CHAPTER 3.0
AFFECTED ENVIRONMENT

3.0 AFFECTED ENVIRONMENT

3.1 INTRODUCTION

This chapter presents the potentially affected existing environment (i.e., the physical, biological, social, and economic values and resources) of the impact area as identified in the Interdisciplinary Team Analysis Record Checklist (Appendix A) and presented in Chapter 1 of this assessment. This chapter provides the baseline for comparison of impacts/consequences described in Chapter 4. Because of small discrepancies in geographic information system (GIS) layers used to describe various project area components of the environment, some acreages and lengths may not always add to exactly the total described. These discrepancies are normal when working with data from a variety of sources and do not affect the overall accuracy of the data and analyses presented.

3.1.1 GENERAL SETTING

The project area is located in the Uinta Basin—part of the Colorado Plateau Province in northeastern Utah. The Uinta Basin is bordered to the north by the Uinta Mountain Range, which is the only major east/west-oriented mountain range in the United States. The eastern and southern boundary of the basin is formed by the Tavaputs Plateau of the Book Cliffs, and the western boundary is formed by the Wasatch Mountains. The center of the basin lies at an elevation between 5,000 and 5,500 feet. The vegetation within the Uinta Basin is primarily shrub/scrub, with some areas of evergreen forest, grasslands, and barren land. The average annual precipitation for the Uinta Basin is less than 8.5 inches. However, the basin contains a number of rivers and streams. The southern slopes of the Uintas are drained by Current Creek, the Duchesne River, Lake Creek, the Uinta River, Ashley Creek, and Big and Little Brush creeks. The southern portion of the basin contains fewer streams that are much smaller in volume than those in the northern region. The Green River flows through the Uintas at Split Mountain and across the Uinta Basin in a southwesterly direction.

3.1.2 RESOURCES OF CONCERN AND OTHER RESOURCES BROUGHT FORWARD FOR ANALYSIS

A total of 31 resources of concern identified in the Interdisciplinary Team Analysis Record Checklist (Appendix A) are brought forward for analysis in Chapter 4: air quality; existing areas of critical environmental concern (ACECs); potential ACECs; cultural resources; environmental justice; Native American religious concerns; threatened, endangered or candidate animal species; threatened, endangered or candidate plant species; wastes (hazardous or solid); county transportation plan; floodplains; lands/access; rangeland health; invasive and non-native species; vegetation, including species status plants; water quality; wetlands/riparian zones; proposed Wild and Scenic Rivers (WSRs); livestock grazing; woodlands/forestry; vegetation; fish and wildlife, including special status species; soils; recreation; visual resources; geology/minerals/energy production; paleontology; fuels/fire management; socioeconomics; wilderness characteristics; and waters of the United States. Some of the resources of concern described in the checklist have been combined into single sections for purposes of analysis, so a total of 16 resource sections is presented below. Each of the identified resources of concern is described in the following sections.

3.2 AIR QUALITY

3.2.1 INTRODUCTION

Regional air quality is influenced by a combination of factors including climate, meteorology, the magnitude and spatial distribution of local and regional air pollution sources, and the chemical properties of emitted pollutants. Within the lower atmosphere, regional and local scale air masses interact with regional topography to influence atmospheric dispersion and transport of pollutants. The following sections summarize the climatic conditions and existing air quality within the project area and surrounding region.

3.2.2 CLIMATE

The project area is located on the West Tavaputs Plateau in the southern foothills of the Uinta Basin; a semiarid mid-continental climate regime typified by dry windy conditions and limited precipitation. The Uinta Basin is bordered by the Wasatch Range to the west, which extends north and south through the middle of the State, and the High Uinta Mountains to the north, which extend east and west through the northeast portion of the State. Elevation of the project area ranges from 4,600 feet above mean sea-level (famsl) in the eastern portion to over 8,000 famsl in the western portion.

3.2.2.1 TEMPERATURE AND PRECIPITATION

The closest climate measurements to the project area were recorded at Nutters Ranch and at Sunnyside, Utah (1963–1986). The Nutters Ranch station is located one mile south of the southwest corner of the project area at an elevation of 5,790 famsl (WRCC 2007). The Sunnyside station is located 18 miles southwest of the southwest corner of the project area at an elevation of 6,670 famsl (WRCC 2007). Table 3-1 and Table 3-2 summarize the mean temperature range, mean total precipitation, and mean total snowfall by month.

Table 3-1. Temperature, Precipitation, and Snowfall at Nutters Ranch, Utah (1963–1986)

Season	Month	Average Temperature Range (in degrees Fahrenheit)	Average Total Precipitation (inches)	Average Total Snowfall (inches)
Spring	March	22.4–51.6	1.2	6.1
	April	29.8–61.4	1.0	4.1
	May	38.5–71.9	1.1	0.6
	Total Spring Average	30.3–61.6	3.3	10.8
Summer	June	46.4–81.3	0.9	0.0
	July	53.6–87.7	1.2	0.0
	August	51.3–85.4	1.4	0.0
	Total Summer Average	50.4–84.8	3.4	0.0
Fall	September	42.2–77.1	1.1	0.5
	October	31.2–65.3	1.2	1.3
	November	20.1–49.4	0.7	5.4
	Total Fall Average	31.2–63.9	3.0	7.2

Table 3-1. Temperature, Precipitation, and Snowfall at Nutters Ranch, Utah (1963–1986)

Season	Month	Average Temperature Range (in degrees Fahrenheit)	Average Total Precipitation (inches)	Average Total Snowfall (inches)
Winter	December	9.2–36.6	0.9	12.4
	January	6.4–35.3	0.6	6.1
	February	11.5–42.0	0.5	9.0
	Total Winter Average	9.0–38.0	1.9	27.6
Total Annual Average		**30.2–62.1**	**11.6**	45.6

Source: Western Regional Climate Center (WRCC) 2007. Data collected at Nutters Ranch, Utah from 1963 to 1986.

Table 3-2. Temperature, Precipitation, and Snowfall at Sunnyside, Utah (1963–1986)

Season	Month	Average Temperature Range (in degrees Fahrenheit)	Average Total Precipitation (inches)	Average Total Snowfall (inches)
Spring	March	22.4–44.9	1.3	6.8
	April	30.0–54.8	1.0	2.6
	May	39.3–64.8	1.2	0.3
	Total Spring Average	30.5–54.8	3.6	9.8
Summer	June	48.3–77.2	0.8	0.0
	July	55.3–84.4	1.2	0.0
	August	53.5–82.2	1.5	0.0
	Total Summer Average	52.4–81.3	3.5	0.0
Fall	September	45.2–72.5	1.7	0.0
	October	34.9–59.7	1.4	0.5
	November	24.3–45.9	0.9	2.8
	Total Fall Average	34.8–59.4	4.1	3.3
Winter	December	15.7–35.9	0.7	6.8
	January	13.8–33.9	0.8	9.2
	February	18.7–40.0	1.0	7.4
	Total Winter Average	16.0–36.6	2.6	23.4
Total Annual Average		**30.2–62.1**	**11.6**	**45.6**

Source: WRCC 2007. Data collected at Sunnyside, Utah from 1963 to 1986.

Prevailing large-scale westerly air masses originating from the Pacific Ocean are typically interrupted by the western mountain ranges before reaching the Uinta Basin. As a result, the lower elevations of the Uinta Basin receive relatively slight amounts of precipitation. The higher elevations of the area generally receive more favorable amounts of precipitation. The annual mean precipitation at Nutters Ranch is 11.6 inches, and ranges from a minimum of 6.4 inches recorded in 1974, to a maximum of 24.8 inches recorded in 1965. On average, February is the driest month with a monthly mean precipitation of 0.5 inches, and August is the wettest month with a monthly mean precipitation of 1.4 inches. The annual average snowfall is 45.6 inches. December, January, February, and March are the snowiest months. A maximum annual snowfall of 102 inches was recorded in 1965.

The surrounding area has an annual mean temperature of 46°F. However, abundant sunshine and rapid nighttime cooling result in a wide daily range in temperature. Wide seasonal temperature variations typical of a mid-continental climate regime are also common. Average winter temperatures range from 9°F to 38°F, while average summer temperatures range from 50°F to 85°F. Recorded daily extreme temperatures are minus 25°F in 1971 and 100°F in 1976.

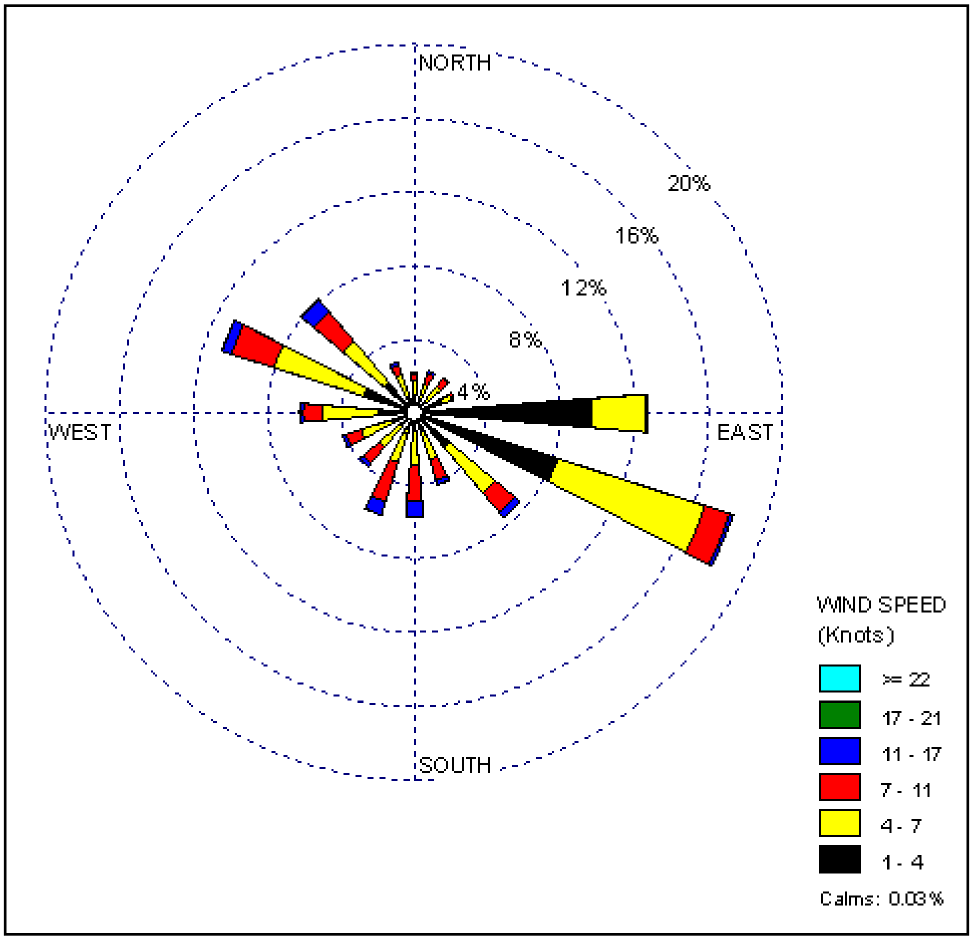
3.2.2.2 Winds and Atmospheric Stability

The transportation and dilution of air pollutants are primarily a function of wind speed and direction. Winds dictate the direction in which pollutants are transported. As wind speed increases, the dispersion of emitted pollutants also increases, thereby reducing pollutant concentrations.

Wind data within the project area have not been directly measured. Local terrain effects will influence the wind profiles specific to the project area. However, representative wind speed and direction data for the area are available at the Canyonlands National Park for the years 1995, 1996, 1997, 1998, and 1999 as part of the Clean Air Status and Trends Network (CASTNET) operated by the U.S. Environmental Protection Agency (EPA) and National Park Service (NPS). These data were prepared for use in the Draft West Tavaputs Plateau Natural Gas Full Field Development Plan EIS (BLM 2008d). Figure 3-1 presents a wind rose depicting wind speed and direction for all five years of data. Note that the data represent the direction from which the wind is blowing (Wind Direction Origin). For example, winds blowing from the north would transport pollutants to the south. As shown, winds originate predominately from the east-southeast 16.7% of the time. The average measured wind speed is 6.4 miles per hour.

The degree of stability in the atmosphere is also important to the dispersion of emitted pollutants. During stable conditions, vertical movement in the atmosphere is limited and the dispersion of pollutants is inhibited. Temperature inversions can result in very stable conditions with virtually no vertical air motion and light winds, thereby restricting dispersion. Conversely, during convective conditions, upward and downward movement in the atmosphere prevails along with stronger winds, and the vertical mixing of pollutants in the atmosphere is enhanced.

The potential for atmospheric dispersion is relatively high for the project area due to the frequency of strong winds. However, calm periods and nighttime cooling may enhance air stability, thereby inhibiting air pollutant transport and dilution.



Average Wind Speed 5.52 Knots = 6.35 miles per hour

Figure 3-1. Wind Rose of Canyonlands NP wind speed direction data 1995-1999 (blowing from).

The region can experience frequent temperature inversions in winter when cold stable air masses settle into the valleys and snow cover and shorter days inhibit ground-level warming. Temperature inversions are less common during the summer months when daytime ground-level heating rapidly leads to inversion break-up and increased vertical mixing. The higher locations of the project area generally will remain warmer at night and less prone to the temperature inversions common to the valleys and drainages.

3.2.3 Existing Air Quality

3.2.3.1 Regulatory Environment

3.2.3.1.1 Criteria Pollutants

The EPA has promulgated National Ambient Air Quality Standards (NAAQS) to protect human health and welfare with an adequate margin of safety. Standards have been set for the following pollutants: ozone (O_3), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), lead (pb), and particulate matter less than 10 microns in diameter (PM_{10}) or 2.5 microns in diameter ($PM_{2.5}$). The primary standards are set to protect public health, whereas secondary standards are set to protect public welfare (e.g., injury to crops or forests). Through air quality monitoring, when an area meets the NAAQS, it is designated as attainment. Conversely if an area does not meet the NAAQS, it is designated as nonattainment. If an area does not have enough air monitoring data to make a NAAQS determination, it is designated as unclassified and is regulated as an attainment area. Uintah County is currently designated as attainment or unclassified for all criteria pollutants.

The NAAQS have been recently revised for the ozone, NO_2, SO_2, PM_{10}, and $PM_{2.5}$ standards. The changes reflect a stricter ozone standard (lowered from 0.08 parts per million [ppm] to 0.075 ppm), the implementation of a 1-hour averaging time standard for NO_2, the implementation of a 1-hour averaging time standard for SO_2, a stricter $PM_{2.5}$ 24-hour standard (lowered from 65 $\mu g/m^3$ to 35 $\mu g/m^3$), and the elimination of the PM_{10} annual standard. These standards and changes are illustrated in Table 3-3. EPA is also reviewing the recently lowered ozone standard, and may lower the standard again to between 0.060 and 0.075 ppm. EPA may also establish a more restrictive secondary standard for ozone in this review.

In most regions of the Rocky Mountain west, ozone and particulate matter are the most common air quality problems. In Utah, the metropolitan areas along the Wasatch Front are designated as nonattainment or maintenance (formally nonattainment) for ozone, PM_{10}, $PM_{2.5}$, CO, and SO_2. The Cache Valley (Logan) area has also been recently designated as nonattainment for $PM_{2.5}$. Typically nonattainment areas are closely correlated with population centers. A general description of particulate matter and ozone follows.

Table 3-3. National Ambient Air Quality Standards

Pollutant	Primary Standards		Secondary Standards	
	Level	Averaging Time	Level	Averaging Time
Carbon Monoxide	9 ppm	8-hour (1)	None	
	35 ppm	1-hour (1)		
Lead	0.15 µg/m^3 (2)	Rolling 3-month Average	Same as primary	
	1.5 µg/m^3	Quarterly average	Same as primary	
Nitrogen Dioxide (NO$_2$)	53 ppb (3)	Annual	Same as primary	
	100 ppb	1-hour (4)	None	
Particulate Matter (PM$_{10}$)	150 µg/m^3	24-hour (5)	Same as primary	
Particulate Matter (PM$_{2.5}$)	15.0 µg/m^3	Annual (6)	Same as primary	
	35 µg/m^3	24-hour (7)	Same as primary	
Ozone	0.075 ppm	8-hour (8)	Same as primary	
Sulfur Dioxide	0.03 ppm	Annual	0.5 ppm	3-hour (1)
	0.14 ppm	24-hour (1)		
	75 ppb	1-hour	None	

(1) Not to be exceeded more than once per year.

(2) Final rule signed October 15, 2008.

(3) The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb (parts per billion), which is shown here for the purpose of clearer comparison to the 1-hour standard.

(4) To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 100 ppb (effective January 22, 2010).

(5) Not to be exceeded more than once per year on average over 3 years.

(6) To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m^3.

(7) To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m^3 (effective December 17, 2006).

(8) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm. (effective May 27, 2008)

(9) (a) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

3.2.3.1.2 Particulate Matter (PM_{10} and $PM_{2.5}$)

Airborne particulate matter consists of tiny coarse-mode (PM_{10}) or fine-mode ($PM_{2.5}$) particles or aerosols combined with dust, dirt, smoke, and liquid droplets. $PM_{2.5}$ is derived primarily from the incomplete combustion of fuel sources and secondarily formed aerosols. PM_{10} is derived primarily from crushing, grinding, or abrasion of surfaces. Sources of particulate matter include industrial processes, power plants, mobile sources (vehicle exhaust and road dust), construction activities, home heating, and fires. Particulate matter causes a variety of health and environmental impacts. Many scientific studies have linked breathing particulate matter to serious health problems, including aggravated asthma, increased respiratory symptoms (e.g., coughing), difficult or painful breathing, chronic bronchitis, decreased lung function, and premature death. Particulate matter is the major cause of reduced visibility. It can stain and damage stone and other materials, including culturally important objects, such as monuments and statues.

3.2.3.1.2.1 Ozone

Ground-level ozone is a secondary pollutant. It is formed by a chemical reaction between nitrogen oxides (NO_x) and volatile organic compounds (VOCs) in the presence of sunlight (photochemical oxidation). Precursor sources of NO_x and VOCs include motor vehicle exhaust, industrial emissions, gasoline vapors, vegetation emissions (i.e., terpenes), wood burning, and chemical solvents. The abundant sunlight during the summer months drives the photochemical process and creates ground-level ozone; therefore, ozone is generally considered a summertime air pollutant.

In the Uinta Basin, ozone concentrations during the winter months have been monitored at levels above the 75 ppb (parts per billion) ozone NAAQS. It is the current scientific consensus that the photochemical processes that form tropospheric ozone in the presence of NO_2 and free radical volatile organics are heightened by increased concentrations of ozone precursors from the stagnant winter atmospheric conditions and increased solar radiation reflected from the winter snow cover (Schnell et al. 2009). However, this is an area of ongoing scientific research.

Ozone is a regional air quality issue because, along with its precursors, it can transport hundreds of miles from its origins, and maximum ozone levels can occur at locations many miles downwind from the sources. Primary health effects from ozone exposure range from breathing difficulty to permanent lung damage. Significant ground-level ozone also contributes to plant and ecosystem damage.

3.2.3.1.3 Prevention of Significant Deterioration

Under the Prevention of Significant Deterioration (PSD) provisions of the Clean Air Act (CAA), incremental increases of specific pollutant concentrations are limited above a legally defined baseline level. Many national parks and wilderness areas are designated as PSD Class I. The PSD program protects air quality within Class I areas by allowing only slight incremental increases in pollutant concentrations. Areas of Utah not designated as PSD Class I are classified as Class II. For Class II areas, greater incremental increases in ambient pollutant concentrations are allowed as a result of controlled growth. The PSD increments for Class I and II areas are presented in Table 3-4. The closest Class I areas are Arches National Park (74 miles south) and Canyonlands National Park (96 miles south) (Figure 3-2).

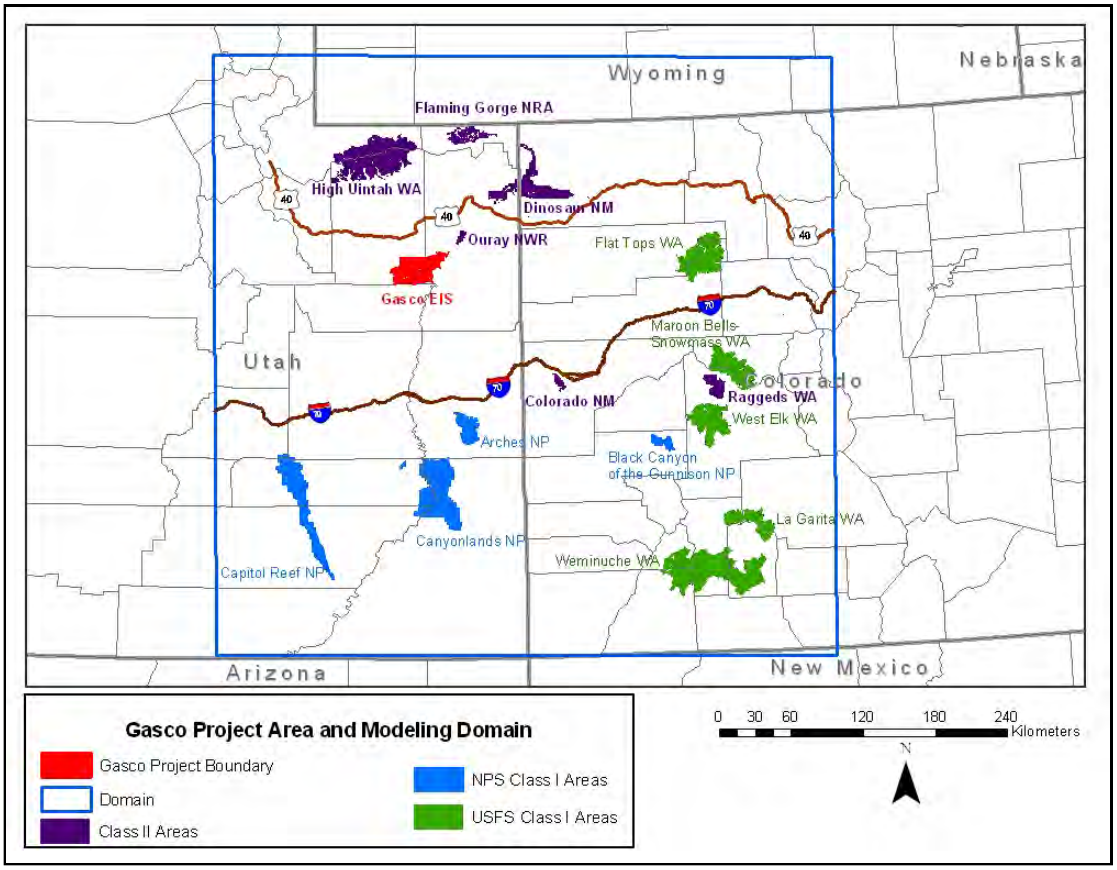


Figure 3-2. Gasco Uinta Basin Natural Gas Development project area with surrounding Prevention of Significant Deterioration Class I and Class II areas.

Table 3-4. Prevention of Significant Deterioration (PSD) Increments

Pollutant	PSD Class I Increment (μg/m^3)	PSD Class II Increment (μg/m^3)
SO_2	2	20
	5	91
	25	512
NO_2	2.5	25
PM_{10}	8	30

3.2.3.1.4 Hazardous Air Pollutants

Hazardous air pollutants (HAPs) are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental impacts. The EPA has classified 187 air pollutants as HAPs. Examples of listed HAPs associated with the oil and gas industry include formaldehyde, benzene, toluene, ethylbenzene, isomers of xylene (BTEX) compounds, and normal-hexane (n-hexane).

The CAA requires the EPA to regulate emissions of toxic air pollutants from a published list of industrial sources referred to as "source categories." The EPA has developed a list of source categories that must meet control technology requirements for these toxic air pollutants. Under

Section 112(d) of the CAA, the EPA is required to develop regulations establishing national emission standards for hazardous air pollutants (NESHAP) for all industries that emit one or more of the pollutants in major source quantities. These standards are established to reflect the maximum degree of reduction in HAP emissions through application of maximum achievable control technology (MACT). Source categories for which MACT standards have been implemented include oil and natural gas production and natural gas transmission and storage.

