual Resources

The 87-mile-long proposed pipeline corridor between the Moab and White Mesa Mill sites passes through areas designated primarily as Class III by BLM (see Section 3.1.15 for an explanation of visual resource classes). Approximately 20 percent of the route is classified as Class IV (south of Monticello and south of Blanding), and approximately 5 percent of the route is classified as Class II (Kane Springs Canyon, approximately 10 miles southeast of Moab; Long Canyon, approximately 10 miles northeast of Blanding; and Recapture Creek, approximately 3.5 miles northeast of Blanding).

A variety of visual settings occur throughout the Class III areas. Between Moab and Monticello, much of the landscape is characterized by gently to moderately rolling terrain that is abruptly dissected by dry, rocky arroyos. The predominantly red sandy soils are covered by moderately sparse vegetation composed of sagebrush, rabbitbrush, bunchgrasses, cheatgrass, piñon-pine, and juniper. Interspersed among the rolling hills are numerous red and beige sandstone outcrops, some occurring as isolated butte-like "islands" and others appearing as linear ridges and cliffs. Between Monticello and Blanding, the Class III areas are characterized more by rough-textured hills, ridges, and valleys that are thickly vegetated with sagebrush, piñon-pine, and juniper.

The Class IV areas south of Monticello and south of Blanding have been culturally modified by farming and ranching. The landscape is a gently to moderately rolling patchwork of plowed fields, green pastures, and cultivated wheat and alfalfa fields. Soils are predominantly red or dark reddish brown.

The Class II areas—Kane Springs Canyon, Long Canyon, and Recapture Creek—are characterized by steep, dissected canyons. The Kane Springs Canyon area contains the rugged red and beige ridges and cliffs of the Entrada Sandstone. These rocky ridges are sparsely vegetated with sagebrush and juniper. The canyons of Long Canyon and Recapture Creek are formed by the somewhat less rugged sandstone ridges and cliffs of the Burro Canyon Formation and Dakota Sandstone. The yellow-brown and tan rocks of these strata are covered with moderately dense piñon and juniper. Figure 3–44 and Figure 3–45 are photographs of the proposed pipeline crossings within Kane Springs Canyon and Recapture Creek, respectively.

Approximately 25 percent of the pipeline corridor, including those portions that cross Kane Springs Canyon and Recapture Creek, is visible to travelers on US-191. A 3- to 4-mile segment of the route that skirts the southwestern slope of Spanish Valley (Map 5, Appendix C) is visible to Moab residents and local traffic. The remaining 75 percent of the route is not visible to the general public.

3.5 Borrow Areas

Different types of borrow materials would be needed for cover materials. These materials range from silts and clays to riprap, or rock materials, that would be used to armor the sides of the disposal cell. Borrow areas that would provide these materials have been identified for each disposal alternative (see Figure 2–8). In some cases, a proposed borrow area would be used for more than one disposal alternative. Two of the proposed borrow areas (LeGrand Johnson and Papoose Quarry) are existing quarries, and specific information on rock materials present has been well documented. The proposed Floy Wash borrow area is near pits previously used by UDOT for highway materials. All other proposed borrow sources were selected on the basis of geologic reports and have not been field tested.

Once a disposal site was selected, the proposed borrow areas for that site would be evaluated for suitability by digging test pits and sampling boreholes. Borrow areas selected for analysis constitute an area larger than would be used. This would allow a contractor enough area to adequately test and configure the borrow area for project needs. For example, if the actual deposit of borrow material were not as deep as anticipated, a larger surface area would be required than if the deposit were thicker than anticipated. A larger area also would allow the contractor greater flexibility to avoid any sensitive resources encountered. Figure 2–8 shows the locations of the borrow areas.

Figure 3–44. View North of Proposed Pipeline Crossing at Kane Springs Canyon
(note existing pipeline corridor in rock outcrop)

Figure 3–45. View Southeast of Proposed Pipeline Crossing at Recapture Creek From US-191

3.5.1 Crescent Junction Borrow Area

The Crescent Junction borrow area is within the area designated as the Crescent Junction site area and, therefore, shares resource characteristics described in Section 3.3.

The general area is underlain by thick Mancos Shale that is composed primarily of mudstone with scattered thin beds of bentonite. The shallowest ground water is 3,000 ft deep in the Dakota Sandstone. No wetlands or federally regulated floodplains are present in this borrow area; however, during large storms, the nearby Crescent Wash will carry heavy flows of an indeterminate volume and lateral extent.

Air quality in this borrow area is expected to be similar to that described for the Moab, Crescent Junction, and Klondike Flats site alternatives. The Moab region is classified as an attainment area under the NAAQS (see Section 3.1.4 for further detail).