There are no applicable federal or State of Utah ambient air quality standards for assessing potential HAP impacts to human health, and monitored background concentrations are rarely available. Therefore, reference concentrations (RfC) for chronic inhalation exposures and reference exposure levels (REL) for acute inhalation exposures are applied as significance criteria. Table 3-5 provides the RfCs and RELs. RfCs represent an estimate of the continuous (i.e., annual average) inhalation exposure rate to the human population (including sensitive subgroups such as children and the elderly) without an appreciable risk of harmful effects. The RELs represent the acute (i.e., 1-hour average) concentration at or below which no adverse health effects are expected. Both the RfC and REL guideline values are for non-cancer effects.

Table 3-5. Hazardous Air Pollutant (HAP) Reference Exposure Levels and Reference Concentrations (RfCs)

HAP	Reference Exposure Level (REL 1-hour Average) ($\mu g/m^3$)	Reference Concentration [a] (RfC Annual Average) ($\mu g/m^3$)
Benzene	1,300 [b, c]	30
	160,000 [d]	-
Toluene	37,000 [b]	5,000
Ethylbenzene	350,000 [d]	1,000
Xylenes	22,000 [b]	100
n-Hexane	390,000 [d]	700
Formaldehyde	94 [b]	9.8

[a] EPA Air Toxics Database, Table 1 (EPA 2007a)
[b] EPA Air Toxics Database, Table 2 (EPA 2007a) REL from California EPA (most conservative level in Table 2)
[c] REL for benzene is for a 6-hour average.
[d] Immediately Dangerous to Life or Health/10, EPA Air Toxics Database, Table 2 (EPA 2007a) because no REL is available.

3.2.3.1.5 Greenhouse Gases (GHGs)

The Council on Environmental Quality (CEQ) has released new (2010) draft guidance on how the National Environmental Policy Act (NEPA) should consider and evaluate greenhouse gas (GHG) emissions and climate change. The draft guidance outlines how federal agencies should consider climate change issues under NEPA. Under this draft guidance, where a proposed federal action would be reasonably anticipated to emit greenhouse gases into the atmosphere in quantities that the agency preparing the NEPA document finds may be "meaningful," the agency should quantify and disclose its estimate of the expected, annual direct and indirect greenhouse gas emissions. Specifically, where a proposed action is anticipated to cause direct, annual emissions of 25,000 metric tons or more of carbon dioxide (CO_2)-equivalent greenhouse gas emissions, a quantitative and qualitative assessment is required together with the consideration of mitigation measures and reasonable alternatives to reduce greenhouse gas emissions.

Several factors affect climate change, including but not limited to GHGs, land use management practices, and the albedo effect.

GHGs are produced and emitted by various sources during phases of oil and gas exploration, well development, and production. The primary sources of GHGs associated with oil and gas exploration and production are CO_2, nitrous oxide (N_2O), and methane (CH_4). In addition, VOCs are a typical source of emissions associated with oil and gas exploration and production. Under specific environmental conditions, N_2O and VOCs form ozone, which also is considered a GHG.

On October 30, 2009, the EPA issued the final mandatory reporting rule for major sources of GHG emissions. The rule requires a wide range of sources and source groups to record and report selected GHG emissions, including CO_2, CH_4, N_2O, and some halogenated compounds. The EPA delayed a comparable rule for GHG emissions for various natural gas industry groups. On December 31, 2010, a rule (Subpart W) became effective that addressed natural gas systems and natural gas transmission source groups, among other things.

The final rule (Subpart W) for natural gas systems specifically identified monitoring and reporting requirements for oil and natural gas systems. The oil and natural gas source category includes on-shore natural gas processing facilities and on-shore natural gas transmission compression facilities, which are applicable components of the proposed project. Combustion units associated with these processes also are included as part of the separate final rule. The EPA final rule concerning mandatory reporting of GHGs do not require any controls or establish any standards related to GHG emissions or impacts.

Additionally, in June of 2010, the EPA finalized the Greenhouse Gas Tailoring Rule. The rule outlines the time frame and the applicability criteria that determine which stationary sources and modification projects become subject to permitting requirements for GHG emissions under the CAA's PSD and Title V programs.

Global mean surface temperatures increased nearly 1.8°F from 1890 to 2006. Models indicate that average temperature changes are likely to be greater in the Northern Hemisphere. Northern latitudes (above 24°N) have exhibited temperature increases of nearly 2.1°F since 1900, with a nearly 1.8°F increase since 1970. Without additional meteorological monitoring systems, it is difficult to determine the spatial and temporal variability and change of climatic conditions, but increasing concentrations of GHGs are likely to accelerate the rate of climate change.

Ongoing scientific research has identified the potential impacts of anthropogenic (manmade) GHG emissions and changes in biological carbon sequestration due to land management activities on global climate. Through complex interactions on a regional and global scale, these GHG emissions and net losses of biological carbon sinks cause a net warming effect of the atmosphere, primarily by decreasing the amount of heat energy radiated by the earth back into space. Although GHG levels have varied for millennia, recent industrialization and burning of fossil carbon sources have caused CO_2(e) concentrations to increase dramatically, and are likely to contribute to overall global climatic changes. The Intergovernmental Panel on Climate Change (IPCC) recently concluded that warming of the climate system is unequivocal, and most of the observed increase in globally average temperatures since the mid twentieth century is very likely due to the observed increase in anthropogenic GHG concentrations (IPCC 2007).

In 2001, the IPCC projected that by the year 2100, global average surface temperatures could increase by 2.5°F to 10.4°F above 1990 levels. The National Academy of Sciences (2010) has confirmed these projections, but also has indicated that there are uncertainties regarding how climate change may affect different regions. Computer model predictions indicate that increases in temperature would not be equally distributed, but are likely to be accentuated at higher latitudes. Warming during the winter months is expected to be greater than during the summer, and increases in daily minimum temperatures are more likely than increases in daily maximum temperatures. Although large-scale spatial shifts in precipitation distribution may occur, these changes are more uncertain and difficult to predict.

The analysis of the Regional Climate Impacts prepared by the United States Global Change Research Program (USGCRP) (2009) suggests that recent warming in the region was among the most rapid nationally. They conclude that this warming is causing decline in spring snowpack and reducing flow in the Colorado River. Their projections of future climate change indicate that further strong warming will reduce precipitation, which in turn will strain regional water supplies, increase the risk of wildfires and invasive species, and degrade recreational opportunities.

Past records and future projections predict an overall increase in regional temperatures, which would cover the development area. As has been observed at many sites to date, the observed increase is largely the result of the warmer nights, and effectively higher average daily minimum temperatures at many of the sites in the region. The USGCRP (2009) projects a region-wide decrease in precipitation, although with substantial variability in interannual conditions. For eastern Utah, the projections range from an approximately 5% decrease in annual precipitation to decreases as high as 40% of annual precipitation.

As with any field of scientific study, there are uncertainties associated with the science of climate change; however, this does not imply that scientists do not have confidence in many aspects of climate change science. Some aspects of the science are known with virtual certainty because they are based on well-known physical laws and documented trends (EPA 2010).

Several activities contribute to the phenomena of climate change, including emissions of GHGs (especially CO_2 and methane [CH_4]) from fossil fuel development, large wildfires, activities using combustion engines, changes to the natural carbon cycle, and changes to radiative forces and reflectivity (albedo). It is important to note that GHGs will have a sustained climatic impact over different temporal scales. For example, recent emissions of CO_2 may influence climate for 100 years.

3.2.3.1.6 EXISTING AIR QUALITY DATA

The existing or background air quality of any given area can be estimated by a variety of methods. The most accurate and rigorous method is when adequate monitoring using Federal Reference Monitors (FRM) has been conducted in compliance with procedures defined in the Code of Federal Regulations (CFR) 40 Part 51 Appendix W, and the monitoring has been conducted for an appropriate amount of time to determine compliance with the applicable NAAQS. For example, to determine compliance with the ozone NAAQS, an FRM site must be operated in compliance with Appendix W for at least three years to meet the averaging time given in the NAAQS. When adequate air monitoring has been conducted such that it can determine compliance with the NAAQS for a given air pollutant, the resulting highest applicable value is considered the “design value” for the area (typically a county). To date, no air monitoring has been conducted in Uintah County that would meet the FRM requirements; therefore, no design values based on FRM methodology currently exist for that county.

The next best method for estimating existing air quality is based on air monitoring conducted that, while not meeting the standards described above, is still considered of sufficient quality to be used for modeling and initial or screening air quality determinations. Reasons for monitoring not meeting NAAQS CFR standards, but still be sufficient for other purposes, might include use of non-FRM certified monitors, not meeting all CFR standards for the monitoring site, or operating otherwise compliant monitors less than the averaging time of the applicable pollutant standard (e.g., less than three years for ozone). Air monitoring data over ten years old are generally considered to be out of date, though they still may be representative if emission sources in the area have not changed much. Given these qualifiers, there has been relevant air monitoring conducted recently in the Uinta Basin for $PM_{2.5}$ and ozone.

3.2.3.1.6.1 $PM_{2.5}$ Air Monitoring

Starting in December 2006 and running through December 2007, the Utah Department of Environmental Quality (UDEQ) conducted air monitoring for $PM_{2.5}$ in the town of Vernal, Uintah County. Over the winter, $PM_{2.5}$ levels were measured at the Vernal monitoring station that were higher than the new $PM_{2.5}$ NAAQS that became effective in December 2006. The maximum 24-hour average concentration over this period was 63.3 ug/m^3. Additional $PM_{2.5}$ monitoring was conducted by UDAQ in Vernal in 2008 and in Vernal and Roosevelt (Duchesne County) in 2009, which also monitored maximum 24-hour values above the NAAQS during the winter months. $PM_{2.5}$ monitoring conducted by UDAQ during the summer of 2007 did not find any elevated concentrations. A limited analysis of the filters used to collect the $PM_{2.5}$ samples was conducted to chemically speciate the particulate samples. This analysis found that the composition was primarily carbon-based. In the case of Teflon filters, the composition was unidentifiable, which in a Teflon filter is typically indicative of also being carbonaceous because these types of filters cannot be used to detect carbon-based particulate.

Beginning in the summer of 2009, $PM_{2.5}$ monitoring is being conducted in the Ouray and Redwash areas of Uintah County. This monitoring is being conducted to comply with an EPA consent order. It is located in a rural area contingent with oil and gas operations and removed from urban sources. No exceedences of the $PM_{2.5}$ 24-hour standard have been observed.

The sources of elevated $PM_{2.5}$ concentrations during winter inversions in Vernal and Roosevelt have not been conclusively identified yet. Based on experiences and studies in other areas of the Rocky Mountain west and the emission inventory in the Uinta Basin, potential sources can be tentatively identified. In Utah, elevated $PM_{2.5}$ concentrations along the Wasatch Front are associated with secondarily formed particles from sulfates, nitrates, and organic chemicals from a variety of sources (UDAQ 2006). In Cache Valley, approximately half of ambient $PM_{2.5}$ during elevated concentrations is composed of ammonium nitrate, most likely from agricultural operations. The other half is from combustion, primarily mobile sources and woodstoves (Martin 2006). For comparison, $PM_{2.5}$ in most rural areas in the western United States is typically dominated by total carbonaceous mass and crustal materials from combustion activities and fugitive dust, respectively (EPA 2009). Because the Uinta Basin is not a major metropolitan area (like those found on the Wasatch Front) nor does it have significant agricultural activities (like those found in Cache Valley), the most likely causes of elevated $PM_{2.5}$ at the Vernal monitoring station are probably those common to other areas of the western US (combustion and dust). The filter speciation that has been done to date tends to support this conclusion because the dominant chemical species from the filters is carbonaceous mass, which is indicative of wood burning, diesel emissions, or both. It is unlikely that significant transport of $PM_{2.5}$ precursors are occurring during the intense winter inversions under which these elevated $PM_{2.5}$ levels are forming, and as there is extensive snow cover during these episodes fugitive dust is also an unlikely significant contributor.

The BLM does acknowledge that uncertainties remain with speciation of $PM_{2.5}$ in the Uinta Basin, and notes that additional monitoring studies planned for the 2011–2012 winter may provide more conclusive information.

The complete UDAQ $PM_{2.5}$ monitoring data can be found at http://www.airmonitoring.utah.gov/dataarchive/archpm25.htm.

The complete EPA Ouray and Redwash monitoring data can be found at http://www.epa.gov/airexplorer/index.htm.

3.2.3.1.6.2 Ozone Air Monitoring

Active ozone monitoring in the Uinta Basin began in the summer of 2009 at the Ouray and Redwash monitoring sites (the ozone monitors are collocated with the $PM_{2.5}$ monitors). Both sites have recorded numerous exceedences of the 8-hour ozone standard during the winter months (January through March). The maximum 8-hour average recorded to date is 0.123 ppm, well above the current ozone NAAQS of 0.075 ppm. These data have recently been released by EPA. Although the monitors are not currently being operated to CFR standards, and are not considered adequate data to make a NAAQS determination, the data are considered viable and representative of the area. Apparently, high concentrations of ozone are being formed under a “cold pool” process, whereby stagnate air conditions with very low mixing heights form under clear skies with snow-covered ground and abundant sunlight that, combined with area precursor emissions (NO_x and VOCs), create intense episodes of ozone. Based on the first year of monitoring, these episodes occur only during the winter months (January through March). This phenomenon has also been observed in similar types of locations in Wyoming, and has contributed to a proposed nonattainment designation for Sublette County.

The National Park Service also operates an ozone monitor in Dinosaur National Monument during the summer months. No exceedences of the current ozone NAAQS have been recorded at this site.

Winter ozone formation is a newly recognized issue, and the methods of analyzing and managing this problem are still in development. Existing photochemical models are currently unable to replicate winter ozone formation satisfactorily, in part due to the very low mixing heights associated with the unique meteorology of these ambient conditions.

Based on the emission inventories developed for Uintah County, the likely dominant source of ozone precursors at the Ouray and Redwash monitoring sites are oil and gas operations near the monitors. The monitors are located in remote areas where impacts from other human activities are unlikely to be significantly contributing to this ozone formation. Although ozone precursors can be transported large distances, the meteorological conditions under which this cold pool ozone formation is occurring tend to preclude any significant transport. Currently, ozone exceedences in this area are confined to the winter months during periods of intense surface inversions and low mixing heights. Significant work remains to definitively identify the sources of ozone precursors contributing to the observed ozone concentrations. Speciation of gaseous air samples collected during periods of high ozone is needed to determine which VOCs are present and what their likely sources are.

The complete EPA Ouray and Redwash monitoring data can be found here: http://www.epa.gov/airexplorer/index.htm.

The complete NPS Dinosaur National Monument monitoring data can be found here: http://www.nature.nps.gov/air/Monitoring/MonHist/index.cfm.

3.2.3.1.6.3 Modeling of Background Air Pollution Concentrations

Another method that can be used to estimate background air pollution concentrations is modeling conducted by "one-atmosphere" models. These models combine comprehensive emission inventories of an area with site-specific, worst-case meteorological conditions to determine worst-case air pollution concentrations based on mathematical algorithms. Examples of these models are the Community Multiscale Air Quality (CMAQ) model and the Comprehensive Air Quality Model with Extensions (CAMX). Although this method is less accurate than actual air monitoring (mean error should be within 35%), in many cases it is the only tool available to estimate background in lieu of actual monitoring data.

The project emission inventory has been included in several one-atmosphere modeling studies conducted recently. The West Tavaputs Draft Environmental Impact Statement (EIS) (BLM 2008) used CMAQ modeling to determine the incremental impact of the Proposed Action's emissions to ozone and other air quality measures, and included the project inventory along with all other reasonably foreseeable development in the area. Figure 3-3 shows the modeling results for the Uinta Basin without the West Tavaputs project. The model did not predict the winter ozone formation that has been monitored. This is expected and not unique to this modeling study, because presently, these models cannot replicate winter ozone formation. It is problematic to place any definitive reliance of the models prediction of background value, because the values predicted in this analysis are near the NAAQS and given the allowable margin of error for these models, the actual value could range anywhere from well below the standard to well above the standard.

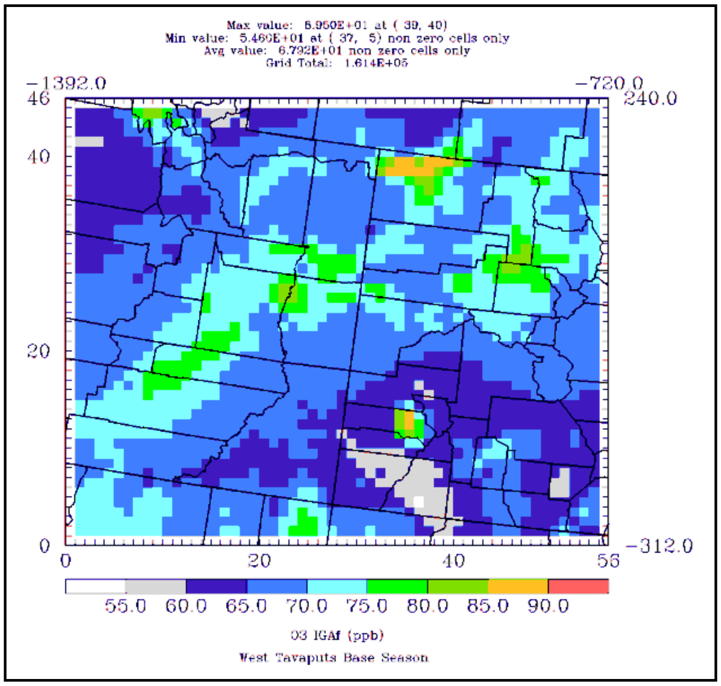


Figure 3-3. West Tavaputs EIS ozone modeling demonstration.

Another recently completed, one-atmosphere modeling study relevant to the project is the Uinta Basin Air Quality Study (IPAMS 2009). This study was an industry sponsored modeling analysis that looked at air quality impacts related to oil and gas development in the Uinta Basin out to 2012. Figures 3-4 and 3-5 show modeled concentrations for ozone and $PM_{2.5,}$ respectively. The overall pattern of modeled ozone concentrations is similar to the West Tavaputs model, and given the allowable, mean, error concentrations, they are well within each other's range. Winter ozone was not modeled in this analysis, so no comparison can be made regarding that. Figure 3-4 includes actual monitored values inset into the map. Based on the monitored data compared to the modeled values, the model succeeded at replicating observed summer ozone concentrations. This lends some assurance that the models are replicating peak summer ozone levels acceptably. Based on these two ozone modeling analyses, peak summer ozone levels in the Uinta Basin are below the current ozone NAAQS; however, they may be approaching or exceeding any potential lower standards EPA may promulgate in the near future.

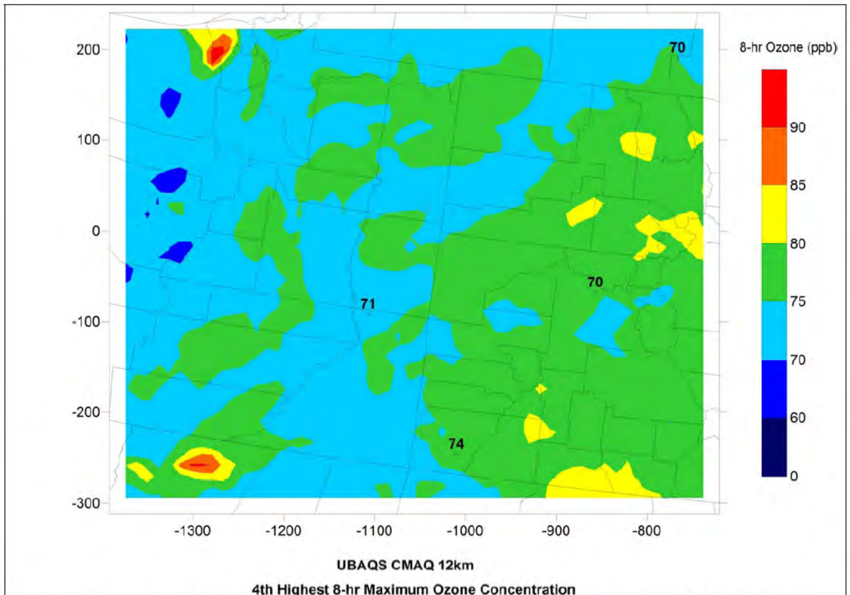


Figure 3-41b. Comparison of predicted and observed fourth highest daily maximum 8-hour ozone concentrations during 2006 in the UBAQS 12 km CMAQ domain.

Figure 3-4. UBAQS ozone modeling demonstration.

Figure 3-5 shows the UBAQS modeled $PM_{2.5}$ concentrations across the Uinta Basin. The $PM_{2.5}$ modeling conducted for the UBAQS has some qualifiers that must be considered when evaluating these data. Primary among them is the lack of speciated aerosol data to properly calibrate the model. Without a good understanding of the secondary particulate formation unique to the area, it is likely the model did not adequately predict $PM_{2.5}$ concentrations. Also the winter inversion episodes were not modeled; therefore, the high concentrations monitored in Vernal and Roosevelt would not have been captured by this study either. The modeling analyses generally predicted $PM_{2.5}$ concentrations below the NAAQS across the Uinta Basin, which is consistent with the limited monitoring data currently available.

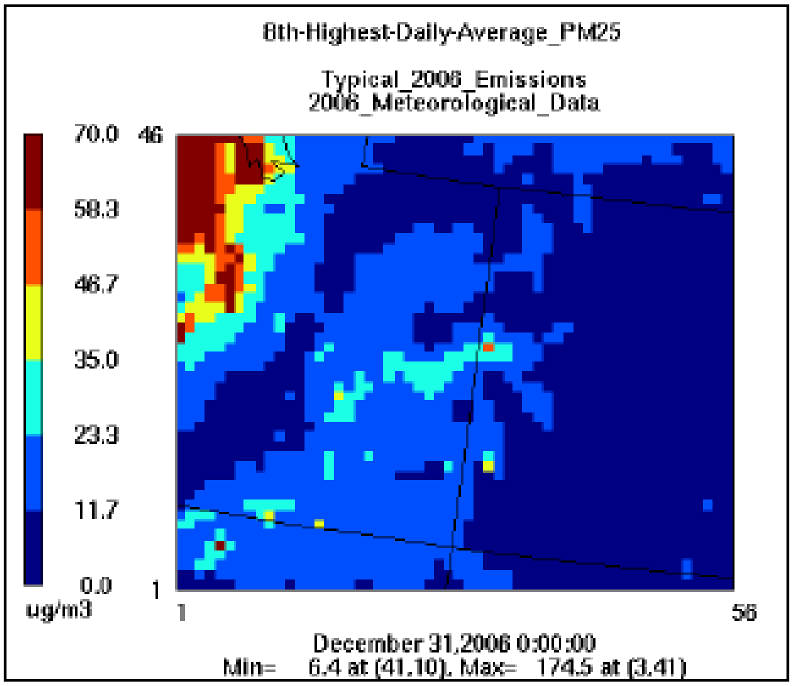


Figure 3-5. UBAQS $PM_{2.5}$ modeling demonstration.

3.2.3.1.6.4 Modeling Background Concentrations

One final method to estimate background air quality is the background concentrations published by the UDAQ as guidance for modeling of permitted sources to ensure NAAQS compliance. These background values are used in dispersion models that need a background value to add to a proposed point sources emissions so that an evaluation can be made on whether the source will meet NAAQS. These background estimates are based on monitored values when possible, and on default factors when monitoring data do not exist. Ambient air monitoring has been conducted recently in the Uinta Basin at two locations. For purposes of this analysis, and as annotated below, values from these local air monitoring stations in the Uinta Basin have been used (Table 3-6).

Table 3-6. Criteria Pollutant Background in the Uinta Basin

Pollutant	Averaging Period(s)	Uinta Basin Background Concentration[a] (µg/m³)	NAAQS (µg/m³)
SO_2	Annual[a] 24-hour[a] 3-hour[a]	5 10 20	80 365 1,300
NO_2	Annual[b]	8.0	100
	1-hour[b]	69.6	188
PM_{10}	24-hour[b]	18	150
$PM_{2.5}$	24-hour[b]	16	35
	Annual[b]	6	15
CO CO	8-hour[b] 1-hour[b]	3,910 6,325	10,000 40,000
Ozone (ppb)	8-hour[c]	117	75 ppb

[a] *Source*: Utah Division of Environmental Quality - Division of Air Quality (UDAQ).