Wildlife diversity and densities are similar to those described in Section 3.3.9 and would be considered limited because of the semiarid climate, vegetation types, and habitat types present. However, the proximity of the Book Cliffs could increase the potential for cliff-dwelling raptors being present. Of the state listed sensitive species that are also protected under the MBTA, the ferruginous hawk and peregrine falcon are of primary concern. No important habitat has been identified for these or other non-federally protected wildlife species close to the Crescent Junction borrow area.

The Crescent Junction borrow area is located within the Crescent Junction site. Of the federally protected species listed in Table 3–32, the endangered black-footed ferret and white-tailed prairie dog (currently under review for federal listing) could potentially occur on and/or in the vicinity of the Crescent Junction borrow area.

UDWR (2003b) reported an unconfirmed sighting of the black-footed ferrets in the vicinity of the Crescent Junction borrow area in 1989. All black-footed ferrets currently in the wild are believed to be the result of a federal reintroduction program. It is highly unlikely that the black-footed ferrets reintroduced in Uinta and Duchesne Counties in 1999 or their offspring could occur on or in the vicinity of the Crescent Junction borrow area.

White-tailed prairie dog colonies around the Crescent Junction borrow area form a complex of colonies ranging in size from 10 acres to 2,445 acres (Seglund 2004). It is unknown to what extent individual colonies or a combination of colonies could support black-footed ferrets.

There is no designated or proposed critical habitat for the black-footed ferret in the vicinity of the Crescent Junction borrow area.

DOE, in consultation with USF&WS and BLM, would determine the need for habitat evaluations and surveys for species that may be affected.

The area surrounding the Crescent Junction borrow area is largely unpopulated. The nearest resident lives southeast of the I-70 interchange with US-191. Many unimproved dirt roads traverse the open country, and dispersed recreation, grazing, and oil and gas leasing occur in the general area, as described in Section 3.3.10.

Results of a Class I cultural resource inventory indicate that Class III cultural resource surveys have not been conducted at this site. Predictive modeling involving soil type and landform (Berry 2003) indicates that 1.9 cultural sites per square mile could be expected to occur within the borrow area. No data exist concerning the presence of potential traditional cultural properties on or near the borrow area. On the basis of Class I cultural resource inventory results, tribal interviews, and published and unpublished literature, the likelihood of occurrence and their estimated density on the site are low (on a scale of low-medium-high-extremely high).

County, federal, and state road access to the general site area is described in Section 3.1.17 and is shown on Figure 3–21. There is no direct access to this borrow area from the Crescent Junction interchange with I-70, and it is anticipated that roads would need to be constructed for access to the borrow materials. If the materials were used for the Crescent Junction site alternative, only minor road improvements would be required. However, if these materials were used for another disposal site alternative, roads would need to be constructed from Crescent Junction or from the proposed Williams Crescent Junction terminal to access US-191.

3.5.2 Floy Wash Borrow Area

The Floy Wash borrow area is in an area that has been previously used by UDOT for borrow materials. It is located about 7 miles west-southwest of Crescent Junction just south of I-70. Material from the existing pits is from terrace gravel deposits that are up to 20 ft thick. The terrace deposits contain gravel composed of quartzite, chert, limestone, and sandstone rock types derived from sources in the Book and Roan Cliffs to the north. The terrace deposits overlie the 3,000-ft-thick Mancos Shale and are underlain by the water-bearing Dakota Sandstone. A single, ephemeral wash, Floy Wash, is immediately adjacent to the area. No perennial streams, wetlands, or federally regulated floodplains are located within the borrow area. A more detailed description of potential riparian resources is included in Appendix F, “Floodplain and Wetlands Assessment and Floodplain Statement of Findings for Remedial Action at the Moab Site.” Minor use of surface water is limited to wildlife and livestock watering during and immediately after storms.

Soils at the Floy Wash site are classified as Mesa-Trook complex (SCS 1989) and are formed on mixed alluvium and fan pediments and terraces derived predominantly from sandstone and conglomerate. These soils are very deep, well-drained, fine sandy loams near the surface; below a depth of about 24 inches, they become very gravelly fine sandy loam.

Vegetation commonly supported on these soils consists of shadscale, galleta grass, Indian ricegrass, and fourwing saltbush. Vegetation observed during a site visit in April 2003 was dominated by phacelia and prickly pear cactus and reflects the history of the site as a gravel quarry. Other species observed include milkvetch, kochia, Gardner saltbush, mat saltbush, bud sagebrush, galleta, globemallow, and cheatgrass.

Depending on the condition of the plant community, wildlife species that may inhabit this area include game species such as antelope and chukar. Desert cottontail, black-tailed jackrabbit, and various other small mammal species may also find suitable habitat in this area. Coyote, red-tailed hawks, golden eagles, and northern harriers may find suitable hunting grounds on the Mesa-Trook soils.

Wildlife population diversity and densities are similar to those described for the Klondike Flats site (Section 3.2.8). Vegetation and habitat are limited and, therefore, limit species diversity. The proximity to I-70 may also limit species diversity.

The general area consists of land administered by BLM and interspersed with SITLA lands. This site is within the existing Athena grazing allotment. Immediate access off I-70 is available, although CR-334 is a backcountry dirt road that is part of the old highway alignment and would connect to US-191, as described in Section 3.1.17 and shown on Figure 3–21.

The Floy Wash borrow area is located nearest to the Crescent Junction site. Of the federally protected species listed in Table 3–32, the endangered black-footed ferret and white-tailed prairie dog (currently under review for federal listing) could potentially occur on and/or in the vicinity of the Floy Wash borrow area.

UDWR (2003b) reported an unconfirmed sighting of the black-footed ferrets in the vicinity of the Floy Wash borrow area in 1989. All black-footed ferrets currently in the wild are believed to be the result of a federal reintroduction program. It is highly unlikely that the black-footed ferrets reintroduced in Uinta and Duchesne Counties in 1999 or their offspring could occur on or in the vicinity of the Floy Wash borrow area.

White-tailed prairie dog colonies around the Crescent Junction area, located a few miles east of the Floy Wash borrow area, form a complex of colonies ranging in size from 10 to 2,445 acres (Seglund 2004). It is unknown to what extent individual colonies or a combination of colonies could support black-footed ferrets.

There is no designated or proposed critical habitat for the black-footed ferret in the vicinity of the Floy Wash borrow area.

Results of Class I cultural resource inventories indicate that Class III surveys have not been conducted for this site. However, on the basis of predictive modeling involving soil type and landform (Berry 2003), it is estimated that 2.7 cultural sites per square mile could be expected to occur within the borrow area. No data exist concerning the presence of potential traditional cultural properties on or near the borrow area. On the basis of Class I cultural resource inventory results, tribal interviews, and published and unpublished literature, the likelihood of occurrence and their estimated density on the site are low (on a scale of low-medium-high-extremely high).

Noise levels at this site are expected to be comparable to noise levels associated with open desert areas. Vehicles on I-70 would constitute the nearest sources of man-made noise. However, activity at an existing borrow pit could also influence background noise levels. The site is situated on a broad, rolling, desert plain; it is sparsely vegetated with saltbush, cheatgrass, and prickly pear cactus. A 10- to 15-ft cut face exposes the types of borrow materials present. Around the site, distant canyons, buttes, and mesas form the background scenery. BLM assigns this area a Class III visual resource designation (Sweeten 2003) (Section 3.1.15 explains visual resource classes.) The borrow area is visible from I-70 and would be considered remote from populations.

3.5.3 Courthouse Syncline Borrow Area

The Courthouse Syncline borrow area is located several miles northwest of the Klondike Flats site. It is near the junction of Thompson and Crescent Washes in a broad open area of poorly developed drainages, where alluvial mud deposits less than 20 ft thick cover the surface. In addition to the alluvial mud deposits, some coarser-grained alluvial material (sand and gravel) also covers the surface of part of the site; this material has been transported from the Book Cliffs down Thompson Wash. The geologic setting at the borrow area is similar to that at the Klondike Flats site. The only significant difference is that the Mancos Shale beneath the borrow area is more than 1,000 ft thick and several hundred feet thicker than at the Klondike Flats site. Section 3.2 provides general background information on this area.

Thompson and Crescent Washes are considered ephemeral and are tributaries to Tenmile Wash, which is a tributary to the Green River. Both washes are dry most of the year and are typical of the drainage features in this area. Flows occur only after large storms. Use of surface water from these drainage features is limited to wildlife and livestock watering during and immediately after storms. No perennial streams, wetlands, or federally regulated floodplains are known to exist in the borrow area, but nearby Thompson and Crescent Washes contain potential riparian vegetation (see Appendix F).

Air quality in this borrow area is expected to be similar to that described for the Moab, Crescent Junction, and Klondike Flats sites. The Moab region is classified as an attainment area under the NAAQS (see Section 3.1.4 for further detail).