[b] Based on data collected at the Ouray or Redwash Monitoring Stations (see the air quality impact assessment section, Greater Natural Buttes Supplement to the Draft EIS, February 2011)

[c] Ozone data are the Highest Fourth High from Ouray Monitoring Station data (EPA AQS Database)

3.2.3.1.6.5 Summary

Based on the combination of methods available to estimate background air quality in the Uinta Basin, conclusions can be made regarding existing air quality in the project area. Ozone is the primary pollutant of concern, with a potential seasonal pattern opposite of what is typically considered for ozone. Ozone concentrations during winter inversion events are being monitored well above the current ozone NAAQS. Summer ozone concentrations, while elevated above what would be considered normal background levels, are below the current NAAQS. These concentrations may become an issue if EPA lowers the existing standard to the lowest values being contemplated. $PM_{2.5}$ at this time does not appear to be an issue in rural areas of the Uinta Basin, though concentrations in urban settings have been recorded above the NAAQS during winter inversion events. This is not an unusual occurrence, even in smaller rural communities, and is typically due to a combination of woodstoves and vehicle emissions (especially diesel). Other criteria pollutants do not appear to be an issue at this time, and are anticipated to all be well below applicable NAAQS concentrations.

3.2.3.2 Existing Sources of Air Pollution

The Uinta Basin has seen recent oil and gas development on tribal, federal, and private lands. Fugitive dust is the most prominent air pollutant in the region and in the project area and is intermittent depending on winds and dust-causing activities. In addition to the Uinta Basin, other geographic areas of industrial and vehicular emissions in the region include the Wasatch Front to the west, the Green River area to the south, and the Castle Valley area to the southwest.

Existing point and area sources of air pollution within the project area and surrounding region include the following:

- Exhaust emissions, primarily CO, NO_x, $PM_{2.5}$, and formaldehyde, from existing natural gas fired compressor engines used in production of natural gas
- Natural gas dehydrator still-vent emissions of NO_x, CO, BTEX and *n*-hexane
- Gasoline and diesel-fueled vehicle tailpipe emissions of VOCs, NO_x, CO, SO_2, PM_{10}, and $PM_{2.5}$
- Oxides of sulfur (SO_x), NO_x, and fugitive dust emissions from coal-fired power plants and coal mining and processing
- Fugitive dust (in the form of PM_{10} and $PM_{2.5}$) from vehicle traffic on unpaved roads, wind erosion in areas of soil disturbance, and road sanding during winter months
- Long-range transport of pollutants from distant sources contributing to regional haze

3.2.3.3 Air Quality Related Values

Areas of special concern, including some Federally-mandated Class I areas and Class II wilderness areas and national parks, are monitored for air quality related value (AQRV) impacts. These AQRVs include terrestrial and aquatic deposition and visibility impairment.

3.2.3.3.1 Atmospheric Deposition

Atmospheric deposition refers to the processes by which air pollutants are removed from the atmosphere and deposited on terrestrial and aquatic ecosystems, and is reported as the mass of material deposited on an area in a period of time (kilograms per hectare per year [kg/ha/yr]). Air pollutants are deposited by wet deposition (i.e., precipitation) and by dry deposition (i.e., gravitational settling of particles and adherence of gaseous pollutants to particles). Total deposition refers to the sum of airborne material transferred to the earth’s surface by both wet and dry deposition.

Total terrestrial deposition levels of concern (LOC) have been estimated for several Class I areas, including Canyonlands National Park in Utah (Fox et al. 1989). Estimated total terrestrial deposition LOC include the “red line” (defined as the total deposition that the area can tolerate) and the “green line” (defined as the acceptable level of total deposition). Total deposition LOC for Canyonlands include a “red line” set at 10 kg/ha/yr for nitrogen and 20 kg/ha/yr for sulfur, and a “green line” set at 3 to 5 kg/ha/yr for nitrogen and 5 kg/ha/yr for sulfur.

The nearest wet and dry deposition measurements collected at a Class I area are available from Canyonlands National Park, located approximately 130 miles south of the project area. Wet deposition data for the Canyonlands station are available through the National Atmospheric Deposition Program (NADP) for the period 1997 through 2004. The NADP assesses wet deposition by measuring the chemical composition of precipitation (rain and snow). Similarly, the Clean Air Status and Trends Network (CASTNet) measures the dry deposition rates of nitrogen and sulfur compounds. Data from the Canyonlands CASTNet station are available from 1995 through 2002.

Table 3-7 summarizes the annual average wet and dry components of total nitrogen and sulfur deposition at Canyonlands. Note that wet deposition data are available from 1997 through 2004, while dry deposition data are available only from 1995 through 2002.

Table 3-7. Nitrogen and Sulfur Deposition at Canyonlands, Utah

Chemical Species	Dry Deposition[1] (kg N ha^{-1} yr^{-1})	Wet Deposition[2] (kg N ha^{-1} yr^{-1})	Total Deposition (kg N ha^{-1} yr^{-1})
Nitrogen Deposition			
Ammonium (NH_4^+)	0.1	0.3	0.4
Nitrate (NO_3^-)	0.0	0.5	0.5
Nitric acid (HNO_3)	0.9	-	0.9
Total	**1.0**	**0.8**	**1.8**
Sulfur Deposition			
Sulfate (SO_4^{2-})	0.1	0.4	0.5
Sulfur dioxide (SO_2)	0.2	-	0.2
Total	**0.3**	**0.4**	**0.7**

kg = kilograms
N = Nitrogen
ha = hectare
yr = year
[1] *Source*: Dry deposition collected at Canyonlands CASTNet site (CAN407) from 1995–2002.
[2] *Source*: Wet deposition data collected at Canyonlands NADP site (UT09) from 1997–2004.
Deposition data represent the annual average over each respective time period.

The average annual pH of precipitation measured at Canyonlands from 1997 through 2004 was 5.2, and ranged from 5.0 to 5.7 over the period. The natural acidity of precipitation is considered to range from 5.0 to 5.6 pH; therefore the average pH of precipitation at Canyonlands is at the acidic end of the range.

3.2.3.3.2 Acid Neutralization Capacity

Aquatic bodies such as lakes and streams are important resources in most Class I areas. Acid deposition resulting from industrial emissions of sulfur and nitrogen based compounds can have a toxic effect on the plants and animals of an aquatic ecosystem. Lakes and streams differ in their inherent sensitivity to inputs of acidifying compounds from the atmosphere. For pristine watersheds, the acid neutralization capacity (ANC) is a good indicator of the sensitivity and buffering capacity of the water body to acid deposition. The ANC for fresh surface waters can be characterized by the combined concentrations of select base positive ions (i.e., calcium, magnesium, potassium, and sodium), expressed in microequivalents per liter (µeq/l) [as in amount of base available to neutralize an equal amount of acid]. The lower the ANC, the more sensitive the water body to acidifying compounds and their toxic effects. Table 3-8 summarizes the existing ANC for selected lakes of special concern.

Table 3-8. Potential Acid Neutralizing Capacity Changes at Sensitive Lakes

Location	Sensitive Lake	Background ANC (µeq/l)
Flat Tops Wilderness Area	Ned Wilson	38.0
Flat Tops Wilderness Area	Upper Ned Wilson	12.6
High Uintah Wilderness Area	Dean	57.3
High Uintah Wilderness Area	Pine Island	95.6

Table 3-8. Potential Acid Neutralizing Capacity Changes at Sensitive Lakes

Location	Sensitive Lake	Background ANC (µeq/l)
Maroon Bells Wilderness Area	Moon	51.5
Raggeds Wilderness Area	Deep Creek #1	44.3
West Elk Wilderness Area	S. Golden	111.0

3.2.3.3.3 VISIBILITY

Visibility is usually characterized by two parameters, visual range (VR) and the light-extinction coefficient (b_{ext}). The visual range parameter represents the greatest distance that a large dark object can be seen, while the light extinction coefficient represents the attenuation of light per unit distance due to scattering and absorption by gases and particulate matter in the atmosphere. Under typical conditions, the visual range and b_{ext} parameters are inversely related to each other. Good visibility conditions are represented by long visual ranges and low b_{ext} values, while poor visibility conditions are represented by short visual ranges and high b_{ext} values. The dimensions of visual range are length, and the parameter is usually expressed in kilometers (km). The units of b_{ext} are 1/length (inverse length) and the coefficient is typically expressed as “inverse kilometers” (km-1), or “inverse megameters” (Mm-1), the reciprocal of one million meters.

Visibility-related background data collected for the Interagency Monitoring of Protected Visual Environments (IMPROVE) program are available for Canyonlands National Park, Weminuche Wilderness, and White River National Forest (Aspen, Colorado, monitoring site). Long-term (10 years or greater) data are available for Weminuche Wilderness and Canyonlands National Park; however, the available data for White River National Forest are limited to four years.

Figures 3-6 and 3-7 present long-term visibility conditions (as reconstructed from aerosol measurements) for the 20% cleanest, 20% haziest, and mid-range 40% to 60% days at Canyonlands National Park and Weminuche Wilderness (IMPROVE 2004). Both annual average and 5-year rolling average visibility data are presented. The annual average data illustrate the variability in visibility conditions that results from forest fires or other short-term factors. The 5-year data represent long-term average conditions analogous to the natural visibility conditions tracked in the regional haze program.

Seasonal visibility conditions can be reconstructed utilizing quarterly particle concentrations measured at the IMPROVE monitoring sites in conjunction with monthly relative humidity factors. Table 3-9, Table 3-10, and Table 3-11 summarize the seasonal visibility conditions at Canyonlands National Park (1988–2004), Weminuche Wilderness (1988–2004), and White River National Forest (2001–2004). Figure 3-8 presents the Standard Visual Range for each of the IMPROVE monitoring areas. As shown, visibility is very good at all three areas with a Standard Visual Range of 193 to 324 km (120 to 201 miles). White River National Forest (Aspen, Colorado monitoring site) exhibits the best visibility. Seasonal visibility conditions are typically the clearest during the fall and winter months (October through March) when particulate concentrations are minimal, while hazier conditions predominate during the spring and summer (April through September) when particulates are at a maximum.

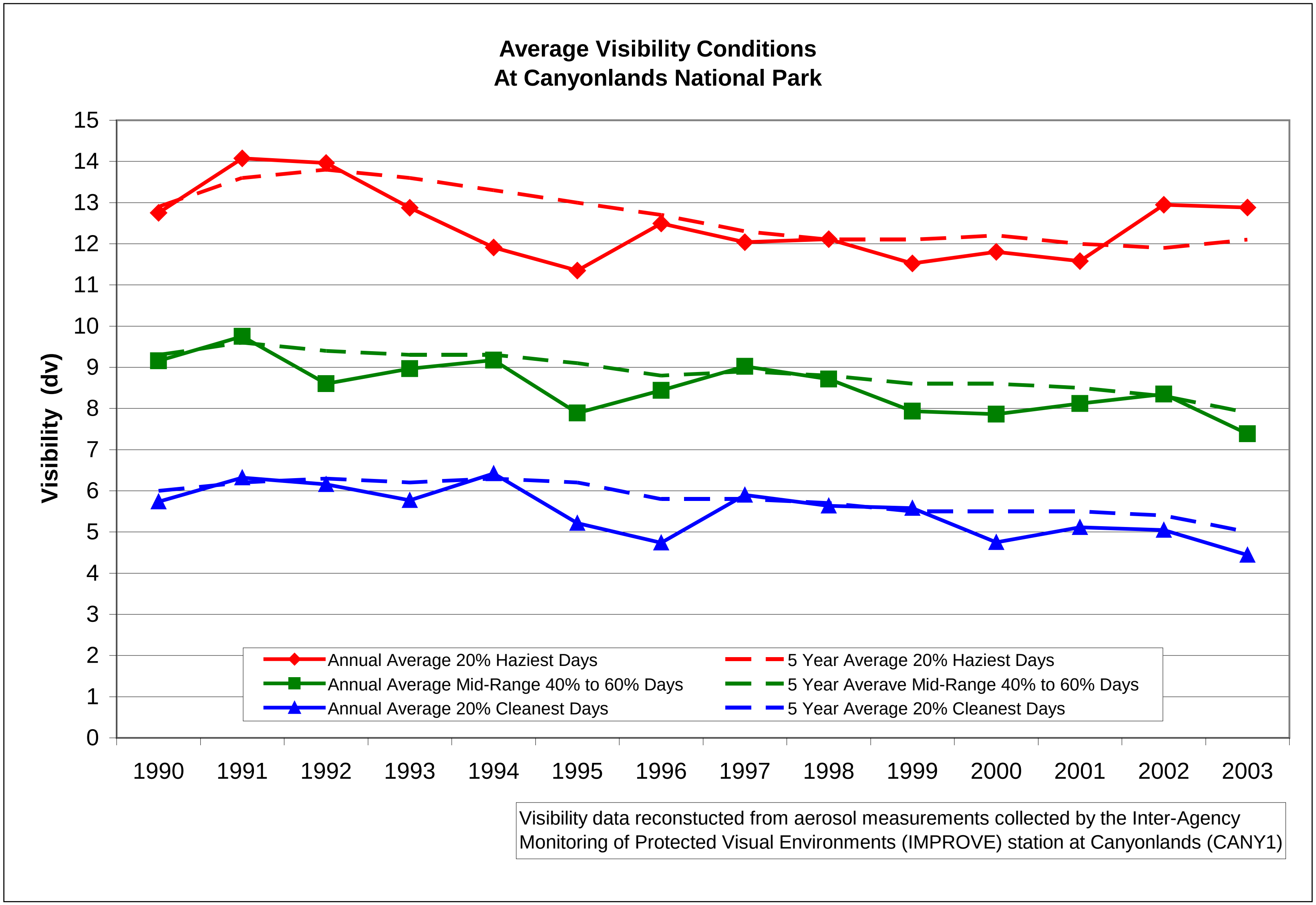


Figure 3-6. Visibility conditions at Canyonlands National Park, Utah.

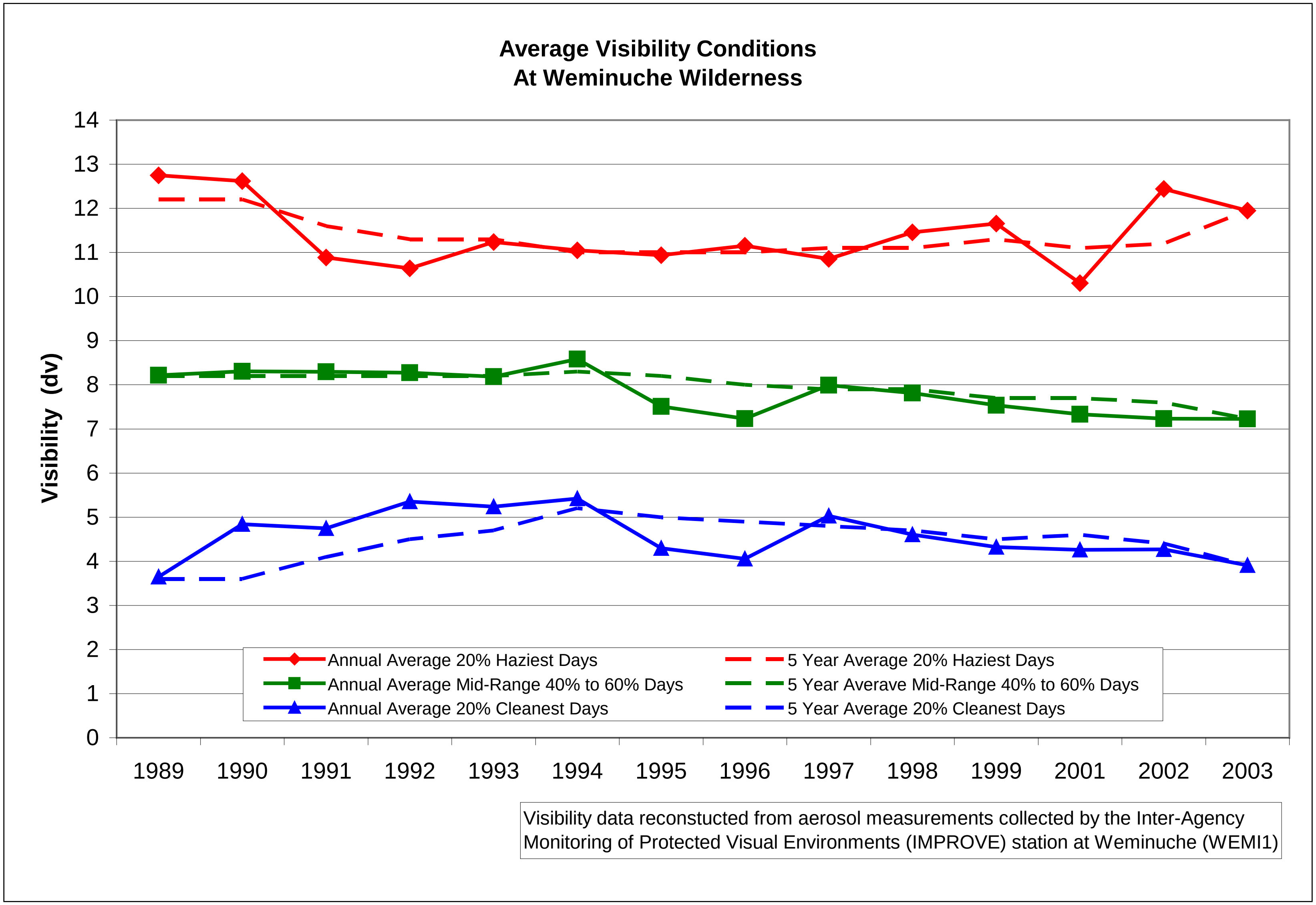


Figure 3-7. Visibility conditions at Weminuche Wilderness, Colorado.

Table 3-9. Canyonlands National Park Reconstructed Visibility Conditions (20% cleanest)

Month	Relative Humidity Factor[1] f(Rh) (unitless)	Dry Hygroscopic Extinction[2] (1/Mm)	Dry Non-hygroscopic Extinction[2] (1/Mm)	Reconstructed Extinction (b_{ext}) (1/Mm)	Deciview (dv)	Standard Visual Range (km)
Jan	2.6	1.524	2.775	16.737	5.2	234
Feb	2.3	1.524	2.775	16.310	4.9	240
Mar	1.7	1.524	2.775	15.396	4.3	254
Apr	1.6	2.298	4.724	18.332	6.1	213
May	1.5	2.298	4.724	18.102	5.9	216
Jun	1.2	2.298	4.724	17.528	5.6	223
Jul	1.3	2.825	5.866	19.538	6.7	200
Aug	1.5	2.825	5.866	19.962	6.9	196
Sep	1.6	2.825	5.866	20.244	7.1	193
Oct	1.6	1.716	3.766	16.528	5.0	237
Nov	2.0	1.716	3.766	17.163	5.4	228
Dec	2.3	1.716	3.766	17.678	5.7	221

Monitoring period: 1988–2004

[1] Relative humidity factors [f(Rh)] from Table A-2, Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule, September 2003 (EPA 2003).

[2] Quarterly particle extinction data provided by Scott Copeland, U.S. Forest Service (USFS), Washakie Ranger District, Lander, WY. December 2005.

Table 3-10. Weminuche Wilderness Reconstructed Visibility Conditions (20% cleanest)

Month	Relative Humidity Factor[1] f(Rh) (unitless)	Dry Hygroscopic Extinction[2] (1/Mm)	Dry Non-hygroscopic Extinction[2] (1/Mm)	Reconstructed Extinction (b_{ext}) (1/Mm)	Deciview (dv)	Standard Visual Range (km)
Jan	2.4	0.968	2.835	15.139	4.1	258
Feb	2.2	0.968	2.835	14.975	4.0	261
Mar	1.9	0.968	2.835	14.626	3.8	267
Apr	1.7	1.753	4.442	17.386	5.5	225
May	1.7	1.753	4.442	17.334	5.5	226
Jun	1.5	1.753	4.442	17.001	5.3	230
Jul	1.6	2.115	6.079	19.526	6.7	200
Aug	2.0	2.115	6.079	20.245	7.1	193
Sep	1.9	2.115	6.079	20.139	7.0	194
Oct	1.7	0.808	3.283	14.666	3.8	267
Nov	2.1	0.808	3.283	14.997	4.1	261
Dec	2.3	0.808	3.283	15.127	4.1	258

Monitoring period: 1988–2004

[1] Relative humidity factors [f(Rh)] from Table A-2, Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule, September 2003 (EPA 2003).

[2] Quarterly particle extinction data provided by Scott Copeland, USFS, Washakie Ranger District, Lander, WY. December 2005.

Table 3-11. White River National Forest Reconstructed Visibility Conditions (20% cleanest)

Month	Relative Humidity Factor[1] f(Rh) (unitless)	Dry Hygroscopic Extinction[2] (1/Mm)	Dry Non-hygroscopic Extinction[2] (1/Mm)	Reconstructed Extinction (b_{ext}) (1/Mm)	Deciview (dv)	Standard Visual Range (km)
Jan	2.2	0.669	0.985	12.438	2.2	314
Feb	2.1	0.669	0.985	12.417	2.2	315
Mar	2.0	0.669	0.985	12.290	2.1	318
Apr	2.0	1.842	3.901	17.641	5.7	222
May	2.1	1.842	3.901	17.678	5.7	221
Jun	1.7	1.842	3.901	17.070	5.3	229
Jul	1.9	1.736	3.201	16.429	5.0	238
Aug	2.2	1.736	3.201	16.950	5.3	231
Sep	2.1	1.736	3.201	16.880	5.2	232
Oct	1.8	0.537	1.098	12.075	1.9	324
Nov	2.1	0.537	1.098	12.220	2.0	320
Dec	2.1	0.537	1.098	12.214	2.0	320

Monitoring period: 2001–2004

[1] Relative humidity factors [f(Rh)] from Table A-2, Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule, September 2003 (EPA 2003).

[2] Quarterly particle extinction data provided by Scott Copeland, USFS, Washakie Ranger District, Lander, WY. December 2005.

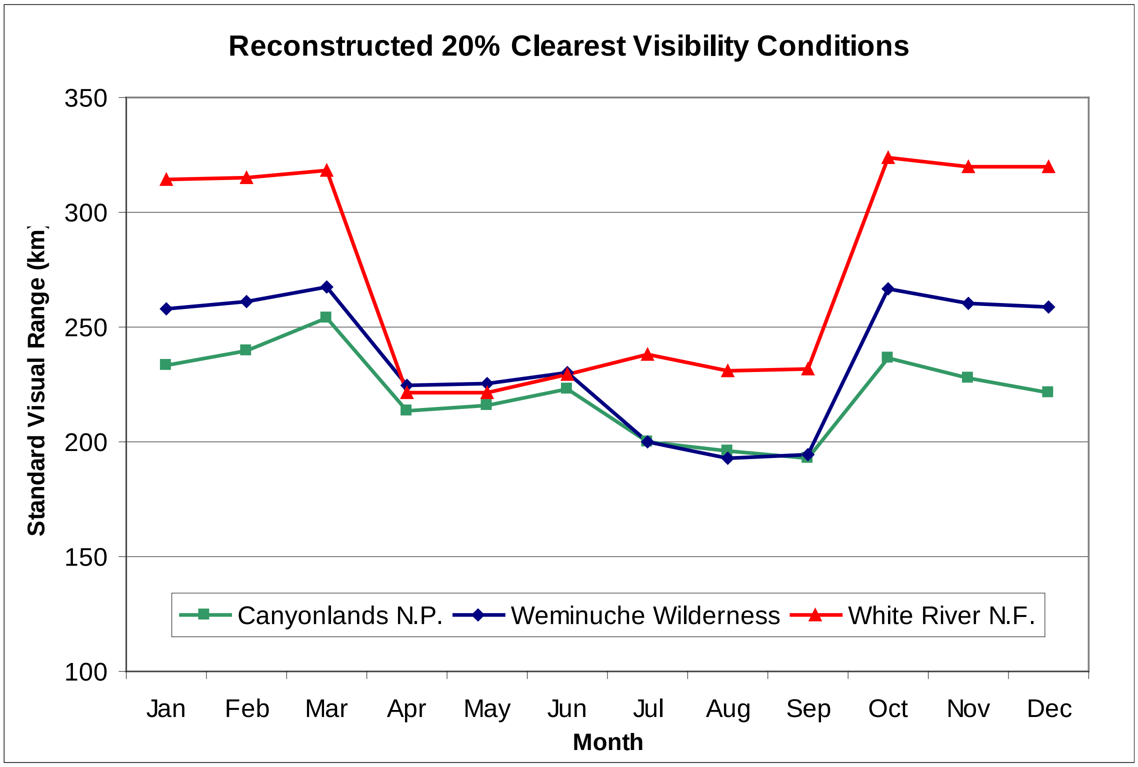


Figure 3-8. Reconstructed 20% clearest seasonal visibility condition.

3.3 Cultural Resources

Expansion of the Monument Butte–Red Wash, East Tavaputs, and West Tavaputs Oil and Gas Field infrastructure under the project alternatives would take place in a wide array of environmental settings and resources long used by humans. Consequently, the project area encompasses a large and diverse assemblage of prehistoric archaeological sites, historical archaeological sites and localities, and locations of traditional cultural value. For the purpose of this chapter, *cultural resources* are defined as both prehistoric and historical archaeological sites and structures, as well as non-archaeological and non-structural sites (i.e., waterways, viewsheds, and resource areas) that have been identified as important for traditional and/or ideological reasons by the various Native American groups with ancestral and/or present ties to the area. Many of these cultural resources have multiple associations and use values. These non-renewable resources provide a record of prehistoric and historical cultures and events and have use value for many contemporary groups, including local residents, scientists, and Native Americans.

3.3.1 Area of Potential Effects (APE)

In accordance with 36 CFR 800 (the implementing regulations for the National Historic Preservation Act), the Bureau of Land Management (BLM) established an area of potential effects (APE) within which direct and indirect effects on cultural resources resulting from the Proposed Action and alternatives could occur. The APE consists of the entire Gasco project area as well as portions of Nine Mile Canyon to the south and portions of the Green River corridor, including Desolation Canyon National Historic Landmark, to the east and southeast. The southern boundary of the Gasco project area ends at the northern rim of Nine Mile Canyon and at the western rim of Desolation Canyon; the proposed project area does not extend into the canyons themselves. However, the APE was expanded to encompass a portion of each canyon within which indirect effects, such as fugitive dust and visual and auditory intrusions on the use of cultural resources, could occur.

3.3.2 IDENTIFYING CULTURAL RESOURCES IN THE PROJECT AREA: PREDICTIVE MODELING AND LITERATURE REVIEWS

Most efforts to identify cultural resource in the APE have been driven by past Section 106 compliance requirements related to specific development or land-use projects unrelated to actions proposed in the EIS. These inventories have addressed discrete locations in an effort to provide “clearance” for small parcels of land and narrow linear corridors, thus creating a patchwork of small disparate archaeological surveys. Such an approach has created a random pattern of data collection, which has affected the current understanding of prehistoric and historic site types, their distribution, and the corresponding land use patterns. The disjointed nature of cultural resource inventories in this area has increased the difficulty in developing efficient large-scale project plans. As a result, the present knowledge regarding the location of cultural resource locations is largely constrained by the nature of previous investigations.

To address these data limitations for the EIS, the BLM Vernal Field Office (FO) employed a two-pronged approach to identifying and quantifying cultural resources in the APE. The first is the application of a predictive site distribution model to the project area. The second is a review of past Section 106 cultural resource investigations in the APE to identify previously documented archaeological and historical sites that have been determined eligible for, or are currently listed on, the National Register of Historic Places (NRHP), or for which no determination of eligibility has been made.

The BLM Vernal FO’s resource management plan (RMP) developed zones of high and low probability for cultural resource site locations within the Vernal BLM district (BLM 2008c). This model examined the relationship between the distribution of cultural resource sites across the landscape and those environmental parameters that conditioned their distribution in order to establish areas that had greater or lesser potential to have archaeological sites. The study found that areas within approximately 1 km of permanent water, or within juniper vegetation zones, sand dunes, or the general area of historical mining districts were considered high site probability zones. Areas with greater than 30% slope, or not having any of the high site probability factors were considered low site probability zones.

This EIS references the cultural resource probability model developed for the Vernal RMP/EIS (BLM 2008c) to identify environmental zones within the project area that have greater or lesser potential for containing cultural resources. By examining the relationship between known historic and prehistoric cultural resources sites and a number of environmental variables (e.g., distance to water, vegetation, slope, mineral distribution, etc.), the probability model predicts high and low probability zones for cultural resources that alleviate the patchwork pattern of information. Thus, the model serves as a management tool that can assist with determining whether or not the proposed development or the subsequent alternatives are more or less likely to impact cultural resources. The model is not intended to predict the exact locations of individual sites and is not of sufficient accuracy to allow for determinations of exact impacts from individual project facilities. Rather, it serves as a broad-scale tool to compare the relative likelihood of the Proposed Action and alternatives to encounter cultural resource sites. That is, it allows the BLM to compare alternatives relative to which ones would affect greater or lesser acreage of areas predicted to have a higher density of cultural resource sites. Four Mile Wash (located near the center of the APE), Nine Mile Canyon (at the southern boundary of the APE), and Desolation Canyon (along a portion of the southeastern boundary of the APE) were identified as locations of high site density that have important scientific, traditional cultural, and conservation values.

To supplement the probability model, the BLM Vernal FO conducted a search of previously completed cultural resource site documentation records in the APE (Patterson et al. 2011). Because federal law explicitly addresses sites listed on or eligible for the NRHP, the BLM focused the records review of those types of resources. The BLM opted to also include sites for which no determination of eligibility for the NRHP has been made. The review identified a total of 1,301 previously documented sites. Of these, 953 are either unevaluated or have been determined eligible for the NRHP. These sites comprise a wide variety of site types, including the following:

- Prehistoric and historic artifact scatters
- Prehistoric sites with above-ground structures
- Prehistoric habitation sites
- Prehistoric rock shelter sites
- Prehistoric quarry sites
- Burials
- Trails
- Rock art
- Historic mines
- Historic roads and railroads
- Historic prospector camps
- Historic buildings and structures

More detailed descriptions of these site types are provided in section 3.3.3, below.

The distribution and density of the known NRHP-eligible or unevaluated sites is heavily influenced by a number of factors, including those used in the site distribution model described above. The densest concentration of prehistoric sites is in the Nine Mile Canyon portion of the APE as well as near the Green River. Historic sites are also clustered in these areas but are also found along most long-established roads in the APE.

3.3.3 Cultural Resources in the Project Area

For this EIS, it is necessary to generate a preliminary understanding of the potential cultural resources that may be encountered during future development within the project area. Collectively, these resources take the form of sites, artifacts, buildings, structures, ruins, features, and natural landscapes with particular cultural importance. With a few exceptions, these remains (or, in the case of natural landscapes, the period of traditional use of that landscape) must be at least 50 years old. The following descriptions of known and potential prehistoric and historic cultural resources within the project area have been taken from the Vernal RMP, as well as cultural resource overviews for the area (e.g., Spangler 1995), and the literature review conducted for this EIS (Patterson et al. 2011). While additional types of cultural resources are likely present, the following descriptions adequately address the range of cultural resources that have been or potentially could be identified within the study area.

3.3.3.1 Prehistoric and Ethnographic Cultural Resources

The following section provides a basic description of the primary known prehistoric site types within the project area. Some site types, such as artifact scatters, are included because they are common throughout the area and are a major component of the Section 106 compliance workload. Others, such as burials, rock art, and ceremonial sites, may not occur as frequently as artifact scatters, but are included because they represent management challenges due to their importance to Native American tribal groups.

Rock Art: A large number of rock art sites have been identified in the Uinta Basin, and more are likely to exist. Specifically, Nine Mile Canyon, located adjacent to the southern boundary of the study area, is widely known for the richness, complexity, and detail of its prehistoric rock art. While Nine Mile Canyon contains one of the densest concentrations of rock art in the Uinta Basin and West Tavaputs Plateau, large quantities are present throughout the entire region. Rock art sites identified in the Uinta Basin are highly variable and may range from one depiction to a panel or series of panels with numerous depictions. Some sites contain large, multiple, and interconnected rock art panels. In addition to variations in size, numerous different rock art styles have been recorded in the Uinta Basin. In some instances, rock art is located near other types of sites; in other instances, rock art is isolated. As rock art is frequently located in difficult terrain, a comprehensive survey of existing rock art and its relationships to other sites has been difficult to complete. Finally, rock art sites have routinely been subjected to acts of vandalism and are susceptible to deterioration (Spangler 1995). Currently, there is still much to learn regarding known rock art sites, with a high probability for further important rock art discoveries.

Well-preserved Open Camp and Village Sites: Open camp and village sites are similar large prehistoric occupations, distinguished primarily on the basis of the presence or absence of residential structures. Habitation areas located on plateaus, outcrops, and valley floors characterize open campsites. These locations typically have evidence of lithic scatters, ceramic scatters, and projectile points, and are often defined on the presence of remnants of hearths and other features. Many of the sites have been characterized as hunting and butchering activity areas.

Platform Sites: Platform sites, or sites located on top of flattened knolls, are rare within the Uinta Basin. One unusual site on a knoll overlooking the Green River appears to have been leveled off (whether manually or by environmental processes is unknown). The leveled surface of the knoll has a circular structure made of flat sandstone slabs approximately 1.5 feet high, with the interior filled with a light-colored clay material. This structure is unknown in function and, to date, is the only known feature of its type within the Uinta Basin. This site has been identified by Northern Ute elders as a traditional cultural property (TCP). Others could be present in the current study area given its proximity to the Green River, but have yet to be discovered.

Rock Shelters and Caves: As their name implies, rock shelter sites contain evidence of human occupation located within existing rock overhangs or caves. The range of rock shelter sites includes relatively long-term single occupations, multiple reuse occupations through time, and ephemeral single-use episodes. Rock shelters and caves are generally located within canyons, and near permanent water sources, such as rivers or streams. In the West Tavaputs area, most of these sites also tend to be located on the northern side of canyons, although they can be found within any portion of geologically suitable areas.

Prehistoric Architectural Sites: A relatively wide range of site types is included in this category. Architectural sites have been recorded in open air and sheltered settings, at nearly all elevations, and in virtually every environment within the Uinta Basin. However, some types of architecture are restricted to only certain regions or settings. To date, the range of architectural sites includes stone or masonry structures, pit structures, temporary brush structures, tipi rings, sweat lodges, storage structures or granaries, stone alignments or walls, cairns, and rubble mounds. Structures such as tipi rings, temporary brush structures, and perhaps sweat lodges are located in more open environments, on knolls, cliff edges, or terraces. Stone or masonry structures, granaries, and often walls are found in cliffside rock shelters, in canyons, or on ledges. Other stone or masonry structures can also be found in open areas, stream and river terraces, upland ridges, small cliff openings, and butte or mesa faces. Typically, such structures are found within reasonable proximity of sandstone formations and outcrops, which provide much of the building source material.

Prehistoric Artifact Scatters: Prehistoric artifact scatters may be encountered in open air or sheltered settings in nearly all environment types and elevations. These types of sites are located throughout the Uinta Basin and number in the thousands. Artifact scatters typically consist of lithic artifacts such as chipped stone debitage, tools, cores, and tool and core fragments. However, many artifact scatters may also contain ceramic artifacts, ground_stone artifacts, or a combination of lithic, ceramic, and ground_stone artifacts. Artifact scatters do not typically contain evidence of architecture, although smaller features such as hearths may be present either on the surface or below the surface. The function of artifact scatters is highly variable and can be subject to differing interpretations, but is likely to have been related to short-term land use settlement systems.

Prehistoric Resource Procurement Sites: Locations where prehistoric populations procured a specific resource are common within the Uinta Basin. A wide range of resources appear to have been exploited in a manner that left archaeological evidence, including game animals (hunting sites), chipped stone materials (lithic procurement sites), and floral materials (botanical processing sites). Several different hunting site types have been identified to date, including hunting blinds, game drives, game traps, and butchery sites. Hunting sites can be designed to either funnel game toward a desired goal or to hide the hunter in ambush-style hunting. In general, hunting sites are identifiable due to the strategic placement of rock or brush structures along game trails or water sources, near topographic features that restrict game movement, or in locales that provide an advantage in elevation. Butchery sites are typically identified by the presence of high numbers of animal bones that bear evidence of processing, such as cut marks or diagnostic breakage patterns.

Prehistoric Ceremonial Sites: Ceremonial sites are usually located in areas with panoramic views, and are recognized by the presence of a stone circle or alignment that contains few or no artifacts. Ceremonial sites are interpreted as vision quest locations (Reed and Metcalf 1999). The vision quest interpretation has largely been inferred from ethnographic work among modern Native American groups. However, the actual nature of prehistoric ceremonial sites is currently not well understood.

Prehistoric Isolated Features: Sites recorded as prehistoric isolated features typically consist of one isolated cultural feature that has few or no associated artifacts. In many instances, the isolated feature is unidentified, while in other cases the feature is identified as a simple cultural feature (e.g., a cairn, etc.).

Prehistoric Landscapes: Prehistoric landscapes are a type of cultural resource that encompasses a range of cultural resource sites within a given environment. The study of prehistoric landscapes is a relatively new endeavor in the New World. This approach has become more common in Great Britain and Europe. The interaction of human sociopolitical and economic systems and the landscapes in which humans live and create environments is one main focus of research in landscape archaeology. In short, the prehistoric landscape can be defined as including humans and their anthropogenic ecosystem.

The types of landscapes that could be characterized within the Uinta Basin include canyons and plateaus. These encompassing landscapes are large in scale, but contain hundreds of smaller, more distinct units of residential dwellings, storage areas, resources scatters, etc., that make up the landscape. Individually, the sites within a given landscape may not be particularly noteworthy or important. However, when each site is taken into consideration with other, geographically close sites, a landscape emerges that encompasses multiple types of past human uses of the landscape. These individual sites cluster together in a setting that sets it apart from the region as a whole. These landscapes could also have importance for extant Native American tribes as sacred or important places with cultural importance.

Prehistoric Trails: Travel routes along river corridors and open drainages were common ways for prehistoric peoples to get from area to area. The White River was a traditional Ute travel route within the eastern Uinta Basin to western Colorado (Spangler 1995). Other trail areas have been formally identified to the east of the region as well as in the Book Cliffs (Reed and Metcalf 1999). Additional unidentified prehistoric and protohistoric trails are likely to exist within the region. Prehistoric trails could potentially be identified through remote sensing and ground-truthing.

3.3.3.2 Historical Cultural Resources

The following section provides a basic description of the historical site types that have been identified or may exist within the project area. Undoubtedly, other site types do exist within the area, but those listed here comprise the bulk of historical sites currently managed by the BLM.

Historical Architectural Sites: Historical structure sites may contain abandoned structures or evidence of structures, or may consist of a structure or structures still in use. Historical architectural sites identified in this general area include structures such as cabins/homesteads, forts or military posts, trading posts, private residences, line shacks, civic structures, stone or masonry walls, fences, corrals or pens (both Euro-American and Ute), sheds, barns, or outhouses. Although typically located in desirable areas or near reliable water sources, historical architecture can be found in nearly every setting or environment.

Artifact Scatters/Middens: Historical artifact scatters and middens may consist of one or more of the following: glass, ceramics, cans, building materials, barbed wire, cartridge cases, faunal material, personal items, and miscellaneous artifacts. Artifact densities may range from relatively sparse to relatively dense scatters. Historical artifact scatters can represent light or intense land use, and can be encountered in nearly any environment or elevation. Artifact scatters may be associated with isolated residences, large settlements, and campsites, or they may be the result of random dumping episodes.

Historical Burials/Cemeteries: Early historic period burials may consist of isolated burials of one or more individuals, while early cemeteries contain numerous individuals. Several cemeteries exist within the Uinta Basin. In addition, several isolated burials, located both on public and private land, have been recorded. Other isolated burials might yet be encountered.

Irrigation Systems/Canals: The development of agriculture and ranching in the Uinta Basin often required the building of waterworks to bring water into relatively dry regions. In general, irrigation works are categorized as either improvements made on natural drainages or as the construction of new waterways. Irrigation works can include ponds, dams, concrete, stone-lined or earthen ditches or canals, headgates, culverts, diversion gates, or wells.

Mining Sites: In many parts of the Uinta Basin, the mining industry has played an important economic role. Mining-related sites are variable in both size and in complexity. Recorded examples include small-scale mining efforts at one locale, small-scale operations at multiple sites, and complex mining works at one or more locations carried out by large mining firms. The goals of Uinta Basin mining efforts are also varied, with several different kinds of precious metals (i.e., gold, silver, copper, and uranium), minerals, and hydrocarbons sought. Besides the actual mine or quarry, mining sites can have related architecture, temporary camps, ore piles, middens, artifact scatters, burials, or aspen art located nearby. Additionally, railroads constructed specifically to serve the mining industry may also be associated with mine sites.

Oil and Gas Industry Sites: Oil and gas industry historical sites can consist of pipelines, wells, processing and transport facilities, and prospects. The first well in the Uinta Basin was drilled on the East Tavaputs Plateau in 1900 (Spangler 1995). Although unsuccessful, the sinking of this first well foreshadowed the fervent activity that would occur in the area 40 years later. While more than 40 wells were drilled in the Uinta Basin between 1908 and 1913, most historical archaeological and structural sites associated with the industry date to the post–World War II era, when oil and gas exploration began in earnest.

Privies/Outhouses: Prior to the installation of buried sewer lines, sanitation facilities often consisted of excavated pits designed to collect and contain waste. Although originally intended to serve as sanitation facilities, privies often served as secondary refuse dumping locales. Additionally, personal items were often accidentally dropped into privies during use. Due to secondary dumping and accidental loss, many privies routinely contain high numbers of artifacts, and because the subsurface deposit is often undisturbed, may serve as valuable sources of data. Privies are routinely found in association with campsites, private residences, public structures, military posts, and commercial buildings. Privy sites have been found on mining sites and other industrial sites as well. There is no clear indication of the frequency and/or distribution of such sites that can be found in the existing cultural resource literature, thus it is unclear how many historical privies and outhouses may exist. However, given their general association with permanent and/or long-term occupation sites, few privies are likely to be found on BLM lands.

Historical Transportation Sites: Establishing efficient transportation routes was one of the main goals of explorers and settlers during the settlement of the West. The Uinta Basin was no different. As Euro-Americans settled the Uinta Basin, establishing efficient travel avenues was of vital importance in aiding the growth of settlements, the mining industry, and the agriculture and ranching businesses. To date, identified transportation-related sites include trails, paths, paved and unpaved roads, bridges, railroads, wagon and stagecoach routes, stagecoach and railroad stops, railroad section stations, ferry sites, and airstrips and runways. Furthermore, as trappers and fur traders routinely used waterways for travel, the shores of various sections of waterways might contain evidence of early travel.

3.3.3.3 Non-Archaeological Site Types

Non-archaeological site types are distinguished from archaeological site types in order to discuss places that are not necessarily associated with prehistoric or historical artifacts assemblages and collections. The most typical non-archaeological site type is a TCP, which is defined as a district, site, building, structure, or object that is valued by a community for the role it plays in sustaining the community's cultural integrity (NPS 1990). Such places generally figure in important community traditions or in culturally important activities and, as such, may be eligible for listing on the NHRP. Tribal representatives commonly identify TCPs during the government-to-government consultation process that is required of federal agencies. However, TCPs can also be identified by representatives of other groups, such as historical culture groups associated with the Euro-American migration to the western United States. Some common site types are lakes and springs, land features, and traditional gathering or collection areas.

3.3.4 National Register-Listed Sites

Regional archaeological data identify several cultural resource sites that have been determined to have local, regional, or national importance. Such sites may be listed on the NRHP. Although there are several such sites in the region, including at least 63 in Nine Mile Canyon, none occur in the project area, only adjacent to it. However, at least some of these sites are located in the portion of the APE for indirect effects. Additionally, the 2010 Programmatic Agreement signed between the BLM and other federal, state, and private parties for the *West Tavaputs Plateau Natural Gas Full Field Development Plan* includes a stipulation by which the BLM is expected to annually nominate sites in Nine Mile Canyon to the NRHP. The stipulation holds that by 2015, or until all previously recorded eligible sites on BLM land in Nine Mile Canyon have been nominated, the BLM will nominate 100 individual sites each year.

Although no NRHP-listed sites are present in the project area, as opposed to the APE, cultural resource sites that have been determined eligible for the NRHP are afforded the same level of protection and consideration in planning and land-use decisions as those that are formally listed. Currently, the locations of some but not *all* NRHP-eligible cultural resource sites in the APE are known. This incomplete knowledge is due to the fact that only a very small overall proportion of the total APE has been physically inspected to identify cultural resources.

3.3.5 Summary of Cultural Resources

Cultural resources within the project EIS study area are numerous, diverse, and widely dispersed. Although many of these resources have been documented over years of study, a comprehensive picture of the exact distribution of the resources is not possible due to the large area encompassed and the lack of region-wide systematic study.

Nonetheless, previous data and investigations do provide a general picture of the types of sites present and their locations. It is not possible to provide exact data on the location of all types of cultural resources and therefore gauge with precision the effects of particular management decisions on those resources. However, it is possible to derive general tendencies for site locations that can be used to gauge the relative probable severity of the impacts of various management decisions on cultural resources in the overall area. For the project EIS study area, the method established in the Vernal RMP for identifying high and low probabilities zones would be used for subsequent cultural resources analyses. The criteria used in that study provide replicable proxy data for site location, and can be used to gauge whether proposed development activities are more or less likely to impact cultural resources.

3.4 Geology and Minerals

3.4.1 Mineral Resources

All federal lands across the project area have been designated as having medium or high occurrence potential for oil and gas resources. Other mineral resources tend to concentrate in a few areas, particularly along the Green River floodplain in the northeastern project area, or along Nine Mile Canyon in the southern project area.

3.4.1.1 Oil and Gas Resources

Oil and natural gas are the major mineral resources in the Uinta Basin, and exploration and extraction of oil and gas is the primary industry (Clem 1985, BLM 2005b). Most of the federal lands in the project area—at least 90%—are currently open to leasing subject standard terms and/or to seasonal or other minor constraints (BLM 2008c). Areas subject to No Surface Occupancy (NSO) are primarily in the floodplain of the Green River and portions of Nine Mile Canyon (BLM 2008c). For the 176,916 acres of federal lands in the project area, leasing is subject to the following stipulations/conditions:

- Category 1—Open to leasing, subject to standard terms and conditions: 148,538 acres
- Category 2—Open to leasing, subject to seasonal or other minor constraints: 11,548 acres
- Category 3—Open to leasing, subject to NSO or other major constraints: 16,830 acres

The Vernal Draft RMP/EIS (BLM 2005a) estimated that there is approximately 22 trillion cubic feet of natural gas reserves in the Uinta Basin.

3.4.1.2 Tar Sands

Tar sand is a type of oil sand or sandstone from which the lighter fractions of crude oil have escaped, leaving a residual asphaltic material to fill the voids between sand grains. Alternatively, a tar sand deposit may be characterized as a body (or bodies) of porous rock saturated by very thick, immobile hydrocarbon residues (e.g., bitumen, tar, or degraded oils that have lost their volatile components) that cannot be recovered by conventional oil-producing methods (BLM 1994). Such hydrocarbons can be liberated from tar sands by heating and other processes. In the Uinta Basin‘s geologic formations, the substance that fills the pore space in coarse sandstones or forms cement in loose unconsolidated sands is a tarry residuum of petroleum (Pruitt 1961), and the ore retrieved is bitumen. The bituminous tar sands in and near the project area, along the margins of the Uinta Basin, are hosted primarily in the Tertiary sediments of the Green River and Uinta formations. The Green River Formation is widely regarded as the principal source rock for all bitumen in the Uinta Basin (BLM 1994; BLM 2005a).

In the early 1980s, certain tar sand deposits in the Uinta Basin were divided into seven Special Tar Sand Areas (STSAs) designated by the U.S. Geological Survey under direction from Congress, pursuant to the Combined Hydrocarbon Leasing Act of 1981 (BLM 2002a). In general, areas included within STSAs have the highest potential for the occurrence and development of tar sands (BLM 1994). Tar sand deposits in the project area are located in one of these STSAs (Table 3-12), the Sunnyside STSA, which is in the southwestern portion of the project area and extends south and west beyond it. The Pariette STSA is immediately north of the project area, in the South Myton Bench area (BLM 2005b, BLM 2002a). The Sunnyside and Pariette STSAs also fall within lands having potential for conventional oil and gas deposits.

In addition, a minor tar sand deposit, the Nine Mile Canyon Tar Sand Deposit, has also been delineated within the project area, though the number of barrels of bitumen has not been estimated (BLM 2002a; Blackett 1996).