Wildlife resources are similar to those described for the Klondike Flats site and are limited by the limited vegetation and habitat present. However, an ephemeral wash on the southern perimeter of the site may provide cover and habitat for small mammals. No critical winter or summer range has been identified for wildlife in this area.

This area is currently open rangeland (Little Grand grazing allotment) administered by BLM. No residential areas or roads provide access. Area access is described in Section 3.1.17 and shown on Figure 3–21.

The Courthouse Syncline borrow area is located nearest to the Klondike Flats site. Of the federally protected species listed in Table 3–25, the endangered black-footed ferret and white-tailed prairie dog (currently under review for federal listing) could potentially occur on and/or in the vicinity of the Courthouse Syncline borrow area.

UDWR (2003b) reported an unconfirmed sighting of black-footed ferrets in the vicinity of the Courthouse Syncline borrow area in 1989. All black-footed ferrets currently in the wild are believed to be the result of a federal reintroduction program. It is highly unlikely that the black-footed ferrets reintroduced in Uinta and Duchesne Counties in 1999 or their offspring could occur on or in the vicinity of the Courthouse Syncline borrow area.

Surveys for white-tailed prairie dogs have been conducted at the Klondike Flats site (BLM 1995). At that time, it was determined that all of the colonies were relatively small and isolated, such that they would not support black-footed ferrets.

There is no designated or proposed critical habitat for the black-footed ferret in the vicinity of the Courthouse Syncline borrow area.

DOE, in consultation with USF&WS and BLM, would determine the need for habitat evaluation and surveys for species that may be affected.

Results of a Class I cultural resources inventory indicate that Class III cultural resource surveys have not yet been conducted in this area. Predictive modeling involving soil type and landform

(Berry 2003) indicates that 22.4 to 27.4 cultural sites per square mile could be expected to occur within the borrow area. No data exist concerning the presence of potential traditional cultural properties on or near the borrow area. On the basis of Class I cultural resource inventory results, tribal interviews, and published and unpublished literature, the likelihood of their occurrence and estimated density on the site are low (on a scale of low-medium-high-extremely high).

This borrow area is remotely located on a flat to gently rolling alluvial plain that is dotted with greasewood shrubs and small bunches of grasses and forbs. Small-scale dune-like features on the soil surface, formed by winds, are prevalent throughout the site. Far north of the site and forming the horizon are the Book Cliffs, a linear geologic feature that trends east-west from Grand Junction, Colorado, to Price, Utah. BLM assigns this area a Class III visual resource designation (Sweeten 2003). The site is not visible to the public.

Neither background noise nor ground vibration data are available for the Courthouse Syncline borrow area. Noise levels at the Courthouse Syncline borrow area are expected to be comparable to noise levels associated with open desert areas, typically 22 to 38 dBA. The nearest source of man-made noise is traffic on US-191; however, the borrow area is 2.75 miles west of the highway and the contribution of noise to the background noise at the borrow site is minimal (less than 40 dBA). Railroad traffic on the Union Pacific rail line that runs parallel to US-191 also has a low potential to contribute to background noise and ground vibration.

3.5.4 Klondike Flats Borrow Area

This borrow area is within the Klondike Flats site. Section 3.2 describes the resources present. Of the federally protected species listed in Table 3–25, the endangered black-footed ferret and white-tailed prairie dog (currently under review for federal listing) could potentially occur on and/or in the vicinity of the Klondike Flats borrow area.

UDWR (2003b) reported an unconfirmed sighting of the black-footed ferret in the vicinity of the Klondike Flats borrow area in 1989. All black-footed ferrets currently in the wild are believed to be the result of a federal reintroduction program. It is highly unlikely that the black-footed ferrets reintroduced in Uinta and Duchesne Counties in 1999 or their offspring could occur on or in the vicinity of the Klondike Flats borrow area.

Surveys for white-tailed prairie dogs have been conducted at the Klondike Flats site (BLM 1995). At that time, it was determined that all of the colonies were relatively small and isolated, such that they would not support black-footed ferrets.

There is no designated or proposed critical habitat for the black-footed ferret in the vicinity of the Klondike Flats borrow area.

3.5.5 Tenmile Borrow Area

The Tenmile borrow area is located about 7 miles west of the Klondike Flats site. Rocks on the area surface are sandstones that are nearly flat lying; they consist of the Dewey Bridge Member of the Carmel Formation and the Slick Rock Member of the Entrada Sandstone. Other than small areas where sandstone is exposed, most of the area is covered by eolian sand. Ground water in the area is present at shallow depths (200 ft or less) in the Navajo Sandstone; springs emerge in draws near this site where the top of the Navajo Sandstone is exposed. No ephemeral or perennial surface water features or resources have been identified within this area, but Tenmile Wash, an ephemeral stream with potential riparian and/or wetland resources, exists nearby (see Appendix F). Section 3.2 provides general background information on this area.