Table 3-12. Estimated Number of Barrels of Bitumen Contained within the STSAs in and Near the Project Area

STSA	Geologic Formations	Barrels of Bitumen
Pariette	Uinta Formation	12.0–15.0 million
Sunnyside (northern)	Wasatch Formation	3.5–4.0 billion

Sources: BLM (1994), BLM (2002a), Blackett (1996), Covington and Young (1985).

Congress has attempted to encourage the development of tar sand resources as an alternative to traditional oil deposits with passage of the Combined Hydrocarbon Leasing Act of 1981. The Pariette and Sunnyside STSAs each contain a Combined Hydrocarbon Lease (CHL), but because they are attractive primarily for their oil and gas potential, and because tar sand development associated with a CHL could be more disruptive to environmental resources than oil and gas development, development on the leases in those STSAs, if it occurs, would most likely be for oil and gas (BLM 2002a, 1994). All CHLs issued in STSAs are regulated by an amended leasing category system, as follows:

- Open to leasing, with standard stipulations
- Open to leasing, with standard and special stipulations
- Open to leasing, with no right of surface occupancy
- Closed to leasing

There was considerable interest in tar sands during the energy "boom" of the early 1980s. While state and federal governments have encouraged tar sands exploration and development research, commercial extraction of oil from tar sand deposits has not yet occurred (Blackett 1996), and the industry has restricted itself to experimental recovery methods on pilot areas (BLM 1994). As of October 2001, only four tar sand surface mining operations were permitted in the Vernal Planning Area as a whole, all located in Uintah County. However, there are no approvals to mine-develop tar sands on any of the CHLs (currently authorized or closed).

The Sunnyside and Pariette STSAs have a high potential for and certainty of occurrence of tar sands. However, because of higher production costs, at current oil and gas prices, extraction of oil from the bitumonous tar sands in the STSAs is not an economical use of this resource. A rise in the price of oil or improvement in extraction technology would be required to cause increased interest in these deposits for the extraction of fossil fuels (BLM 2002a). There are no active tar sand mining projects in the Myton Bench area or in the project area (BLM 2005b). Therefore, for economical, logistical, regulatory, and environmental reasons, the potential for development of this resource, other than for asphalt paving (as in Uintah County's privately owned asphalt pits), is anticipated to remain low over the next 15 years (BLM 2002a).

In November 2008 the BLM released the Approved Resource Management Plan Amendments/Record of Decision for Oil Shale and Tar Sands Resources to Address Land Use Allocations in Colorado, Utah, and Wyoming and Final Programmatic Environmental Impact Statement (BLM 2008a). This decision designated some of the Vernal FO as available for application for commercial leasing and future exploration and development of tar sands resources. None of the lands open for commercial leasing of tar sands fall within the project area.

3.4.1.3 Oil Shale

Oil shale generally refers to fine-grained, sedimentary rock (e.g., marlstone) containing kerogen, which is a fossilized organic material that can be converted to conventional oil via retorting or distillation. This process can yield 15 gallons or more of oil per ton of rock (Cashion 1967). Oil shale is hosted within the lower part of the Parachute Creek Member of the Green River Formation, at a depth of 2,000 to 4,000 feet, where it accumulated in lake sediments during the deposition of the Green River Formation. The Mahogany Oil Shale Zone of the Parachute Creek Member, which outcrops in the southern part of the project area and dips north toward Uinta Basin (Cashion 1967), is the source of oil shale in the project area (BLM 2005a).

One known oil shale deposit encroaches on the northeastern project area. Here, oil shale has an overburden of less than 3,000 feet, and the mahogany bed is 30–40 feet thick, with an oil shale yield of at least 25 gallons per ton (BLM 2002a, BLM 2006c). However, the thicker mahogany oil shale zones east of the project area are considered the more productive reserves (BLM 2005b). The most recent basin-wide assessment of oil shale resources in the Uinta Basin was completed in 2008 (Vanden Berg 2008). This study assesses the oil shale resources at various yields from 15 gallons per ton to 50 gallons per ton. The deposits that encroach on the northeastern portion of the project area range from 35 to 50 gallons per ton; however, the study indicates that lower-yielding deposits from 15 to 25 gallons per ton, with thicknesses of at least 5 feet and less than 3,000 feet of overburden, extend throughout much of the rest of the project area as well.

In November 2008 the BLM released the Approved Resource Management Plan Amendments/Record of Decision for Oil Shale and Tar Sands Resources to Address Land Use Allocations in Colorado, Utah, and Wyoming and Final Programmatic Environmental Impact Statement (BLM 2008a). This decision designated some of the Vernal FO as available for application for commercial leasing and future exploration and development of oil shale resources. A total of 80,834 acres of the lands open for commercial leasing of oil shale fall within the project area.

Considering the presence of the underlying Mahogany Oil Shale Zone, there is a high potential for occurrence of oil shale within the northeastern portion of the project area, and a lesser potential throughout the remainder of the project area. However, there are currently no active mine permits or extraction activities in the project area, and most development activity during the next 15 years, if it occurs, is expected to occur east of the Green River (BLM 2002a, BLM 2005a). Therefore, although 80,834 acres are designated as Open to oil shale leasing (BLM 2008c), development and production of oil shale in those lands is unlikely during the life of the project.

3.4.1.4 Gilsonite

Gilsonite is a black, pitch-like, petroleum substance that occurs in pure form in veins in the Tertiary sediments of the Uinta Basin. It is a petroleum substance of uniform composition and texture. Gilsonite compounds are often quite strong and offer resistance to heat, acids, and alkalies, making them valuable for weatherproofing, but also for fuels, lubricants, high-grade varnishes, lacquers, paints, acid proofing, inks, and mastic (Crawford 1960). The Uinta Basin is the principle source of gilsonite in the world (BLM 1994).

Gilsonite is known to occur in the Uinta and Green River formations, and especially where the Green River Formation abuts the Uinta Formation—which happens right in the middle of the project area. The composition of the Uinta Formation is more uniform east of the Green River and more broken and shaley west of the river, which has had a direct effect on the level of gilsonite detection and development on each side of the river. The composition of the Green River Formation has resulted in more dikes of gilsonite (which cut across the bedding planes of the surrounding rock and thus are visible on the surface) east of the river and more sills of gilsonite (which occur parallel to and between bedding planes and thus are shorter, narrower, and less likely to be exposed at the surface) west of the river (BLM 1994, BLM 2005b).

The project area overlaps with one of two main areas of moderate to high gilsonite potential west of the Green River in the Vernal Planning Area (BLM 1994). The known Pariette System dikes are near, less than 2 miles north and east of the project area (BLM 2005a, Verbeek and Grout 1993), and the buffers for these dikes extend into the northern and eastern project area, accounting for approximately 5,000 acres. The northern and eastern project area (approximately 44,000 acres; BLM 1994) have been designated as having high potential, and the central and western project area (approximately 55,000 acres; BLM 1994) have been designated as having moderate potential.

Currently, there are no active leases or prospecting permits for gilsonite within the project area or north of the project area (BLM 1994, BLM 2005a). To date, commercial interest has focused solely upon the most accessible deposits east of the Green River and the project area. However, as the higher-grade eastern deposits are exhausted, the poorer western deposits will become more attractive to mining. Therefore, it is possible that lands within and north of the project area with high gilsonite potential would be explored for development in the future, potentially during the life of the project.

3.4.1.5 Locatable Minerals

Within the project area, only a few locatable minerals have potential to occur: uranium and placer gold. Uranium deposits are known to exist in the carboniferous units of the Uinta Formation (Chenoweth 1992), which underlies most of the project area. Small placer deposits of fine gold occur in alluvium along the Green River starting in the northeastern corner of the project area and extending northeastward along the river.

As provided by the BLM, no mining claims are currently in the project area (BLM 2002a). The exploration and development of locatable minerals has been historically low in the vicinity of the project area, due to the majority of public lands being withdrawn from mineral entry by Executive Order 5327 (April 15, 1930), as amended by Public Land Order 4522 (September 13, 1968). The uranium deposits in and near the project area have not been developed since 1958, when the lone operation shut down after yielding 161 tons of ore and 649 lb of uranium oxide (U3O8), averaging 0.2% uranium (Chenoweth 1992). The gold placer deposits are unlikely to be profitable enough to warrant operations during the life of the project and, thus, are unlikely to be developed (BLM 1994).

Based on the known geology of the area, these locatable minerals (i.e., uranium and gold) in the project area are classified as having moderate occurrence potential with a high degree of certainty. However, there is a low potential for new mining claims to be issued over the life of the project, due to regulatory requirements and low economic quality and quantity of deposits in the project area (BLM 2002a).

3.4.1.6 Mineral Materials

Mineral materials within the project area comprise primarily building stone, but also sand and gravel. Building stone has a high to moderate potential for occurrence in the southern portion of the project area, from Duchesne County into Uintah County, adjacent to the Bad Land Cliffs and within Nine Mile Canyon (BLM 1994, BLM 2002a). In this area, where the Green River Formation is above the Mahogany Zone and below contact with the Uinta Formation, building stone is also likely of high quality; the thin sandstones of the Green River Formation, particularly of the Parachute Creek Member, are known to be high-quality sources of building stone, and the many, steep, continuous cliffs of Green River Formation outcrop and erode into float material (BLM 1994, BLM 2002a) in this area. In the project area, there are 27,651.1 acres of open leasing for mineral materials. In the southern half (Green River Formation), there are 21,185.1 acres open for mineral leasing.

Sand and gravel, of quality varying from poor to medium, have medium to high potential for occurrence along Wells Draw (in the west-central portion of the project area) and in the alluvial deposits of the Green River (BLM 1994, BLM 2002a), but low development potential.

It is likely that exploration and development of building stone in the southern project area would continue over the life of the project (BLM 1994, BLM 2002a).

3.5 LAND USE AND TRANSPORTATION

3.5.1 LAND USE

The primary land uses within and adjacent to the project area include oil and gas development, livestock grazing, hunting, and dispersed recreation. See Sections 3.16, Wildlife; 3.6, Livestock Management; and 3.8, Recreation, for details on these specific land uses. There is minimal cultivated cropland in the area, given the composition of dry desert shrubland, typical of the Uinta Basin. There are no commercial buildings/facilities or private residences within the project area. The nearest residential community is Myton (population 550), located approximately 15 miles north of the northern project boundary line.

There are 31 road and utility rights of way (ROWs) within the project area. All of the ROWs in the project area are well field–related (Table 3-13).

Table 3-13. Project Area Rights of Grants

Right-of-way (ROW) Number	ROW Grant Holder	Type of ROW Grant	Expiration Date
UTU-047455	Canyon Gas Resources	Gas Pipeline	11/24/2011
UTU-032707	EOG Resources	Gas Pipeline	08/02/2011
UTU- 062794	Dominion Exploration and Production	Gas Pipeline	12/31/2035
UTU-050806	Dominion Exploration and Production	Gas Pipeline	05/20/2012
UTU-077736	Dominion Exploration and Production	Gas Pipeline	12/31/2031
UTU-77733	Dominion Exploration and Production	Gas Pipeline	12/31/2031
UTU-071257	Dominion Exploration and Production	Access Road	12/31/2024
UTU-069105	Dominion Exploration and Production	Access Road	12/31/2022
UTU-049204	Dominion Exploration and Production	Gas Pipeline	06/23/2012
UTU-053910	Dominion Exploration and Production	Gas Pipeline	05/06/2014
UTU-081577	Gasco Production	Gas Pipeline	12/31/2035
UTU-081576	Gasco Production	Access Road	12/31/2035
UTU-080369	Gasco Production	Gas Pipeline	12/31/2034
UTU-081601	Gasco Production	Gas Pipeline	12/31/2035
UTU-079035	Gasco Production	Gas Pipeline	12/31/2032
UTU-079030	Gasco Production	Access Road	12/31/2031
UTU-076935	Gasco Production	Access Road	12/31/2019
UTU-081261-03	Uintah County	Access Road	No Expiration Date
UTU-081573-06	Duchesne County	Access Road	No Expiration Date
UTU-050807	Wexpro Company	Access Road	07/13/2012
UTU-050815	Questar Gas	Gas Pipeline	07/11/2012
UTU-057507	Questar Gas	Gas Pipeline	09/18/2015

Table 3-13. Project Area Rights of Grants

Right-of-way (ROW) Number	ROW Grant Holder	Type of ROW Grant	Expiration Date
UTU-69139	Questar Gas	Gas Pipeline	12/31/2023
UTU-050827	Questar Gas	Gas Pipeline	08/30/2012
UTU-050828	Questar Gas	Gas Pipeline	08/30/12
UTU-054797	Questar Gas	Gas Pipeline	04/29/2015
UTU-057508	Questar Gas	Gas Pipeline	09/18/2015
UTU-059129	Questar Gas	Gas Pipeline	05/31/2017
UTU-069109	Questar Gas	Gas Pipeline	12/31/2013
UTU-077734	Questar Gas	Gas Pipeline	12/31/2031
UTU-077735	Questar Gas	Gas Pipeline	12/31/2031

Source: BLM (2006d).

3.5.2 TRANSPORTATION

Access to the project area is from U.S. Highway 40 (US-40), 15 miles to the north. It is the major thoroughfare for the area, serving as a route to Vernal and other communities and for tourist traffic to public lands, Dinosaur National Monument, Flaming George National Recreation Area, and other National Forest locations.

The transportation network that serves the project area consists primarily of county and BLM-maintained dirt and two-track roads. Approximately 3,000 miles of roads (including well field access roads) currently provide access for oil and gas operations, livestock grazing, and recreation activities in the project area. Major roads in the study area are the Sand Wash Road, Wrinkle Road, Wells Draw Road, Pariette Bench Road, Eightmile Flat Road, and Nine Mile Canyon Road (Map 26). Sand Wash Road provides access to the area from US-40. This road runs south through the project area and ends at a BLM Ranger Station and boat launch ramp for the Desolation Canyon section of the Green River. Pariette Bench Road and Eightmile Flat Road are offshoots of Sand Wash Road, providing access to the eastern portions of the project area. Wrinkle Road and Nine Mile Canyon Road run through the southern end of the project area.

Most of the traffic on these roads is oil tanker trucks that visit producing wells in the area. These trucks often travel approximately 175 miles one way to Salt Lake City via US-40 and Interstate 80. Other traffic on the road(s) includes water tanker trucks and maintenance and passenger trucks associated with oil and gas development. These vehicles generally commute locally from Roosevelt and Vernal. In 2009, the annual average daily traffic (AADT)[1] reported on the portion of US-40 just east of Myton (the least-used section between Vernal and the project area) was 7,785 vehicle trips per day. On the portion of US-40 located east of the State Highway 87 interchange but west of Roosevelt, the AADT was 9,220 vehicle trips per day (UDOT 2009). The AADTs between Myton and Roosevelt ranged between 5,740 and 9,360 in 2006, 7,125 and 10,370 in 2007, and 7,795 and 9,980 in 2008 (UDOT 2006, 2007, 2008).

[1] AADT is the total volume of vehicle traffic on a road for a year, divided by 365 days. Average daily traffic, or ADT, is the average number of vehicles traveling past a particular point on a road in a 24-hour period. The AADT measurement is used to account for seasonal variations.

Nine Mile Canyon Road, Franks Road, Gate Canyon Road, Wells Draw Road, and a segment of Sand Wash Road are collectively referred to as the Nine Mile Canyon Backcountry Byway; they provide access to Nine Mile Canyon, a major representative area of the prehistoric Fremont Culture. The Nine Mile Canyon Backcountry Byway was designated as a Utah Scenic Backway and BLM National Backcountry Byway in 1989. Backways and byways are components of the National Scenic Byway that meet the byway criteria but generally do not meet full federal safety standards, meaning they are not wide enough, graded enough, or level enough to be safe year-round for passenger cars. To be considered for designation within the National Scenic Byway program, a road must possess characteristics of regional importance within at least one of six intrinsic quality categories (archaeological, cultural, historic, natural, recreational, and scenic). The 1989 dedication document recognizes "Nine Mile Canyon road and its scenic corridors" as a major area representative of prehistoric Fremont Culture, and notes that the main attraction for visitors is the profusion of rock art panels and cliff granaries along the main road and up side canyons (BLM 1989).

Approximately 80 miles long, the Nine Mile Canyon Backcountry Byway begins in Wellington, Utah, on Soldier Creek Road, enters and travels through part of Nine Mile Canyon, turns north onto Gates Canyon Road (which becomes Wells Draw Road), and ascends above the canyon rim, ending approximately 60 miles later at US-40 just west of Myton, Utah. Most of the non-construction-related vehicle traffic in Nine Mile Canyon is associated with cultural and heritage tourism. Visitation to the area occurs year-round, with peak visitation on the weekends from the spring through the fall.

Table 3-14 identifies the six byway segments included in Gasco's transportation network.

Table 3-14. Nine Mile Canyon Backcountry Byway Segments Included in Gasco's Proposed Transportation Network (north to south)

Nine Mile Canyon Backcountry Byway Segment	Miles
Sand Wash Road/US-40 to Wells Draw Road	2
Wells Draw Road/Sand Wash Road to Wrinkle Road	25
Gate Canyon Road/Wrinkle Road to Gate Canyon Upper Bench	1
Gate Canyon Road/Gate Canyon Upper Bench to Nine Mile Canyon Road	4
Nine Mile Canyon Road–From Gate Canyon Road to the West	3
Franks Road–Nine Mile Canyon Road to the East of Franks Road[1]	8
Total	**43**

According the West Tavaputs Natural Gas Full Field Development Plan Final EIS traffic study (BLM 2010a), the 2005–2006 average daily traffic (ADT) count for the Nine Mile Canyon portion of the backcounty byway is 104 vehicles per day (as measured by two monitors placed north and south of the canyon itself, near the Gate Canyon/Nine Mile Canyon intersection and Soldier Creek Roads, respectively). Approximately 75% of that traffic (78 vehicles) entered the canyon from the north (i.e., using Sand Wash Road, Wells Draw Road, and Gate Canyon Road), as measured by the Gate Canyon monitor. A subsequent two-week visual monitoring study at the Gate and Nine Mile Canyon intersection indicated an average ADT of approximately 140, with oil and gas traffic constituting approximately 75% of the total traffic observed (BLM 2010a). These baseline traffic studies only measure traffic entering Nine Mile Canyon itself. They do not reflect traffic levels on roads above the canyon rim, such as Sand Wash Road, which services thousands of private and commercial boaters annually, or Wells Draw Road, which services existing oils and gas wells above the canyon rim. There are no available baseline traffic data for the sections of the Nine Mile Canyon Backcounty Byway above the canyon rim.

3.6 LIVESTOCK MANAGEMENT

3.6.1 REGIONAL MANAGEMENT OVERVIEW

The BLM Vernal FO administers grazing in the project area in accordance with the Guidelines for Grazing Management as developed by the Utah BLM in 1997 (BLM 1997). These guidelines were instituted for all Utah rangelands in order to meet the Standards for Rangeland Health (BLM 1997), based on basic ecological principles that underlie sustainable production of rangeland resources. The four fundamental standards are as follows:

- Watersheds are in or making significant progress toward properly functioning physical condition. This condition includes their upland, riparian/wetland, and aquatic components. Soil and plant conditions support infiltration, soil moisture storage, and the release of water that are in balance with climate and landform, and maintain or improve water quality, and timing and duration of flow.
- Ecological processes, including the hydrologic cycle, nutrient cycle, and energy flow, are maintained, or there is significant progress toward their attainment, in order to support healthy biotic populations and communities.
- Water quality complies with state water quality standards and achieves or is making significant progress toward achieving established BLM management objectives such as meeting wildlife needs.
- Habitats are or are making significant progress toward being restored or maintained for federal threatened or endangered species, federal proposed, categories 1 and 2, federal candidate, and other special status species.

Section 3 of the Taylor Grazing Act of 1934 authorizes livestock grazing on BLM-administered public lands.

3.6.2 ALLOTMENTS IN THE PROJECT AREA

Grazing allotments encompass 204,713 acres within the boundaries of the project area (Table 3-15 and Map 11). There are 19 grazing allotments; seven that occur almost completely (98% or more) within the project area, and 11 that fall partially within the project area. The allotments that are entirely or almost entirely within the boundaries are Big Wash, Big Wash Draw, Bull Canyon, Devils Canyon, Little Desert, Twin Knolls, and Water Canyon 2. The allotments that occur only partially within the project area are Antelope Powers, Castle Peak, Currant Canyon, Eightmile Flat, Five Mile, Green River, Green River Allotment Management Plan (AMP), Green River Bottoms, Max Canyon, Stone Canyon, Wells Draw, and Wetlands. There is also a 4,785-acre stock drive trail, 896 acres of which is in the project area. Over 960 acres of the project area has been removed from livestock grazing.

The 19 allotments are classified in three selective management categories: M (Maintain), I (Improve), and C (Custodial). In the Maintain category, management objectives are to ensure that current uses, range conditions, and productivity are maintained. The Improve designation means that current uses, range conditions, and productivity are not at optimal levels and must be addressed. Management objectives include implementation of actions that will improve existing resource conditions and productivity and enhance overall multiple use opportunities. Custodial management means that present management is satisfactory or is the only logical management under existing conditions.

Table 3-15. Allotment Acreages and Animal Unit Months (AUMs) in the Project Area

Allotment	Management Category[1]	Livestock Class	Total Allotment Acreage	Acres in Project Area	Percentage of Allotment in Project Area[2]	Total AUMs Allocated to Livestock	Calculated AUMs in Project Area
Antelope Powers	M	Cattle/Sheep	40,466	4,261	11%	4,463	470
Big Wash	M	Cattle	5,367	5,367	100%	980	980
Big Wash Draw	M	Cattle	8,372	8,372	100%	516	516
Bull Canyon	M	Cattle	16,578	16,521	100%	1,000	997
Castle Peak	M	Sheep	51,824	39,732	77%	4,760	3,649
Currant Canyon	M	Cattle	6,975	1,815	26%	433	113
Devils Canyon	M	Cattle	22,351	17,037	76%	2,720	2,073
Eightmile Flat	M	Sheep	27,550	5,685	21%	4,266	880
Five Mile	M	Cattle	15,622	14,323	92%	2,161	1,981
Green River[3]	M	Cattle	139,485	1,558	1%	10,668	119
Green River AMP	I	Cattle	9,608	24	0%	554	1
Green River Bottoms	I	Cattle	7,159	3,728	52%	462	241
Little Desert	M	Sheep	49,361	48,955	99%	3,804	3,773
Max Canyon	C		365	7	2%	20	0
Stone Cabin[3]	I	Cattle	30,463	47	0%	5,001	8
Twin Knolls	M	Cattle	6,969	6,969	100%	992	992
Water Canyon #2	C	Cattle	6,698	6,686	100%	362	361
Wells Draw	M	Cattle/Sheep	10,923	10,229	94%	1,220	1,142
Wetlands	I	Cattle	18,481	13,397	72%	1,666	1,208
Total			**474,617**	**204,713**		**46,048**	**19,505**

[1] M (Maintain), I (Improve), and C (Custodial)

[2] The percentage of each allotment in the project area has been rounded to the nearest digit and does not include acreages that have been withdrawn from grazing.

[3] Green River and Stone Cabin allotment acreage includes areas separately managed by the Vernal and Price FO. Allotment information includes acreages and AUMs within both FOs.

The carrying capacity of a livestock grazing allotment is defined in terms of Animal Unit Months (AUMs). An AUM is the amount of forage necessary to sustain one animal weighing 1,000 pounds for one month. In general terms, an AUM is the amount of forage needed to sustain one cow and her calf for a month.

Table 3-15 shows the total number of acres for each allotment whose boundaries cross into the project area, as well as the number of acres and percentage of the allotment that actually falls within the project area. The table also includes the total AUMs that are allocated to livestock in each allotment, and the calculated number of AUMs that fall within the project area based on percentages. The number of AUMs in the project area was calculated by multiplying the total AUMs allocated to livestock by the percentage of the allotment that falls within the project area.

3.7 PALEONTOLOGICAL RESOURCES

Paleontological resources, or fossils, are the remains, imprints, or traces of once-living organisms preserved in rocks and sediments. These include mineralized, partially mineralized, or unmineralized bones and teeth, soft tissues, shells, wood, leaf impressions, footprints, burrows, and microscopic remains. The fossil record is the only evidence that life on earth has existed for more than 3.6 billion years. Fossils are considered non-renewable resources because the organisms they represent no longer exist. Thus, once destroyed, a fossil can never be replaced.

This paleontological resource assessment is an evaluation of potential impacts on scientifically important non-renewable paleontological resources that could result from energy development within the project area.

3.7.1 REGIONAL OVERVIEW

The paleontological resource APE (which is the same as the project area) is located within the south-central Uinta Basin in Uintah and Duchesne counties, Utah. Structurally, the Uinta Basin is an asymmetrical, elongate, east-west-trending synclinal basin bounded by the Uinta Mountains to the north, the Douglas Creek Arch and Roan Plateau to the east, the Book Cliffs/Tavaputs Plateau to the south, and the Wasatch Range to the west.

Sediments that today comprise the Uinta Mountains were first deposited in an east-west-trending basin between 1,000 and 600 million years ago (mya). At this time, more than 25,000 feet of shallow water sandstone and shale accumulated from westward-flowing stream deposits. The basin filled and major deposition was halted, although slight periodic subsidence allowed for thickening of sedimentary deposits (Stokes 1986). These deposits were eventually uplifted during the Rocky Mountain–forming Laramide Orogeny (Rasmussen et al. 1999) in the latest Cretaceous period and Paleocene epoch to form the Uinta Mountains. In conjunction with this uplift, the southerly adjacent synclinal Uinta Basin formed (Rasmussen et al. 1999).

The Uinta Basin and the highlands surrounding the basin define a region that is well known for its geologic history and paleontologic importance. The region preserves a discontinuous but rich fossil record spanning at least 535 million years from the Cambrian period to the Pleistocene epoch. Many important fossil specimens, including numerous holotypes (single physical examples of an organism), have been collected from this region, and are now housed in museums throughout the United States.

3.7.2 Resource Assessment Guidelines

Paleontological resource classification is a ranking of areas and geologic units according to their potential to contain vertebrate fossils or noteworthy occurrences of invertebrate or plant fossils. These rankings are used in land-use planning, as well as for identifying areas that may warrant special management and/or special designation (such as ACECs). Using published geologic maps (Cashion 1973; Rowley et al. 1985; Witkind 1995) and the results of the literature and museum data searches, the APE for this EIS was classified using both the BLM and U.S. Forest Service (USFS) paleontological resource management classification systems (BLM 1998; USFS 1996), as described below. Note that both classification systems were used in this study at the suggestion of the BLM; although the 1998 General Procedural Guidance for Paleontological Resource Management H-8270-1 (BLM 1998) is being phased out as BLM policy, and the Potential Fossil Yield Classification (PFYC), developed by the USFS, is currently being adopted as a replacement, per Instructional Memorandum No. 2008-009. General Procedural Guidance for Paleontological Resource Management categorized paleontological resources by "condition" while PFYC categorizes them by "class" discussed below.

3.7.2.1 Condition Classification System

The BLM, in its General Procedural Guidance for Paleontological Resource Management H-8270-1 (revised 1998), classifies public lands based on the potential for paleontological "areas" to contain noteworthy occurrences of fossils using the following criteria:

- **Condition 1:** Areas that are known to contain vertebrate fossils or noteworthy occurrences of invertebrate or plant fossils. Consideration of paleontological resources will be necessary if the FO review of available information indicates that such fossils are present in the area.
- **Condition 2**: Areas with exposures of geological units or settings that have high potential to contain vertebrate fossils or noteworthy occurrences of invertebrate or plant fossils. The presence of geologic units from which such fossils have been recovered elsewhere may require further assessment of these same units where they are exposed in the area of consideration.
- **Condition 3**: Areas that are very unlikely to produce vertebrate fossils or noteworthy occurrences of invertebrate or plant fossils based on surface geology, igneous or metamorphic rocks, extremely young alluvium, colluvium, aeolian deposits, or deep-soil presence. However, if possible it should be noted at what depth bedrock may be expected in order to determine if fossiliferous deposits may be uncovered during surface-disturbing activities.

Either Condition 1 or Condition 2 may trigger the initiation of a formal analysis of existing data prior to authorizing land-use actions involving surface disturbance or transfer of title. Condition 3 suggests that further paleontological consideration is generally unnecessary (BLM 1998).

3.7.2.2 Potential Fossil Yield Classification

Occurrences of paleontological resources are closely related to the geologic units that contain them. The potential for finding important paleontological resources can therefore be broadly predicted by the presence of the pertinent geologic units at or near the surface. Therefore, geologic mapping can be used as a proxy for assessing the potential for the occurrence of important paleontological resources. The PFYC system was originally developed by the USFS's

Paleontology Center of Excellence, and the Region 2 (USFS) Paleo Initiative (USFS 1996). The PFYC is in the process of being formally adopted by the BLM to promote consistency between agencies and throughout the BLM. It should be used for land-use planning efforts and for the preliminary assessment of potential impacts and mitigation needs for specific projects.

Under the PFYC system, geologic units are classified based on the relative abundance of vertebrate fossils or uncommon invertebrate or plant fossils and their sensitivity to adverse impacts, with a higher class number indicating a higher potential. This classification should be applied at the geologic formation or member level. It is not intended to be an assessment of whether important fossils are known to occur occasionally in these units (i.e., a few important fossils or localities widely scattered throughout a formation does not necessarily indicate a higher class). Nor is it intended to be applied to specific sites or areas. The classification system is intended to provide baseline guidance to assessing and mitigating impacts to paleontological resources. In many situations, the classification should be an intermediate step in the analysis, and should be used to assess additional mitigation needs.

- **Class 1:** This describes geologic units that are unlikely to contain recognizable fossil remains. This includes units that are igneous or metamorphic in origin (but excludes tuffs), as well as units that are Precambrian in age or older. Management concern for paleontological resources in Class 1 units is negligible or not applicable. No assessment or mitigation is needed except in very rare circumstances. The occurrence of scientifically important fossils in Class 1 units is non-existent or extremely rare.
- **Class 2:** This describes sedimentary geologic units that are not likely to contain vertebrate fossils or scientifically important nonvertebrate fossils. This includes units in which vertebrate or important nonvertebrate fossils are unknown or very rare, units that are younger than 10,000 B.P., units that are aeolian in origin, and units that exhibit considerable diagenetic alteration. The potential for impacting vertebrate fossils or uncommon invertebrate or plant fossils is low. Management concern for paleontological resources is low, and management actions are not likely to be needed. Localities containing important resources may exist, but would be rare and would not influence the classification.
- **Class 3:** This describes fossiliferous sedimentary geologic units where fossil content varies in importance, abundance, and predictable occurrence. It also describes sedimentary units of unknown fossil potential. These units are often marine in origin with sporadic known occurrences of vertebrate fossils. Vertebrate fossils and uncommon nonvertebrate fossils are known to occur inconsistently, and predictability is low. The Class 3 designation includes units that are poorly studied and/or poorly documented, so that the potential yield cannot be assigned without ground reconnaissance. Management concern for paleontological resources in these units is moderate, or cannot be determined from existing data. Surface-disturbing activities may require field assessment to determine a further course of action.

  The Class 3 category includes a broad range of potential impacts. Geologic units of unknown potential, as well as units of moderate or infrequent fossil occurrence, are included. Assessment and mitigation efforts also include a broad range of options. Surface-disturbing activities will require sufficient assessment to determine whether important fossil resources occur in the area of a proposed action, and whether the action could affect the paleontological resources."

- **Class 4:** This describes Class 5 geologic units (see below) that have lowered risks of human-caused adverse impacts and/or lowered risk of natural degradation. They include bedrock units with extensive soil or vegetative cover, bedrock exposures that are limited or not expected to be impacted, units with areas of exposed outcrop that are smaller than two contiguous acres, units in which outcrops form cliffs of sufficient height and slope so that impacts are minimized by topographic effects, and units where other characteristics are present that lower the vulnerability of both known and unidentified fossil localities.

  The potential for impacting fossils is moderate to high, and is dependent on the proposed action. The bedrock unit is Class 5, but a protective layer of soil, thin alluvial material, or other mitigating circumstances may lessen or prevent potential impacts to the bedrock resulting from the activity. Class 4 and Class 5 units are often combined as Class 5 for general application, such as planning efforts or preliminary assessments, as Class 4 is determined from local mitigating conditions and the impacts of the planned action.

- **Class 5:** This describes highly fossiliferous geologic units that regularly and predictably produce vertebrate fossils or uncommon invertebrate or plant fossils, and that are at risk of human-caused adverse impacts or natural degradation. These include units in which vertebrate fossils or uncommon invertebrate or plant fossils are known and documented to occur consistently, predictably, or abundantly. Class 5 pertains to highly sensitive units that are well exposed with little or no soil or vegetative cover, units in which outcrop areas are extensive, and exposed bedrock areas that are larger than two contiguous acres.

  Management concern for paleontological resources in Class 5 units/areas is high, because the potential for impacting fossils is high. Vertebrate fossils or uncommon nonvertebrate fossils are known from the impacted area, or can reasonably be expected to occur in the impacted area. Assessment by a qualified paleontologist is required in advance of surface-disturbing activities or land tenure adjustments, and mitigation will often be necessary before and/or during surface-disturbing actions. Field surveys prior to authorizing any surface-disturbing activities will usually be necessary. On-site monitoring may also be necessary during construction activities. Designation of areas of special interest and concern may be appropriate.

3.7.3 Resource Assessment Overview

Ground disturbance associated with the Proposed Action has the potential to impact the six mapped geologic units listed in Table 3-16 (Cashion 1973; Rowley et al. 1985; Witkind 1995). Four of these have the potential to contain fossils of varying taxonomic affinities, importance, and abundance. The paleontological sensitivities of the six units were evaluated using the classification systems developed by the BLM and USFS presented in Sections 3.7.2.1 and 3.7.2.2. The results are summarized in Table 3-16, and were used to compile paleontological sensitivity maps (see Maps 12 and 13).

Table 3-16. Summarized Paleontological Sensitivities of Geologic Units in the Project Area Using the Condition Classification System and the PFYC System[1]

Geologic Unit	Map Abbreviation	Age	Typical Fossils	Condition Classification	PFYC
Alluvium	Qa, Qal, Qac	Holocene	None	Condition 3	Class 2
Colluvium	Qac	Holocene	None	Condition 3	Class 2
River Terrace Deposits	Qr	Pleistocene	Vertebrates[2]	Condition 3	Class 2
Older Pediment Deposits	Qop	Pleistocene	Vertebrates[2]	Condition 3	Class 2
Uinta Formation	Tu, Tul	Eocene	Vertebrates, invertebrates	Condition 1	Class 5
Green River Formation	Tgsl, Tgs, Tgu, Tgm, Tgdu, Tge	Eocene	Vertebrates, invertebrates, plants	Condition 1	Class 5

[1]Map abbreviations are from published U.S. Geologic Survey (USGS) geologic maps: Cashion (1973), Rowley et al. (1985), and Witkind (1995).

[2]No records of fossil localities of Pleistocene age from the study area and vicinity were found during the museum record searches.

3.7.4 SUMMARY

Based on the geologic mapping of Cashion (1973), Rowley et al. (1985), and Witkind (1995), the APE for the project area contains six geologic units (Map 9). These consist of four surface deposits including alluvium and colluvium of Holocene age and river terrace deposits and older pediment deposits of Pleistocene age, and two bedrock units including the Green River and Uinta formations of Eocene age. With the exception of the Holocene-age alluvial and colluvial deposits, which are too young to contain fossils, four units have the potential to contain scientifically important fossils.

At least 134 previously recorded fossil localities occur within the Green River and Uinta formations in the project area. Additionally, paleontological data received from two museums were georeferenced only to the county level. From Uintah and Duchesne counties, these institutions have 302 catalogued vertebrate and invertebrate fossil specimens from the Uinta Formation, and 22 catalogued plant, invertebrate, and vertebrate fossil specimens from the Green River Formation. Because of the lack of geographic coordinates associated with these records, it is not known whether these specimens were collected from inside or outside of the study area, but they do corroborate the paleontological sensitivity of the geologic units within it.

3.8 RECREATION

3.8.1 REGIONAL OVERVIEW

Public lands within Uintah and Duchesne counties provide diverse recreational opportunities such as boating and fishing on the Green and White Rivers, off-highway vehicle (OHV) use, hunting, sightseeing and wildlife viewing, hiking, and dispersed camping. Some of the major attractions in the region are the San Rafael Swell, the Book Cliffs-Westwater Area, Nine Mile Canyon, Desolation Canyon, Flaming Gorge National Recreation Area, Price Canyon Recreation

Area, and Dinosaur National Monument. The region attracts recreational users from throughout the Uinta Basin, as well as from western Colorado, Wyoming, Idaho, and Utah's heavily populated Wasatch Front.

3.8.2 RECREATIONAL OPPORTUNITIES

The BLM's basic units of recreation management are the Special Recreation Management Area (SRMA) and the Extensive Recreation Management Area (ERMA). An SRMA is an area where recreation is emphasized. Within an ERMA, recreation is generally unstructured and dispersed, minimal recreation-related investments are required, and there are minimal regulatory constraints (BLM 2005a). ERMAs generally cover all areas that are not designated as SRMAs. The majority of the project area lies within the ERMA; however, popular recreational destinations in the project area include Nine Mile Canyon Backcountry Byway, Nine Mile Canyon, Desolation Canyon, and Pariette Wetlands. These four areas provide recreational opportunities to river rafters, scenic drivers, waterfowl hunters, and bird watchers each year. In addition, land approximately 3 miles east and west of Wells Draw on the bench above Nine Mile Canyon is used by the wilderness therapy group Second Nature for its operations. OHV riding and hunting are both common, but dispersed, activities in the project area.

There are no data available for ambient noise levels in the project area. However, based on values reported for the Glen Canyon National Recreation Area (a similar recreation environment to some of the least developed parts of the project area), average, hourly noise levels begin at 25 dBA at 7:00 am, steadily increase to approximately 45 dBA by noon, slowly decrease to 30 dBA by 6:00 pm, and then decrease further to 25 dBA through the rest of the evening and night (BLM 2008d). The higher noise levels during the day are attributed mostly to high wind speeds. Based on these data, a night noise level in the Nine Mile Canyon SRMA, the Green River corridor, and other remote locations in the project area may be 25 dBA, and the daytime level may be 30–45 dBA, depending mostly on wind conditions. In areas where there is ongoing well development, noise levels may range from 81 to 88 dBA at 50 feet from the source. Background noise would be higher along transportation corridors, such as the Sand Wash Road and at the Sand Wash campground, where there are concentrations of vehicles moving in and out of the area and river runners preparing to launch. Table 3-17 shows typical sound levels measured in various environmental settings, and shows that noise levels of less than 40 dBA give the subjective impression of "quiet" (Beranek 1988). In an outdoor setting, noise levels of 55 dBA and below are identified as levels that would not cause interference in outdoor activities and are also the requisite threshold to protect public health and welfare with an adequate margin of safety (EPA 1974). The predominant noise sources in undeveloped portions of the project area during the daytime would be general environmental ambient sounds including rustling vegetation, birds, and occasionally aircraft in the distance and insects. In developed portions, noise sources would be generators, pumps, vehicles, drill rigs, and construction equipment. Noise levels in developed areas would depend on the level and proximity of development activities.

Table 3-17. Typical Sound Levels Measured in the Environment and Industry

Example Noise Source or Noise Environment	A-weighted Sound Levels (dBA)	Subjective Impression
Shotgun (at shooter's ear) or on a carrier flight deck	140	Painfully loud
Civil defense siren (100 feet)	130	–
Jet takeoff (200 feet)	120	Threshold of pain
Loud rock music	110	–
Pile driver (50 feet)	100	Very loud
Ambulance siren (100 feet) or in a boiler room	90	–
Pneumatic drill (50 feet) or in a noisy restaurant	80	–
Busy traffic; hair dryer	70	Moderately loud
Normal conversation (5 feet) or in a data processing center	60	–
Light traffic (100 feet); rainfall or in a private business office	50	–
Bird calls (distant) or in an average living room or library	40	Quiet
Soft whisper (5 feet); rustling leaves or inside a quiet bedroom	30	–
In a recording studio	20	–
Normal breathing	10	Threshold of hearing

Source: Beranek 1998.

3.8.3 Recreation Use in Special Recreation Management Areas

3.8.3.1 Nine Mile Canyon SRMA

Nine Mile Canyon (including the land within the canyon, as well as the surrounding mesas) is managed by the BLM as an SRMA to protect cultural values and scenic vistas (BLM 2008c). Most of the SRMA is located between the Duchesne/Carbon County line and the Nine Mile Canyon Road to the south, and the Wrinkle Road to the north. This SRMA intersects the project area along the project area's southern boundary. Approximately 32,552 acres of Nine Mile Canyon that are managed as an SRMA lie inside the boundaries of the project area (Map 14). Nine Mile Canyon is noted for containing the highest concentration of petroglyphs in the United States (BLM 2005a). Historically, the canyon was a stage and freight route; remains of stage stops, roadhouses, and an old telegraph line are also present. The substantial amount of rock art, Fremont cultural artifacts, Ute tribal remains, and historical artifacts located in the SRMA has prompted consideration of the area as a National Historic District under the National Historic Preservation Act. Cultural resources within Nine Mile Canyon are also protected by the Antiquities Act, which prohibits excavations or acts that may injure or destroy any historic or prehistoric ruins, dwellings, or other structures (BLM 2007c). Nine Mile Canyon Road is a popular touring route on weekends in the spring and summer. Travel through the canyon is possible along a narrow, unpaved road suitable for most passenger and small recreational vehicles in fair weather. Due to the unique and rare cultural and natural resources within the canyon, Nine Mile Canyon Road and its associated access roads have been designated as a Backcountry Byway. Responding to the 1989 President's Commission on American Outdoors, the BLM began designating backcountry byways to highlight an area's special recreational and scenic values, and to increase public awareness of its lands and resources. Visitor services are available in the canyon, but limited, and camping is not allowed except at a private facility near the top of the canyon called Nine Mile Ranch (BLM 2007d).

Within Nine Mile Canyon and its tributary canyons, all motorized (OHV) and mechanized (mountain bike) activity is restricted to existing roads (mostly informal "two-tracks"). Though few mountain bikers use the Nine Mile Canyon area, OHV use is very common (see Section 3.8.4.2., OHV Recreation). The most popular routes for biking and OHV use include North Franks Canyon (a dry wash), Dry Canyon, Cottonwood Canyon, Prickly Pear Canyon, and Harmon Canyon. Dogs are allowed in Nine Mile Canyon, but must be kept under control at all times and must not disturb wildlife (BLM 2007d).

A large portion of Nine Mile Canyon SRMA (19,658 acres) was inventoried by BLM in 2007 (2007h) and was determined to provide opportunities for primitive/unconfined recreation (see Map 14). Areas that provide outstanding opportunities for primitive recreation are typically large, roadless, and mostly undeveloped landscapes. They may also contain cultural, scenic, geologic, botanical, or wildlife values that supplement the recreational opportunities. Adjacent roadless and undeveloped landscapes present in the Desolation Canyon Wilderness Study Area (WSA) to the south and east of the SRMA enhance this recreation setting and its opportunities.

A large portion of the SRMA provides a setting that supports primitive, non-motorized, and undeveloped recreation opportunities, including hiking, horseback riding, climbing, river floating, fishing, viewing/studying cultural and historic sites, viewing wildlife, and viewing scenic landscapes. This is an expansive landscape, accessible mostly by foot, horseback, or boat. The large size of the area, coupled with a diverse landform and variety of vegetation communities, provides a setting where visitors can be alone and isolated from the outside world and a setting where visitors can experience personal challenge and accomplishment. This setting also has historic and pre-historic cultures, the exploration of the Colorado River system by Powell, and pioneer settlement. This history provides today's visitor a sense and appreciation for difficulties of early cultures and pioneers, and of the importance of this place in American history.

While much of this area is unroaded and undeveloped, vehicle routes are present in and adjacent to the SRMA. These routes provide opportunities for back country driving and vehicle-supported camping in an undeveloped setting.

3.8.4 Recreation Use in Extensive Recreation Management Areas (ERMAs)

Areas not managed as SRMAs are managed as part of the Vernal ERMA for dispersed recreation uses that require minimal facility development. Within the project area, 174,018 acres are managed as part of the ERMA. Much of the ERMA's landscape is a roaded and developed. Many miles of roads (of varying quality) traverse the ERMA, providing access for oil and gas development and production, livestock grazing and other public land uses, and recreation destinations such as Pariette Wetlands, the Green River, and Nine Mile Canyon. Oil and gas development has left its mark on the land in the form of roads, well pads, pipelines, compressor stations, and power lines. However, while the landscape exhibits a presence of human development, it still retains some of its original, basic character.

The ERMA setting provides opportunities for a variety of motorized and non-motorized recreation activities. Motorized activities include backcountry driving and vehicle-supported camping, picnicking, fishing, wildlife viewing, and sightseeing. Non-motorized activities include hiking, mountain biking, hunting, river floating, fishing, and wildlife viewing. A portion of the ERMA east and west of the Little Desert Road is part of the area inventoried and found to provide opportunities for primitive/unconfined recreation (BLM 2007h). The recreation activities and experiences this area provides are the same as described in the SRMA section above.

The following are popular recreation opportunities and destinations in both the Nine Mile Canyon SRMA and Vernal ERMA of the project area.

3.8.4.1 Hunting and Fishing

The project area lies within one of the premier Rocky Mountain elk hunting regions in Utah. The herd of elk in this region is estimated at around 1,000 individuals, and only a few hunting permits are awarded via lottery each autumn during the rut (four for archery, nine for rifle, and two non-resident permits during two weeks in September and one week in November). Because being chosen for a permit is rare, most elk hunters stay out on the land for their full allotted time (approximately one week). Hunters generally drive a truck out to their desired site, set up a staging area, call in elk using a hand-held bull-call device, and select from among 10–50 bulls a day that come within range. Once an animal is killed, hunters often drive an OHV overland from their camp or truck to retrieve it. Over a period of years, elk hunting occurs diffusely across the entire project area; however, hunters go where the herd is, and are often relatively concentrated in one area during a particular hunting period. A popular winter habitat for Rocky Mountain elk is in the northwest corner of the project area near Wells Draw, though this does not necessarily indicate the most likely location of the herd during the rut in the fall.

Aside from elk hunting, low levels of waterfowl hunting occur in the project area. On the opening weekend of waterfowl season, 50–80 hunters can be found at the Pariette Wetlands hunting ducks and geese. On subsequent weekends throughout the season, hunters trickle onto the refuge (see Section 3.8.4.4., Wetlands Recreation). Waterfowl hunters are generally not found in any other parts of the project area.

Recreational fishing is uncommon but present along the Green River adjacent to the project area. The most accessible sections of the river for fishing are its confluence with Pariette Draw (in the northeast corner of the project area) and around the Sand Wash Ranger Station (in the southeast corner, where river runners put-in for trips through Desolation Canyon). The rest of the Green River, between Pariette and Sand Wash, is largely inaccessible, and attracts only the occasional angler.

3.8.4.2 OHV Recreation

According to the Utah Department of Motor Vehicles the number of statewide OHV permits issued between 1988 and 1998 increased from approximately 20,000 to 70,000. Permits have continued to increase since 1998, with 183,543 registered OHVs in Utah in 2008 (UDMV 2008). Current OHV registrations within Uintah County total 1,954, while Duchesne County has 808 permitted OHVs. The use of OHVs in and around the project area will likely continue to increase as new trails are officially identified and the State of Utah continues to promote OHV recreation on public lands.

Within the Vernal FO, OHV use is designated as either Open, Limited, or Closed. In areas Open to OHVs, where there are no compelling resource protection needs, user conflicts, or public safety issues, motorized access can occur at any time in any place. A designation of Limited restricts OHV use to meet specific resource management objectives. Limitations may be placed on the number or type of vehicles, time and season of use, or specific routes. Areas are designated as Closed to OHV use to protect resources, ensure visitor safety, or reduce user conflicts (BLM 2006e).

Practically all of the public land within the project area is designated as OHV Limited (99.9%), with a remaining small portion of the area designated as Closed to OHV use (see Map 14; Table 3-18).