Soils and potential natural vegetation at the Tenmile borrow area are classified as Nakai fine sandy loam, described previously in Sections 3.2.1 and 3.2.2. However, approximately 25 percent of Nakai sandy loam at the Tenmile borrow area is covered with stabilized and active parabolic dunes consisting of fine sand. Ephedra is the common dune stabilizer in the area. Other common plants are sand sage, hopsage, Indian ricegrass, and wild buckwheat in fine sand areas and fourwing saltbush, jimmyweed, rabbitbrush, galleta, and yucca in sandy loam areas. Tamarisk and greasewood occur in areas with relatively shallow ground water.

Air quality in this area is expected to be similar to that described for the Moab, Crescent Junction, and Klondike Flats sites. The Moab region is classified as an attainment area under the NAAQS (see Section 3.1.4 for further detail).

Wildlife population diversity and densities in the vicinity of this site are similar to those described for the Klondike Flats site in Section 3.2.8. Because of the level of recreational activity in this area, densities may be further limited seasonally. No critical winter or summer range has been identified for wildlife in this area. Of the identified threatened, endangered, or sensitive species potentially present, the black-footed ferret is the primary species of concern. No critical habitat is present in this area.

The Tenmile borrow area is located nearest to the Klondike Flats site. Of the federally protected species listed in Table 3–25, the endangered black-footed ferret and white-tailed prairie dog (currently under review for federal listing) could potentially occur on and/or in the vicinity of the Tenmile borrow area.

UDWR (2003b) reported an unconfirmed sighting of the black-footed ferret in the vicinity of the Klondike Flats site in 1989. All black-footed ferrets currently in the wild are believed to be the result of a federal reintroduction program. It is highly unlikely that the black-footed ferrets reintroduced in Uinta and Duchesne Counties in 1999 or their offspring could occur on or in the vicinity of the Tenmile borrow area.

Surveys for white-tailed prairie dogs have been conducted at the Klondike Flats site (BLM 1995). At that time, it was determined that all of the colonies were relatively small and isolated, such that they would not support black-footed ferrets.

There is no designated or proposed critical habitat for the black-footed ferret in the vicinity of the Tenmile borrow area.

DOE, in consultation with USF&WS and BLM, would determine the need for habitat evaluations and surveys for species that may be affected.

Land in the area is administered by BLM. Blue Hills Road is the major access to this site, although the area is laced with interconnecting backcountry roads and trails. There is high recreational use in the general area. Traffic counters placed on Blue Hills Road received up to 80 vehicle counts per day over a 1-month period, indicating that at least 80 individuals accessed this area daily over the period of record. Other uses in the area include grazing and oil and gas leasing. The nearest residence is approximately 9 miles east at the Canyonlands Field Airport.

Results of a Class I cultural resources inventory indicate that Class III cultural resource surveys have not yet been conducted in this area. Predictive modeling involving soil type and landform (Berry 2003) indicates that 22.4 to 27.4 cultural sites per square mile could be expected to occur within the borrow area. No data exist concerning the presence of potential traditional cultural properties on or near the borrow area. On the basis of Class I cultural resource inventory results, tribal interviews, and published and unpublished literature, the likelihood of their occurrence and estimated density on the site are low to medium (on a scale of low-medium-high-extremely high).

Neither background noise nor ground vibration data are available for the Tenmile borrow area. Noise levels at the Tenmile borrow area are expected to be comparable to noise levels associated with open desert areas, typically 22 to 38 dBA. The nearest source of man-made noise is traffic on US-191. The borrow area is about 8 miles from US-191, and no contribution of highway noise to the background noise at the borrow site is expected. Railroad traffic on the Union Pacific rail line that runs parallel to US-191 also has a little potential to contribute to background noise and ground vibration.

This borrow area is situated on gently rolling topography that is capped by small, hummocky sand dunes. Scattered sand sage shrubs, bunch grasses, and desert primrose impart a rough texture to the lands and create a pleasing contrast to the pale red soils. Dominating the near-background are steep sandstone cliffs striated with red, beige, and tan rock strata. BLM currently assigns this area a Class IV visual resource designation (Sweeten 2003). This borrow area is highly visible to travelers on the adjacent road.

Access to the general area is described in Section 3.1.17 and shown on Figure 3–21.

3.5.6 Blue Hills Road Borrow Area

The Blue Hills Road borrow area is located about 4 miles south of the Klondike Flats site. A variety of rock types composing the Cedar Mountain Formation are exposed at this site. These rock types include mudstone, sandstone, gritstone, conglomerate, and limestone. Alluvial and eolian deposits cover bedrock in some areas within this borrow area. Ground water is at least 600 ft deep in the Entrada and Navajo Sandstones. Section 3.2 provides general background information on this area.

Soils at the Blue Hills Road borrow area are classified as Nakai fine sandy loam and the Toddler-Ravola-Glenton association. These soils and the potential natural vegetation are described in Sections 3.2.1 and 3.2.2.

A single, unnamed ephemeral wash, a tributary to Bartlett Wash and, therefore, to the Colorado River, is within the boundary of disturbance identified for this borrow area. No perennial surface waters, wetlands, or federally regulated floodplains are present within the boundaries of the borrow area, but a small spring with associated wetland vegetation exists directly adjacent to the southwestern boundary (see Appendix F).

Air quality in this area is expected to be similar to that described for the Moab, Crescent Junction, and Klondike Flats site alternatives. The Moab region is classified as an attainment area under the NAAQS (see Section 3.1.4 for further detail).

Wildlife population diversity and densities in the vicinity of this borrow area are similar to those already described for the Klondike Flats site (see Section 3.2.8). Because of the high level of recreational activity in the area and proximity of Blue Hills Road, densities and diversity are further limited. No critical winter or summer range has been identified for wildlife in this area.

The Blue Hills borrow area is located nearest to the Klondike Flats site. Of the federally protected species listed in Table 3–25, the endangered black-footed ferret and white-tailed prairie dog (currently under review for federal listing) could potentially occur on and/or in the vicinity of the Blue Hills borrow area.

UDWR (2003b) reported an unconfirmed sighting of black-footed ferrets in the vicinity of the Klondike Flats site in 1989. All black-footed ferrets currently in the wild are believed to be the result of a federal reintroduction program. It is highly unlikely that the black-footed ferrets reintroduced in Uinta and Duchesne Counties in 1999 or their offspring could occur on or in the vicinity of the Blue Hills borrow area.

Surveys for white-tailed prairie dogs have been conducted at the Klondike Flats site (BLM 1995). At that time, it was determined that all of the colonies were relatively small and isolated, such that they would not support black-footed ferrets.

There is no designated or proposed critical habitat for the black-footed ferret in the vicinity of the Blue Hills borrow area.

DOE, in consultation with USF&WS and BLM, would determine the need for habitat evaluation and surveys for species that may be affected.

Oil and gas leases are in the area, but no oil or gas leases are currently active. A potassium permit was issued in 2001. Grazing occurs within the Arth's Pasture Grand grazing allotment. The closest residential property is adjacent to the Canyonlands Field Airport, approximately 3 miles east.

Results of a Class I cultural resource inventory indicate that Class III cultural resource surveys have not been conducted at this site. Predictive modeling involving soil type and landforms (Berry 2003) indicates that 1.9 to 27.4 cultural sites per square mile could be expected to occur within the borrow area. No data exist concerning the presence of potential traditional cultural properties on or near the borrow area. On the basis of Class I cultural resource inventory results, tribal interviews, and published and unpublished literature, the likelihood of occurrence and their estimated density on the site are low (on a scale of low-medium-high-extremely high).

Neither background noise nor ground vibration data are available for the Blue Hills Road borrow area. Noise levels at the Blue Hills Road borrow area are expected to be comparable to noise levels associated with open desert areas, typically 22 to 38 dBA. The nearest source of man-made noise is traffic on US-191. The borrow area is about 3 miles from the highway, and the contribution of noise to the background noise at the borrow site is minimal. Railroad traffic on the Union Pacific rail line that runs parallel to US-191 also has a low potential to contribute to background noise and ground vibration.

This borrow area is located on a smooth, flat, desert plain with evenly scattered bunchgrasses and forbs. The light- and dark-green plants form a moderate contrast with the pale, reddish-beige soils. In the immediate background, steep hillsides rise from the valley floor and form conical and horizontal features. BLM assigns this area a Class III visual resource designation (Sweeten 2003). This site is visible to travelers on Blue Hills Road.

3.5.7 LeGrand Johnson Borrow Area

This privately owned existing commercial gravel pit is located about 8 miles south of Moab along US-191 in Spanish Valley (see Figure 2–8). It has an estimated available volume of 600,000 yd^3 of sand, gravels, and road base materials. No federally protected species are known to occur at the LeGrand Johnson borrow area.