Table 3-18. Acres and Percentage of Project Area Open, Limited, and Closed to OHV Use

OHV Use Designation	Acres in Project Area	Percentage in Project Area
Open to overland OHV use	0	0
Limited to designated routes	177,552	99.9%
Closed to OHVs	4	<0.1%
Total	**177,556**	**100.0%**

Though OHV use is dispersed throughout most of the project area, it is quite popular in and around Nine Mile Canyon. A popular OHV route begins at the southern end of Wells Draw, heads east along Nine Mile Canyon Road, and circles back around via Wrinkle Road and/or North Franks Canyon. Popular side trips from the main canyon include Prickly Pear Canyon, Dry Canyon, and Cottonwood Canyon. Another popular OHV route commonly called East/West Pipeline Road runs along the flat northern rim of Nine Mile Canyon. The Vernal RMP has designated this as an area where OHVs are limited year-round to roads and trails, though there is some evidence of overland travel through vegetation and not on a defined track.

3.8.4.3 River Recreation

Portions of the Green River are popular among river rafters, kayakers, and shore fishermen. The boating season on the Green River runs from approximately March 15 to November 15, though commercial outfitters run most of their trips between Memorial Day and Labor Day each year. The bulk of commercial and private boating use occurs on two stretches of the river, as discussed below.

The 84-mile Desolation Canyon portion of the river begins at the Sand Wash put-in (boat launch), located just inside the southeastern boundary of the project area. The Desolation Canyon section of the Green River is very popular with rafters and kayakers; more than two-dozen commercial guide companies run trips out of the Sand Wash put-in (BLM 2007d). According to the BLM Price FO, 3,752 private boaters put in at Sand Wash during the 2005 river-running season, while approximately 2,000 individuals (guests and guides) participated in commercial boating trips (personal communication between Kendy Radasky, SWCA, and Amy Adams, BLM Price FO, 2006). The remote Sand Wash Ranger Station is located adjacent to the put-in; both are accessed via a series of dirt roads in the southeastern corner of the project area. A campground is located at Sand Wash and is typically used by river runners prior to launch.

Twenty-three miles of the eastern project boundary runs directly adjacent to the Green River (immediately upstream of the Sand Wash put-in). Though this stretch of river is occasionally used by boaters and fishermen, recreational use is not nearly as frequent as in Desolation Canyon below the Sand Wash put-in.

3.8.4.4 Wetlands Recreation

The Pariette Wetlands Complex ACEC is located in the northeast corner of the project area, in Pariette Draw (approximately 24 miles southwest of Vernal). Prior to 1972, the perennial creek running through Pariette Draw fanned out near its confluence with the Green River into a small area of wetlands and riparian habitat. BLM wildlife biologists recognized an opportunity to increase waterfowl production and seasonal habitat in the desert region of the Uinta Basin, and dug a series of 23 gravity-fed ponds between 1972 and 1975 (Utah Travel Industry 2007). The completed Pariette Wetlands Complex now supports more than 1,800 ducks and 100 geese during spring and fall migration each year, as well as more than 105 bird and mammal species. The ACEC encompasses 10,437 acres, of which more than 2,000 acres are designated as open water, riparian, or marshy wetlands (BLM 2007e; BLM 2008c).

The BLM manages Pariette Wetlands not only for waterfowl, but also for humans who enjoy the recreational pursuits of hunting, bird watching, and fishing. According to the BLM Vernal FO, most visitors arrive on the opening weekend of waterfowl hunting season, when the wetland experiences approximately 60–70 visitor days. Hunting visitation declines substantially over the remainder of the season, with an average of 5–10 hunters every month traveling to the area. Approximately a dozen bird watchers visit the wetlands each spring; another dozen return to observe fall migration of shorebirds and waterfowl. The occasional group of deer or antelope hunters uses the uplands surrounding the Pariette Wetlands each year.

The BLM encourages visitation by providing directions to the site, road conditions, options for group tours, and hunting and fishing regulations. In total, an estimated 100–150 people visit the site each year via the partially graveled dirt roads leading from Fort Duchesne and Myton, Utah.

3.8.4.5 Hiking

Hiking is infrequent and dispersed within the project area. With the exception of Nine Mile Canyon, there are few attractions for hikers. There are 5 miles of perennial streams in Pariette Draw and two seeps or springs. The Green River also runs along the project area's eastern border, therefore water for use by hikers and campers is sporadically available but must be treated prior to human consumption. Sightseeing visitors who drive vehicles through Nine Mile Canyon often leave their vehicles to view rock art or other cultural points of interest, though they usually do not stray far from the road.

The Duchesne-based wilderness therapy group Second Nature runs outdoor therapy camps within the Nine Mile Canyon area between November and May each year. The characteristic scope of activities includes shuttling youth and counselors in vehicles from Duchesne to primitive camping areas, where they typically spend 1–3 months living on and walking the land. The group's wilderness camps are located on Cowboy Bench, just above Nine Mile Canyon and within 3 miles east or west of Wells Draw. A group generally consists of nine students and three to four counselors, and there are usually two or three groups on the land at any one time. Second Nature makes approximately 20–30 vehicle trips each month along Highway 91 and Wells Draw to provide the youth and staff on the land with food, medical supplies, and transportation to and from Duchesne (personal communication between Kendy Radasky, SWCA, and Sean Woodard, Second Nature, 2006).

3.9 SOCIOECONOMICS

The project area is located in both Uintah and Duchesne counties. The natural gas development activities resulting from this project would have impacts on both counties. Therefore, the socioeconomic analysis will examine the current social and economic conditions of both counties.

The land use practices of Utah's northeastern Uintah and Duchesne counties have traditionally been linked to resource-based production. The agriculture and mining sectors have shaped the development of communities in the Uinta Basin, and continue to contribute to the social and economic values of that region. The citizens of the local communities enjoy the quality of life that the rural, resource-based land uses bring to the two counties.

Oil and gas development has been an important economic factor in the Uintah and Duchesne County economies for more than 40 years. While the demand for oil and gas development has led to the growth and decline in the local economy and population, the development remains an important industry for Uintah and Duchesne County economies. Other important economic contributors include government services, trade, utilities, and transportation. Recreation and tourism activities such as mountain biking and river rafting have recently contributed to an increase in local revenue.

3.9.1 POPULATION GROWTH, DISTRIBUTION, AND CHARACTERISTICS

The population of Uintah and Duchesne counties has grown gradually since the 1990s. Between 1990 and 2000, the populations of both counties increased 14%. Growth in these counties has lagged behind the state growth rate for the same period, which increased 26%. Population in the two counties has continued to increase since 2000, with a 4% increase in both Uintah and Duchesne County populations in 2004. Table 3-19 compares 1990, 2000, and 2004 population rates, with the State of Utah included for comparative purposes.

The largest population concentration in Uintah County is in the city of Vernal, with a population of 7,939 in 2004. The majority of Uintah County's population resides in the unincorporated areas of the county. In 2004, 16,690 of the county's total population (26,224) lived outside the county's larger cities (Vernal, Ballard, and Naples). In terms of racial composition, 85.9% of Uintah County's population is Caucasian, 9.4% is Native American, and the remaining 4.7% is Hispanic/Latino and of other ethnicities (U.S. Census Bureau 2006). In Duchesne County, the largest population concentration is in Roosevelt, with a population of 4,437. Approximately 8,232 of the county's 14,933 residents live outside the cities of Altamont, Duchesne, Myton, Roosevelt, and Tabiona (UDWS 2005a, 2005b). In terms of racial composition, approximately 88.8% of Duchesne County's population is Caucasian, 7.2% is Native American, and the remaining 4% is Hispanic/Latino and of other ethnicities (U.S. Census Bureau 2006).

Table 3-19. Uintah and Duchesne County Population 1990–2004

	Population		
	1990	**2000**	**2004**
Uintah County	22,111	25,224	26,224
Duchesne County	12,645	14,371	14,933
State of Utah	1,772,850	2,233,169	2,469,230

Source: U.S. Census Bureau (1990, 2000a, 2006).

3.9.1.1 LABOR FORCE CHARACTERISTICS

The major sources of employment in the Uinta Basin include mining and oil and gas industries; government at the federal, state, and local level; wholesale and retail trade; and services. The recent surge in the mining industry has created an increased demand for goods and services in both Uintah and Duchesne counties, directly creating additional jobs (UDWS 2005a).

Some 135 people are currently employed by the Ute Tribal Enterprises LLC business operation. Seasonal unemployment is often high on the reservation, leaving jobs sometimes few and far between. The tribe-owned LLC business operation not only provides jobs, it provide services needed in the community such as the Ute Plaza Grocery Store, LLC; Ute Petroleum, LLC in Fort Duchesne and Myton; Agricultural Products, LLC, which owns the largest cattle feed yard in Utah; Ute Oil Field Water Hauling and Trucking Services, LLC, which provides services to the oil patch; and the Ute Finance Company, LLC, a rural business development and re-lending company that supports local entrepreneurs who want to start their own business (Ute Tribe 2007).

The non-agricultural labor force in Uintah County was 10,882 in 2004, and the average monthly non-farm wage was $2,592. In 2005, mining-related jobs accounted for 19% of the labor force in Uintah County. Wages in mining-related operations are substantially higher than non-mining industry wages. The average monthly wage for mining was $4,669, in contrast to retail trade and manufacturing wages, which were $1,653 and $1,808, respectively (UDWS 2006).

Duchesne County has experienced similar changes in its employment base in the past several decades. The non-agricultural labor force in Duchesne County was 5,404 in 2004 and the average monthly non-farm wage was $2,254. In 2005, mining-related jobs accounted for 9% of the labor force in Duchesne County. Wages in mining-related operations are substantially higher than non-mining industry wages. The average monthly wage for mining was $4,721, in contrast to retail trade and manufacturing wages, which were $1,375 and $2,531, respectively (UDWS 2006).

3.9.2 EMPLOYMENT AND INCOME

Uintah and Duchesne counties have experienced considerable changes in their employment base in the past 50 years. Initially, agriculture-related activities such as ranching and farming dominated the economy. Then, during the second half of the twentieth century, the development of oil and gas reserves provided a major contribution to growth. Now, retail trade, private services, and government services collectively are major contributors to the counties' economies. This evolution in employment base demonstrates the counties' shift from an agrarian economy to one that services and supports oil and gas pursuits and the boom in public land industries.

Unemployment rates in Uintah and Duchesne counties have generally decreased since the 1980s. After a 17.7% unemployment rate in 1984, Uintah County has experienced fairly continual reductions in unemployment to reach 5.2% in 2004. Duchesne County's unemployment rates follow similar trends, although the rates are consistently higher than Uintah County's. In 2004, Duchesne County's unemployment rate was 6.8%. Both counties' unemployment rates were higher than the State of Utah's 4.7% in 2004.

Per capita income, or average income per person, in Uintah County has increased at an average annual rate of 7.9% from $8,379 in 1990 to $24,234 in 2004 (UDWS 2005b). Duchesne County's per capita income has increased an average of 7.7% annually from $8,197 in 1990 to $23,081 in 2004 (UDWS 2005a). Both counties' per capita income levels are slightly lower than the State of Utah's average of $26,603.

Table 3-20 compares 1990 and 2004 labor force, unemployment, and income levels in Uintah and Duchesne counties. State of Utah numbers are given for comparative purposes.

Table 3-20. Uintah and Duchesne County Employment and Income 1990–2000

	Civilian Labor Force		Unemployment Rate (%)		Per Capita Income ($)	
	1990	2004	1990	2004	1990	2004
Uintah County	8,799	13,964	5.6	5.2	8,379	24,234
Duchesne County	4,931	6,247	7.4	6.8	8,197	23,081
State of Utah	816,258	1,104,431	4.3	4.7	11,029	26,603

Sources: Utah Division of Workforce Services (UDWS) 2005a, 2005b; U.S. Census Bureau 1990, 2006.

3.9.3 Housing

Given the recent oil and gas boom in the Uintah Basin, there is a substantial housing shortage in the area. Hotels, homes, and apartments are all full, with waiting lists for rental opportunities. Due to the shortage, oil and gas companies have even provided mobile homes on the project sites to provide housing for workers. Companies are attempting to build new housing to accommodate the need (personal communication between Elisha Wardle, SWCA, and Bill Johnson, Uintah County–Vernal City Economic Development, 2006).

3.9.4 Public Services and Infrastructure

The BLM is responsible for law enforcement and fire response on federal lands within the project area. The Uintah or Duchesne County Sheriff may respond, depending on the nature of the crime or emergency. Medical services are provided by Ashley Valley Medical Center in Vernal. Ambulance service to the medical center is available via Gold Cross Ambulance, a contract service provider. In situations requiring rapid patient evacuation, CareFlight helicopter service to St. Mary's Hospital in Grand Junction, Colorado, is available.

Duchesne County has 398 miles of paved roads and more than 700 miles of gravel roads to maintain each year. According to the Duchesne County Web site, the road department has 24 employees, made up of truck drivers, operators, mechanics, a secretary, and a supervisor (Duchesne County 2005b). Uintah County has a total of 1,318 miles of road, which consist of 512 miles of paved roads and more than 700 miles of gravel road. Their road department has 28 employees (Uintah County 2003). In the winter, road department personnel are kept busy with snow removal, crushing natural asphalt, and building up roads for summertime paving. In the summer they grade and patch roads, crush gravel, cut weeds along roadsides, and oil and gravel roads. Duchesne County has its own county-owned natural asphalt pit.

3.9.5 PUBLIC COSTS AND REVENUE

Revenues from oil and gas play an important role in the area's economy, and the contribution from oil and gas revenues within Uintah and Duchesne counties is expected to grow in the near future. On federal lands, 12.5% of the production revenue from oil and gas operations is allocated to the federal government in royalties. Of that total, 10% pays administrative fees, 45% is allocated to the federal government (into the Reclamation and General Funds), and 45% is paid back to the state (BLM 2005b). The state then redistributes 40% of the royalty back to the county of origin, and the majority of the balance is used to fund other local projects, such as transportation and water projects.

Annual taxes paid to state and local governments by developers contribute to the local economy. The following is an explanation of some of the taxes paid by Gasco and other developers. A severance tax based on production is paid to the state and ranges 3–5% of production revenue. In 2005, Gasco's well count was 34 oil wells and 41 gas wells. The production of these 75 wells led to the payment of $237,648 in severance tax to the State of Utah.

Two types of *ad valorem* (or property) taxes are paid to the county. The first type is based either on the production of the well or the depreciated value of the equipment on the property, whichever is higher. The second type of *ad valorem* tax is based on the assessed value of the land (BLM 2005b). Because Gasco does not own the property where the wells are located, *ad valorem* taxes are assessed according to production or the deprecated value of the equipment on-site. In 2005, Gasco paid approximately $44,402 to the Utah State Tax Commission in *ad valorem* taxes for the production of 75 wells.

Oil and gas operations also contribute revenue in the form of worker payroll taxes, and sales taxes on goods and services used. Based on the 75 wells in operation on 2005, Gasco's contribution to local sales and use taxes totaled $74,295. Table 3-21 summarizes the amount of operational taxes Gasco paid to local and federal agencies in 2005.

Table 3-21. Gasco's 2005 Tax Contributions

Descriptions	Recipient	Amount
Federal royalties	Federal Minerals Management Service	$2,274,755
State royalties	State of Utah	$1,095,221
Ad valorem taxes	Utah State Tax Commission	$44,402
Conservation taxes	Utah State Tax Commission	$37,472
Mineral withholding taxes	Utah State Tax Commission	$395,631
Severance taxes	Utah State Tax Commission	$237,648
Payroll taxes	Utah State Tax Commission	$274,440*
Local sales and use taxes	Local counties and communities	$74,295**

* This number represents UT/1099 gross payments to consultants.

** Sales tax rates for Duchesne County and Uintah County is 6.0% and 6.5%, respectively.

Source: Personal communication between J. Kamp, Gasco, and L. Burch, SWCA, 2006.

In general, royalty payments to Uintah and Duchesne counties from all natural resource development activities have increased continuously in recent years. In 2001, Uintah County received $16,427,143.09 in federal royalty revenue, and Duchesne County received $2,061,107.30. In 2006, Uintah County received $88,348,096.86 and Duchesne County received $9,300,325.44 (Utah State Tax Commission 2007). Royalty payments to the counties are likely to remain high in the near future, until the resource is depleted or the demand for the natural resources decreases.

Uintah County collected approximately $25 million in total, local, centrally assessed, and fee in lieu of property taxes in 2005. Approximately $4.1 million or 19% of this total was oil and gas extraction property taxes. In Duchesne County, $13 million was paid in total property taxes in 2005. Of this total $1.7 million or 13% was oil and gas extraction property taxes (Utah State Tax Commission 2006).

On School and Institutional Trust Lands Administration (SITLA) lands, 12.5% of the production revenue is paid to the state government in royalties for deposit into a permanent school trust fund. Interest on this fund is redistributed to the schools on a per capita basis.

On privately owned lands (fee properties), royalty revenues are paid according to individual contracts. Gasco typically pays 15% in royalties to private landowners who own property where Gasco's wells are located.

3.9.6 Tourism and Recreation

Tourism also contributes to the economies of Uintah and Duchesne counties. Visitors are drawn to the vast open space found in eastern Utah. Tourists enjoy hunting, fishing, river rafting, hiking and a number of other activities available in the area. As a result, traveler spending is considered an economic benefit to the area. According to the Utah Office of Tourism, spending by travelers in Uintah County increased 40% from 2002 to 2003, with $51.6 million spent in 2002 and $72.6 million spent in 2003 (Utah Travel Industry 2006). Local tax revenue from tourist spending in Uintah County also increased 40.7%, from $1.08 million in 2002 to $1.52 in 2003. In contrast, employment related to travel and tourism decreased 2%, from 1,661 jobs in 2002 to 1,628 jobs in 2003 (Utah State Department of Tourism 2004). The dramatic increase in tourism-related spending and revenue is likely attributed to recent surge in oil and gas development in the region. Temporary workers that drill, complete, and service the wells stay in local hotels and patronize local businesses similar to a tourist in the area.

Duchesne County sees remarkably less revenue and tourist-related employment compared to Uintah County. In 2002, spending by travelers totaled $22.0 million, and decreased 0.9% in 2003 to $21.8 million. Local tax revenue from traveler spending in Duchesne County also decreased, from $461,400 in 2002 to $456,000 in 2003. Travel- and tourism-related employment declined 3.1%, from 717 jobs in 2002 to 695 jobs in 2003 (Utah State Department of Tourism 2004). Although Duchesne County sees some of the revenue and employment from tourist-related services, most of the services (hotels, restaurants, retail goods, and service stores) are located in the town of Vernal in Uintah County. Nine Mile Canyon is an area with historical, cultural, recreational, scenic, and biological values. Current special designations associated with the canyon and its environs include ACEC, SRMA, Utah State Scenic Byway, and the BLM Backcountry Byway (BLM 2010a). The canyon is noted for containing the highest concentration of petroglyphs in the United States. As stated in Section 3.8.3.1, 32,552 acres of the Nine Mile Canyon SRMA lies in the project area.

The Desolation Canyon section of the Green River, located southwest of the project area, is accessed via Sand Wash Road in the project area; it provides river running and primitive recreation experiences. Private and commercial companies run the 84-mile stretch of river from mid-March to mid-November each year. In 2005, approximately 5,752 rafters and kayakers floated the Desolation Canyon portion of the Green River (see Section 3.8.4.3).

The eastern project boundary runs directly adjacent to the Green River (immediately upstream of the Sand Wash put-in). Although this stretch of river is occasionally used by boaters and fishermen, recreational use of this stretch of the Green River is substantially less frequent that the Desolation Canyon stretch. No user numbers are available for this stretch of the river.

Beneficial, economic impacts from visitor expenditures occur where people stop and stay while visiting an attraction. The routes that people take to access attractions determine where expenditures occur. Most of the regional economic impact from tourism in Nine Mile Canyon is likely to occur in Carbon County (BLM 2010a). The economic impact of river rafting in Desolation Canyon would likely be dispersed through Uintah, Duchesne, and Carbon counties.

The economic impacts from recreation-based tourism are included in the spending and employment numbers in the opening paragraphs of this section. However, the reports from the Utah State Department of Tourism do not detail what tourist-based activities generated the spending or employment. Tourism dollars could be generated from river rafters, bird watchers, or oil and gas development employees staying at local motels. Although the exact amount of recreation-based tourism revenue is difficult to distinguish, a recent report on the economic contribution of river rafting provides an estimate of recreation-specific tourism dollars generated as a result of the river rafting on the Green River. Similar to the 2005 estimate, approximately 6,000 boaters floated Desolation Canyon in 1998, the year for which the best economic data on river trips is available (BLM 2010a). The average duration of the trip was six days. The average cost incurred per person was $605.20 (inflated to 2011 dollars) for the six-day trip. The average cost per person was broken down by trip type (i.e., commercial or private boats). Boaters on commercial trips spent an average of $1,617.65 and boaters on private trips spent an average of $288.91. The study also gathered information on expenditures of Utah residents and non-Utah residents. The per-person expenditure of Utah residents was $138.43 and a non-resident's expenditure was $637.31 (BLM 2010a).

3.9.7 Environmental Justice

Consideration of environmental justice (EJ) issues is mandated by Executive Order (EO) 12898, which was published on February 11, 1994. This EO requires that all federal agencies incorporate EJ into their mission by "identifying and addressing…disproportionately high and adverse human health or environmental effects of [their] programs, policies and activities on minority and low-income populations in the United States" (EPA 1994).

The goal of the EO is to ensure the following:

- That all people are treated fairly with respect to the development and enforcement of protective environmental laws, regulations, and policies
- That potentially affected community residents are meaningfully involved in the decisions that would affect their environment and/or their health

The EPA defines a community with potential EJ populations as one that has a greater percentage of minority or low-income populations than an identified reference community (EPA 1994). The standard for identifying minority populations is either 1) the minority population of the affected area exceeds 50% or 2) the minority population percentage of the affected area is "meaningfully greater" than the minority population percentage in the general population or other appropriate unit of geographic analysis, such as a reference community (CEQ 1997). The EPA has not specified what percentage of the population can be characterized as "meaningfully greater" in order to define an EJ population. For the purposes of this analysis, it is assumed that if the affected area's minority and/or poverty status population is 50% or greater than the reference community, there is likely an EJ population of concern. The BLM standard for identifying a low-income population is the poverty level used by the U.S. Census Bureau (CEQ 1997). The poverty threshold level for an individual in 2000 was $8,794.00 (U.S. Census Bureau 2000b).

Table 3-22. shows the proportions of low-income, minority, and tribal populations in selected communities near the project area in Duchesne and Uintah counties. For the purposes of assessing the presence of EJ populations, Duchesne and Uintah counties and cities therein are considered the reference communities that the smaller more rural areas near the project area are compared to. State of Utah percentages are also provided for comparative purposes. The table includes the main communities in each county near the project area and three communities on the Uintah and Ouray Reservation. The reservation communities are Fort Duchesne, Randlett, and Whiterocks. These communities are referred to as Census Designated Places (CDPs), which are defined as unincorporated communities with boundaries defined for purposes of enumeration during the decennial census.

Resident populations with a poverty rate over 50% exist in the Fort Duchesne, Randlett, and Whiterocks CDPs. Elsewhere in Duchesne and Uintah counties, the poverty rate varies from 38.4% in Myton City to 12.4% in Duchesne City, compared to 9.4% in the State of Utah. The 38.4% poverty rate in Myton City is more than 50% greater than the reference community of Duchesne County and 75% greater than the state average. Table 3-22. shows that Fort Duchesne, Randlett, and Whiterocks are also minority communities, each having populations of more than 90% minority, principally American Indian. The concentration of the American Indian population in the three CDPs is consistent with a 1994 survey of the Ute Tribe members in which 64% of the respondents living on the reservation reported their residence in Whiterocks, 16% in Fort Duchesne, and 85% in Randlett. The remaining survey respondents cited places of residence not enumerated by the U.S. Census Bureau (BLM 2011a). The 32.0% minority population in Myton City is 65% greater than the reference community of Duchesne County and 54% greater than the state average. The minority population percentages in the other rural areas near project area are not meaningfully higher than the reference communities of Duchesne and Uintah counties or the state average.

In summary, economic demographic data from the 2000 census indicate several concentrations of minority and/or low-income populations residing north of the project area, thus meeting the BLM standard for analysis of potential EJ communities (Map 36). In Table 3-22. , the EJ communities are highlighted in bold font and italicized. The reference communities from which the determinations were based are highlighted in bold font only.