3.5.8 Papoose Quarry Borrow Area

This existing commercial quarry, operated by the Cotter Corporation on state lands, has an estimated available large rock volume of 13 million yd^3. It is located in Lisbon Valley south of SR-46 and at the intersection of CR-113 and CR-370 (see Figure 2–8). No federally protected species are known to occur at the Papoose Quarry borrow area.

3.5.9 Blanding Borrow Area

This borrow area, located north of the White Mesa Mill site and northeast of Blanding, is near existing sand and gravel pits. Section 3.4 provides area resource information.

Recapture Creek, a perennial stream, is located within this site area. Surface flow information is unavailable. There is also an intermittent stream present, and both it and Recapture Creek are vegetated by tamarisk, cottonwood, willow, and shrub oak (BLM 2003c). These streams would need a more detailed water resource inventory should this site be chosen. Wildlife present is believed to be similar to that described in Section 3.4.9. Compared to other borrow areas under consideration, this site is believed to support greater diversity and abundance of wildlife. Mule deer migration routes have been identified south of this site in T. 33 S. to T. 35 S. and within ranges both east and west of US-191. Critical winter range is found in T. 35 S. to T. 37 S. and in ranges east of US-191. Restrictions are in effect from November 15 to April 30 of each year.

Of the federally protected species that could be potentially present in the Blanding borrow area (Table 3–51), the Gunnison sage grouse, a federal candidate species, is of primary concern. The Blanding borrow area lies within a Gunnison sage grouse conservation area (Sage Grouse Working Group 2000). High quality habitat for the Gunnison sage grouse has been designated in T. 31 S.–T. 33 S., R. 24 E. (Maps 10 and 11, Appendix C). The burrowing owl may also be present in the Blanding borrow area.

This site is easily accessible from US-191 (see Section 3.4.15) and is on land administered by BLM. It is within a designated transportation and utility corridor and is open to off-highway vehicle use. Other existing uses include grazing and mineral, oil, and gas leasing.

The cultural history of the Blanding borrow area is included in the more general cultural history of southeastern Utah described in Section 3.1.13.1.

Results of the Class I inventory indicate that Class III cultural resource surveys have not been completed for most of the Blanding borrow area. However, one Pueblo II (A.D. 900–1150) habitation site, eligible for inclusion in the National Register of Historic Places, has been documented in the area. On the basis of nearby archaeological surveys (Davis et al. 2003), it is estimated that approximately 56 cultural sites (or 45 sites eligible for inclusion in the National Register of Historic Places) per square mile could be expected to occur within or near the borrow area. The Blanding borrow area is an important plant gathering area for White Mesa Utes and is important to the traditional route from Allen Canyon/Cottonwood Wash area to the White Mesa community. Recent interviews (Fritz 2004) with tribal members indicate that at least two potential traditional cultural properties associated with the Ute Tribe exist on or near the proposed borrow area. These are “potential” traditional cultural properties because their eligibility for National Register status has yet to be determined; this determination would be made during the Section 106 consultation process. In this area, the likelihood of occurrence of traditional cultural properties and their estimated density are extremely high (on a scale of low-medium-high-extremely high) and are likely associated with the Ute Tribe, Navajo Nation, and Hopi Tribe (Fritz 2004). Traditional cultural properties on or near the site may include sacred gathering areas, sacred ceremonial sites, sacred healing areas, sacred springs, and burial areas.

Neither background noise nor ground vibration data are available for this borrow area. Noise levels at the IUC off-site borrow area are expected to be comparable to noise levels associated with open desert areas, typically 22 to 38 dBA. The nearest source of man-made noise is traffic on US-191 that passes through the northern part of this site. The community of Blanding is located about 1 mile from the southwest corner of the site. Background noise levels at the site would be influenced by traffic on US-191 and could raise noise levels to about 60 dBA measured 50 ft from roadside. There are no rail lines near the borrow area.

This site is located on a hilltop overlooking US-191. The beige soil material within the existing open borrow pits contrasts sharply with the smooth, rolling, dark-green hills surrounding the site. BLM assigns this area a Class III visual resource designation (Sweeten 2003). The site is currently visible for approximately 5 to 10 seconds to southbound travelers on US-191. Northbound travelers do not see the site.

3.5.10 White Mesa Mill Borrow Area

The White Mesa Mill borrow area is located south of Blanding within the IUC property boundary. This borrow area contains clay from the upper part of the Brushy Basin Member of the Morrison Formation that contains about 90 percent bentonite. The geologic setting is about 200 ft lower stratigraphically than at the White Mesa Mill site. Ground water is present in a perched shallow system in the Dakota Sandstone and Burro Canyon Formations. It emerges in seeps at the base of the Burro Canyon Formation in the slopes of the canyon above the borrow area. Ground water directly beneath the borrow area is in the deeper artesian aquifer of the Entrada and Navajo Sandstones. A description of area resources is provided in Section 3.4.

This site is remotely located at the head of a broad, deeply dissected canyon. Composed of valley bottoms and steep hill slopes, the area is a colorful mix of gray, maroon, and pale-green rock strata that are dotted with dark-green piñon and juniper trees. BLM-managed land surrounding this privately owned borrow area is designated Class III (Sweeten 2003). Because of its remote location, this site is not visible to the public.

Of the federally protected species that could be potentially present in the White Mesa Mill borrow area (Table 3–44), the Gunnison sage grouse, a federal candidate species, is of primary concern. The White Mesa Mill borrow area lies within the White Mesa Mill site which itself lies within a Gunnison sage grouse conservation area (Sage Grouse Working Group 2000). However, this species is not known to occur at the White Mesa Mill site (IUC 2003).

The cultural history of the on-site IUC borrow area is included in the more general cultural history of southeastern Utah described in Section 3.1.13.1.

Results of the Class I inventory (Davis et al. 2003) indicate that a Class III survey was conducted at this borrow area in 1980 as part of the larger cultural resource inventory of the White Mesa Mill site. Six cultural sites are documented within the boundaries of the borrow area. Of these, three sites are eligible for inclusion in the National Register of Historic Places. One is a Pueblo II (A.D. 900–1150) permanent habitation site, one is a permanent habitation site of indeterminate age, and one is a General Pueblo (A.D. 750–1300) limited activity site. The White Mesa Mill borrow area is an important plant gathering area for White Mesa Utes and is important to the traditional route from Allen Canyon/Cottonwood Wash area to the White Mesa community. Ongoing interviews with White Mesa elders have identified burial sites in the area. Recent interviews (Fritz 2004) with tribal members indicate that at least three potential traditional cultural properties associated with the Ute Tribe exist on or near the proposed borrow area. These are “potential” traditional cultural properties because their eligibility for National Register status has yet to be determined; this determination would be made during the Section 106 consultation process. In this area, the likelihood of occurrence of traditional cultural properties and their estimated density are extremely high (on a scale of low-medium-high-extremely high) and are likely associated with the Ute Tribe, Navajo Nation, and Hopi Tribe (Fritz 2004). Traditional cultural properties on or near the site may include sacred gathering areas, sacred ceremonial sites, sacred healing areas, sacred springs, and burial areas.

Neither background noise nor ground vibration data are available for this borrow area. Noise levels at this borrow area reside within the boundaries of the White Mesa Mill site. Background levels are expected to be comparable to noise levels associated with open desert areas, with some influence from existing White Mesa Mill operations that are centered about 1 mile to the north of the borrow area. These noise levels could approach 50 to 60 dBA at the borrow area as a result of operations at the White Mesa Mill facilities. US-191 passes about 1 mile to the east of the designated borrow area. Background noise levels at the site would be influenced by traffic on US-191. There are no rail lines near the borrow area.

3.6 References

10 *Code of Federal Regulations* (CFR) 40, U.S. Nuclear Regulatory Commission, “Domestic Licensing of Source Material.”

10 CFR 100, U.S. Nuclear Regulatory Commission, “Reactor Site Criteria.”

40 CFR 6, U.S. Environmental Protection Agency, "Procedures for Implementing the Requirements of the Council on Environmental Quality on the National Environmental Policy Act."

40 CFR 50, U.S. Environmental Protection Agency, "National Primary and Secondary Ambient Air Quality Standards."

40 CFR 51, U.S. Environmental Protection Agency, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans."

40 CFR 61, U.S. Environmental Protection Agency, "National Emission Standards for Hazardous Air Pollutants."

40 CFR 81, U.S. Environmental Protection Agency, "Designation of Areas for Air Quality Planning Purposes."

40 CFR 93, U.S. Environmental Protection Agency, "Conformity to State or Federal Implementation Plans of Transportation Plans, Programs, and Projects Developed, Funded or Approved Under Title 23 U.S.C. or the Federal Transit Laws."

40 CFR 141, U.S. Environmental Protection Agency, "National Primary Drinking Water Regulations."

40 CFR 192, U.S. Environmental Protection Agency, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings."

50 CFR 10, U.S. Fish and Wildlife Service, U.S. Department of the Interior, "General Provisions."

50 CFR 17, U.S. Fish and Wildlife Service, U.S. Department of the Interior, "Endangered and Threatened Wildlife and Plants."

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