Table 3-22. Poverty and Minority Population Characteristics of Selected Communities in Duchesne and Uintah Counties, 2000

Population	Percent of Total Population in Poverty	Minority as Percentage of Total Population[1]	Percent American Indian
Duchesne County	**16.8**	**11.2**	**5.4**
Duchesne City	12.4	5.0	0.7
Roosevelt	22.1	14.9	8.1
Myton	***38.4***	***32.0***	***11.1***
Uintah County	**14.5**	**14.1**	**9.4**
Vernal	14.8	8.2	2.3
Naples	6.7	4.1	0.8
Fort Duchesne CDP[2]	***54.6***	***94.8***	***90.2***
Randlett CDP	***54.5***	***96.4***	***93.3***
White Rocks CDP	***70.9***	***94.4***	***93.8***
State of Utah	9.4	14.7	1.3

[1]The total minority population comprises all persons of a minority racial identity plus persons of Hispanic origin not already included because of race.

[2] CDP - Census Designated Place

Note: Reference Communities are highlighted in **bold font.** EJ communities are highlighted in **bold font and italicized.**

Source: BLM (2010a), U.S. Census Bureau (2000b).

3.10 Soils

3.10.1 Regional Overview

The project area is classified as arid to semi-arid, and the landscape consists of benches, hillslopes, toeslopes, and valley bottoms. Parent materials present include residium, colluvium, and alluvium, which are derived from the sedimentary, metamorphic quartzite, and volcanic rocks of the Uinta Mountains, Wasatch Mountains, and Tavaputs Plateau of the Book Cliffs, the boundaries of the Uinta Basin. The central portion of the Uinta Basin has an elevation between 5,000 and 5,500 feet. Soils are found from level bench locations to fairly steep slopes, and soil depths range from shallow to very deep.

3.10.2 Soil Characteristics of Greatest Management Concern

Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) data (NRCS 2006), and the *Soil Survey of Uintah Area, Utah* (NRCS 2003) were used to determine soil mapping units, soils series, and soil characteristics for the project area. Soils in this area vary widely in their characteristics. Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. Forty soil-mapping units composed of one or more soil series, are present within the project area. A brief description of each mapping unit is found in Appendix E, which summarizes the soils in the project area.

3.10.2.1 Rehabilitation Restrictions

Several reclamation-limiting factors (i.e., factors that prevent soils from being fully reclaimed following surface disturbance) are found in the project area's soils. In reclamation-limited soils, one or more factors make site reclamation difficult in semi-arid environments: alkalinity, droughty soils, soil rooting depth, salinity, available water capacity, sodium adsorption, and reclamation potential. Available water capacity refers to the amount of water available for plant uptake. Salinity refers to the amount of salt within soils that can be dissolved in surface waters. The sodium adsorption ratio refers to the amount of sodium that can be held by the soils and influence nutrient uptake. Rooting depth refers to the depth of soil, which influences how far plant roots can grow. Alkalinity refers to soil pH, and generally limits plants' ability to establish when alkalinity is higher (i.e., more basic). Finally, reclamation potential is a soil measurement that combines pH and salinity, as well as the soil's clay content and presence of course fragments, to estimate a soil's overall reclamation potential.

Reclamation-limited soils are difficult to reclaim or restore. Once they are disturbed, the impact usually is long lasting (BLM 1993b). Within the project area as a whole, these conditions affect between approximately 16% and 40% of the area's soils at the "highly restrictive" level, and between approximately 12% and 49% of the soils at the "moderately restrictive" level. The criteria used to determine the level of restriction of each soil feature are described in Table 3-23.

Table 3-23. Parameter Ranges Used to Define Soil Features Restrictive to Rehabilitation

Soil Features Restrictive to Rehabilitation	Parameters	Highly Restrictive Range	Moderately Restrictive Range
Salinity[3]	Salinity (MMHOS/CM) of surface layer	≥16	8
Sodium absorption ratio[4]	Sodium absorption ratio of surface layer	>13	4–13
Alkalinity	pH	>9.0	7.9–9.0
Rooting depth	Minimum depth to bedrock or hardpan (inches)	<10	10–20
Droughtiness[2]	Available water supply (average to 100 cm) cm/cm	<5	5–10
Water erosion hazard[1]	Kw Factor of surface layer *and* Slope	≥0.37 *and* ≥10% *or* 0.20–0.36 *and* >30%	0.20–0.36 *and* 10%–30% *or* <0.20 *and* >30%
Wind erosion hazard	Wind erodibility group of surface layer	1,2	3,4,4L
Reclamation potential[5]	pH *or* Salinity (MMHOS/CM)	≥9 *or* 8 or 16	Not defined

*Draft parameters developed by the BLM's National Science and Technology Center (BLM 2000a), SSURGO soils mapping (NRCS 2006).

[1]K Factor of surface layer adjusted for the effect of rock fragments. Slope is the maximum value for the range of slope of a soil component within a map unit.

[2]Maximum value for the range of available water capacity for the soil layer; inches of water per inches of soil.

[3]Maximum value for the range in soil salinity.

[4]Maximum value for the range in sodium adsorption ratio.

[5]Also includes the clay content and presence of course fragments.

3.10.2.1.1 SALINITY

Soil salinity can have considerable impacts on soil erosion and reclamation potential. Erosion of saline soils can also have major impacts on the water quality of downstream watersheds. Soils with electrical conductivity levels of 8 deciSeimens/meter (dS/m) or greater were considered saline in all soil surveys. Highly or moderately saline soils occur in more than 16,795 acres, or approximately 7% of the BLM-administered lands in the project area (Table 3-24).

Table 3-24. Extent of Soils with Restrictive Characteristics in the Project Area (in acres)

Restrictive Features	High Risk	Moderate Risk	Low Risk	Unknown	N/a (water)	Total Area
Excess Salt (salinity [MMHOS/CM] [surface layer])	9,564	7,231	136,238	53,126	667	206,826
Excess Sodium (sodium absorption ratio [surface layer])	43,960	102,293	6,780	53,126	667	206,826
Alkaline Soils (pH)	37,935	114,669	0	53,555	667	206,826
Droughty Soils (available water supply [average to 100 cm] cm/cm)	87,723	28,452	0	89,984	667	206,826
Rooting Depth (depth to bedrock or hardpan [in inches])	74,288	0	78,745	53,126	667	206,826
Water Erosion Hazard (Kw Factor [surface area] and slope)	213	921	151,899	53,126	667	206,826
Wind Erosion Hazard (wind erodibility group [surface layer])	507	35,735	116,791	53,126	667	206,826
Reclamation Potential Risk	94,366	0	0	111,793	667	206,826

Source: BLM (2000a).

Saline sediments that originate in the project area eventually flow into the Green River, a major tributary to the Colorado River. Salinity levels in the Colorado River are a regional, national, and international issue. Control of sediment discharged from public lands is mandated by the Colorado River Basin Salinity Control Act of 1974. Proper land use is the BLM’s preferred method of achieving salinity control, with the planning process being the principal mechanism for implementation.

3.10.2.1.2 SODIUM ABSORPTION RATIOS

Soils with high levels of sodium (sodium absorption ratios of 13 or greater) are considered sodic. Infiltration of precipitation into these soils is reduced by the dispersion of soil particles caused by the high levels of sodium. Reduced infiltration rates result in greater surface runoff rates, and increased soil erosion and sediment yields. Many sodic soils have a thin layer of suitable soil above the sodic horizon, but when this layer is disturbed or removed, the resulting impact can be irreversible (BLM 2008c). Soils with high and moderate risk potential for excess sodium occur in approximately 146,253 acres, or approximately 70% of the project area (see Table 3-24).

3.10.2.1.3 ALKALINITY

Alkaline soils are soils (mostly clay soils) with a high pH value (greater than 9), a poor soil structure, and a low water infiltration capacity. Alkaline soils are not necessarily saline. Alkaline soils can limit reclamation and revegetation potential due to a reduced nutrient and micronutrient availability. Soils with a high risk potential for alkalinity occur in approximately 37,935 acres, or approximately 18% of the project area (see Table 3-24).

3.10.2.1.4 DROUGHTINESS

Droughty soils are typically characterized by course texture, low water-holding capacity, and a minimal amount of soil organic matter. Droughty soils can therefore be prone to soil erosion and have limited reclamation potential. Droughty soils have a high occurrence potential in approximately 87,723 acres, or approximately 42% of the project area (see Table 3-24).

3.10.2.1.5 DEPTH TO BEDROCK

Depth to bedrock refers to the soil depth to fixed rock. Shallow soils are often not conducive to vegetation establishment, are prone to soil erosion, and limit reclamation potential. Soils that have a shallow depth to bedrock occur in approximately 74,288 acres, or approximately 36% of the project area (see Table 3-24).

3.10.2.1.6 EROSION HAZARDS

The *Soil Survey of Uintah Area, Utah* (NRCS 2003) rates each of the soil series as having a slight, moderate, high, or very high water and wind erosion hazards. These ratings were developed using soil erodibility and runoff factors and the Wind Erodibility Index, as defined in the National Soil Survey Handbook (NRCS 1996).

The wind and water erosion hazards become critical issues when protective vegetation is removed during and following construction activities, such as road and well-pad construction. Typically, soils found on steeper slopes have a high water erosion hazard, and soils found on gentler slopes have a low water erosion hazard. Finer-grained soils are at greater risk of wind erosion, and soils with more gravel and/or stones have a lower risk of wind erosion.

Hydrologic groups are used to estimate precipitation runoff where soils are not protected by vegetation. The groups (labeled A through D) are based on infiltration of water when soils are thoroughly wet.

In general, the slower the rate of infiltration, the greater the amount of runoff. Group A soils have high rates of infiltration when thoroughly wet; Group B soils have moderate rates of infiltration; Group C soils have a slow rate of infiltration; and Group D soils have a very slow rate of infiltration (see Appendix E).

3.10.2.1.7 Reclamation Potential

Soil reclamation potential is described by the NRCS (2005). A soil is defined as "having poor potential for reclamation" if it meets any of the following criteria:

- Clay content greater than 60%
- Coarse fragments greater than 35% by volume (because a large number of coarse fragments reduces a soil's available water-holding capacity)
- pH less than 4.5 or greater than 9.1
- Salinity greater than 9 μhos/cm[2]

3.10.2.2 Presence of Biological Soil Crusts

The presence of biological crusts in arid and semi-arid lands have a substantial influence on reducing soil erosion by both wind and water, fixing atmospheric nitrogen, retaining soil moisture, and providing a living organic surface mulch. "These crusts are a complex mosaic of cyanobacteria, green algae, lichens, mosses, microfungi, diatoms, and other bacteria" (BLM 2001). They can be used as an indicator of rangeland ecological health. Development of biological crusts is strongly influenced by soil texture, soil chemistry, and successional colonization by crustal organisms.

The type and abundance of biological crust can be used by land managers to determine the ecological history and condition of a site. Biological crusts are generally found where there are openings in the vascular plant cover and they protect those open areas from wind and water erosion.

No data exist on the distribution of biological soil crusts in the project area; however, the highest likelihood for biological soil crust occurrence appears to be under sagebrush and pinyon-juniper woodland communities, which occur on a total of approximately 54% of the project area (approximately 71,312 acres and 39,821 acres of the project area, respectively).

3.10.3 Soils Resources Summary

There are eight soil characteristics that restrict reclamation within the project area (see Table 3-24). Several of these restrictive characteristics may be present in a single location or soil unit. As shown in Table 3-24, the soils in the project area have the following characteristics:

- 1,134 acres in the project area have soils with a moderate or high water erosion hazard.
- 36,242 acres in the project area have soils with a moderate or high wind erosion hazard.
- 94,366 acres in the project area have soils at high risk for poor reclamation potential.

A total of 97,706 acres of soils in the project area have at least one of the restrictive features described above.

[2] μhos/cm = millimhos per cm, which is a measure of soil electrical conductivity.

3.11 SPECIAL DESIGNATIONS

Special management areas are congressionally and administratively designated areas, including WSRs and ACECs. There are three ACECs and two eligible WSRs in the project area. Management of the three existing ACECs in the project area focuses on resources and values that are relevant and important to each specific ACEC.

Within the project area, there are 42,603 acres currently designated as ACECs under the Vernal RMP (BLM 2008c). The Pariette Wetlands ACEC is located in the northeast corner of the project area. The Lower Green River ACEC is located throughout the eastern border of the project boundary. The Nine Mile Canyon ACEC comprises much of the project area's southern parcels. Within the project area, the Vernal RMP proposed to recommend a segment of the lower Green River for designation as a WSR. There are no wilderness study areas (WSAs) in the project area. Desolation Canyon WSA is the nearest WSA and is 2.7 miles from the project area.

3.11.1 PARIETTE WETLANDS ACEC

The 10,437-acre Pariette Wetlands ACEC (4,859 acres within the project area) comprises a wetland ecosystem that contains special status bird and plant species, including potential habitats for the federally listed Pariette cactus (*Sclerocactus brevispinus*) and Uinta Basin hookless cactus (*Sclerocactus wetlandicus*). The BLM's objectives for managing the Pariette Wetlands ACEC (BLM 2008c) are to protect the relevant and important special status bird and plant habitat as well as wetlands ecosystem values, waterfowl production, and soil.

The BLM's management prescriptions for the Pariette Wetlands ACEC emphasize seasonal and surface occupancy restrictions for protection of wildlife and plant species, protection of floodplains and erosive soils, and the management of vegetation to benefit riparian and watershed values. The development of oil and gas resources is restricted to protect the natural area. The complete list of management prescriptions for the Pariette Wetlands ACEC is found in Section E of the Vernal RMP (BLM 2008c) and is hereby incorporated by reference. Some of the leases may predate the Vernal RMP that imposed those restrictions. If that is the case, as provided in the Vernal RMP development of those leased resources cannot be precluded by the referenced restrictions (but must be in conformance with all applicable laws and regulations, such as the Endangered Species Act [ESA]).

The Pariette Wetlands ACEC was established after the majority of the underlying land was leased for oil and gas development. Consequently, there are currently more than 50 existing or approved oil and gas wells and associated access roads located within the ACEC boundary. The majority of these wells are located in uplands bounding the Pariette Draw (BLM 2005b). The Pariette Wetlands ACEC contains approximately 980 acres of riparian habitat. It is home to 516 acres of ponds that provide open-water waterfowl habitat; 3,553 acres of potential habitat for the Uinta Basin hookless cactus; and 1,313 acres of potential habitat for the Pariette cactus. The Pariette Wetlands ACEC also contains 46 acres that the USFWS and BLM have identified as a result of the 2009 Castle Peak-Eight Mile Flat EIS as core conservation areas (referred to hereafter in this document as 2009 core conservation areas) to further recovery efforts for Pariette cactus. (see Section 3.12.1.1.2.1 Pariette Cactus). The Pariette Draw watershed has no acres of highly erodible soils within the ACEC.

3.11.2 Lower Green River Corridor ACEC

The Lower Green River ACEC totals 8,470 acres (3,090 acres fall within the project area) and contains relevant and important riparian habitat, special status plant and animal species habitat, including approximately 272 acres of occupied and suitable habitat of the federally threatened clay reed mustard (*Schoenocrambe argillacea*), and high-quality scenic values. The management objective according to the Vernal RMP (BLM 2008c) is to protect the relevant and important riparian habitat and scenic values.

The ACEC management prescriptions for the area emphasize the protection of riparian and special status species through seasonal and surface occupancy restrictions and the protection of the Green River viewshed. Surface occupancy for leasable materials is restricted on all 8,470 acres to protect the listed management objectives for the Lower Green River ACEC. The complete list of management prescriptions for the Lower Green River ACEC can be found in Section E of the Vernal RMP (BLM 2008c). Some of the leases may predate the Vernal RMP that imposed those restrictions. If that is the case, as provided in the Vernal RMP development of those leased resources cannot be precluded by the referenced restrictions (but must be in conformance with all applicable laws and regulations, such as the ESA).

The Lower Green River ACEC contains approximately 1,338 acres of riparian habitat. It encompasses 5,167 acres of potential Uinta Basin hookless cactus habitat, and 662 acres within 1/2 mile of known raptor nests. Approximately 30 miles of the Green River with wild and scenic qualities run adjacent to the ACEC.

3.11.3 Nine Mile Canyon ACEC

The 44,168-acre Nine Mile Canyon ACEC contains nationally noteworthy Fremont, Ute, and Archaic rock art and structures, regionally noteworthy populations of special status plant species, and high-quality scenery. The ACEC is located along the project area's southern border, and 34,653 acres occur within the project area. Part of the BLM's management objective for the Nine Mile Canyon ACEC (BLM 2008c) is to "protect and enhance the cultural and special status plant species values of the canyon while enhancing its scenic, recreation, and wildlife resource values."

The ACEC management prescriptions for the area emphasize the preservation of cultural sites, and habitat for a variety of plant and animal species through seasonal and surface occupancy restrictions. (See Section E of the Vernal RMP [BLM 2008c] for a complete list of management prescriptions.) Operations pertaining to oil and gas development in the area are restricted by stipulations designed to protect the natural and primitive values of the area. Some of the leases may predate the Vernal RMP that imposed those restrictions. If that is the case, as provided in the Vernal RMP development of those leased resources cannot be precluded by the referenced restrictions (but must be in conformance with all applicable laws and regulations, such as the ESA).

Approximately 15,374 acres of the Nine Mile Canyon ACEC are considered "high" probability for the presence of cultural resources (as determined with the methodology established in the Vernal RMP [BLM 2008c]). The ACEC also contains the Nine Mile Canyon Special Recreation Management Area (SRMA). The Nine Mile Canyon SRMA is a popular tourist destination, and is noted for having the highest concentration of rock art sites in the United States. Travel through the SRMA is possible via narrow, unpaved roads suitable for most passenger vehicles.

The Nine Mile Canyon ACEC also encompasses 32,579 acres of potential habitat for the threatened Uinta Basin hookless cactus. The wildlife resource values in the Nine Mile Canyon ACEC include large areas designated as antelope, bighorn sheep, elk, and mule deer range in the Diamond Mountain RMP (BLM 1994), as shown in Table 3-25.

Table 3-25. Acres of Wildlife Habitat within Nine Mile Canyon ACEC

Habitat Season	Habitat Designation[1]	Antelope	Bighorn Sheep	Elk	Mule Deer
Year-long	Crucial	4,334	–	–	1,566
	High Priority	19,452	–	–	–
	Substantial	–	–	–	–
	Limited	18,121	–	–	25,496
Winter	Crucial	–	–	671	1,404
	High Priority	–	–	27,001	19,370
	Substantial	–	–	16,101	277
	Limited	–	–	4,334	–
Potential		–	44,765	–	–

[1] Acreages shown are within ACEC boundaries and habitat designations established in the Diamond Mountain Resource Management Plan (BLM 1994). Acreages may change following a record of decision (ROD) on the Vernal Draft RMP/EIS (BLM 2005a).

3.11.4 Lower Green River Wild and Scenic River

The Vernal RMP (BLM 2008c) proposed congressional designation of the lower Green River within the project boundary as a WSR. Until Congress acts on the designation, the BLM is required to manage the river to protect its free-flowing nature, outstanding remarkable values, and tentative classification within a corridor measuring ¼ mile from the high water mark on each side of the river bank. The BLM currently manages approximately 27 miles of shorelines out of a total of 30 shoreline miles along the river. The Vernal RMP has tentatively classified the lower Green River as “Scenic.” Under the Wild and Scenic Rivers Act (P.L. 90–542), these are rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads. As such, the proposed Lower Green River WSR would be managed to protect recreational use and fish habitat, the outstanding remarkable values identified in the Vernal RMP. The Vernal RMP places an NSO stipulation on areas within 1/2 mile of the river and visible from the river, and allows waivers where site-specific analysis shows these impacts can be mitigated.

3.12 SPECIAL STATUS SPECIES

For BLM management purposes, "special status species" include species that are federally listed as endangered, threatened, proposed, and/or candidate species under the ESA, as well as those species listed as sensitive in the State of Utah by the BLM.

Species that are federally listed as threatened or endangered are afforded protection under the ESA (BLM Manual 6840). The BLM is required to consult with the U.S. Fish and Wildlife Service (USFWS) on potential impacts to federally listed species. The USFWS also suggests that the BLM consult with them informally when assessing projects that may impact candidate species. Periodic review of the special status species list allows for additions and/or removals depending on the status of populations, habitats, and potential threats.

Sensitive species are managed by the BLM and the State of Utah with the same level of protection as candidate species to prevent further listing (BLM Manual 6840). BLM sensitive species are designated by the State Director under 16 United States Code (USC) 1536 (a)(2).

The terms used here to describe special status species' habitats are defined as follows:

- *Potential habitats* are areas that satisfy the broad criteria of the species' habitat description; usually determined by preliminary, in-house assessment.
- Suitable habitats are areas that exhibit the specific habitat features necessary for species' persistence, as determined by field inspection and/or surveys, but that may or may not contain the species.
- *Occupied habitats* are any areas within 300 feet of a listed plant individual.
- *Designated or proposed critical habitats* are habitats that have been deemed essential for the conservation of a threatened, endangered, or candidate species and that may require species management and protection under Section 4 of the ESA.
- *Core conservation areas* are the cactus habitat areas that would be necessary for recovery of the Pariette cactus. The core conservation areas referred to in this document are those developed in 2009 as a result of the Castle Peak/Eightmile Flat EIS consultation (abbreviated hereafter in this document as the 2009 core conservation area).

3.12.1 FEDERALLY LISTED THREATENED, ENDANGERED, AND CANDIDATE SPECIES

Appendix D lists the federally listed threatened, endangered, and candidate species with the potential to occur in Duchesne and Uintah counties. Because of a lack of suitable habitat in the project area, Barneby ridgecress, White River penstemon, black-footed ferret, and the Canada lynx have been eliminated from detailed analysis; justification for elimination is provided in Appendix D. The six plant, three bird, and four fish species with suitable habitat in the project area or in the Green River corridor that could be impacted by Alternative A (Proposed Action) or other alternatives are described below.

3.12.1.1 THREATENED, ENDANGERED, AND CANDIDATE PLANT SPECIES

3.12.1.1.1 CLAY REED-MUSTARD AND SHRUBBY REED-MUSTARD

Clay reed-mustard (*Schoenocrambe argillacea*) is currently federally listed as a threatened species under the ESA, and shrubby reed-mustard (*Schoenocrambe suffrutescens*) is federally listed as endangered. Oil and gas development is identified as a key threat to these Book Cliffs soil endemics and was a major factor in their listing (USFWS 1994b). Other threats to the species include habitat loss and mortality through mineral and building material development, road building, off-road vehicle travel, and grazing. The 1994 recovery plan for these species (USFWS 1994a) states the following:

> The two species are vulnerable to surface disturbing activities associated with energy development within their habitats (England 1982, USFWS 1990c). The habitat of both species is underlain by petroleum deposits; similar deposits are currently being developed in locations adjacent to occupied habitat. The potential for decimation of *S. argillacea* and *S. suffrutescens* populations from petroleum resource development operations is a significant potential threat. Trampling from off-road vehicles and possibly livestock are, also, active and potential threats. Unrestricted off-road vehicle use and future development of oil and gas wells and ancillary facilities could endanger the continued existence of this species unless appropriate measures are undertaken to protect this species and its habitat.

3.12.1.1.1.1 Clay Reed-mustard

Clay reed-mustard occurs mostly in the Uinta Basin in Uintah County, Utah. This member of the mustard family is a perennial herb with a stout, woody base and hairless foliage that produces lilac to white, purple-veined flowers from mid-April through mid-May. Clay reed-mustard typically occurs in mixed desert shrub communities on precipitous, north-facing slopes on clay soils overlain with sandstone talus derived from shales and sandstones that occur at the interface of the Uinta and Green River geologic formations (USFWS 1994b). This species requires substrates consisting of at-the-surface bedrock, scree, and fine-textured soils from 4,721 to 5,790 feet elevation (Utah Division of Wildlife Resources [UDWR] 2002a).

The clay reed-mustard is found in the Book Cliffs on the contact zone between the upper Uinta and lower Green River Shale formations in mixed desert shrub of Indian ricegrass and black sagebrush. There are six known populations of this species totaling 6,000 individuals from the south-central Uinta Basin near the Green River in Uintah County (Franklin 1992; USFWS 1994b; USFWS 2011d). These six populations are scattered on BLM-administered lands between Willow Creek and Sand Wash within a limited range extending from the west side of the Green River to the east side of Willow Creek, approximately 19 miles across (USFWS 1994b; USFWS 2011d). Occupied or suitable habitats, or those currently or historically known to support populations of clay reed-mustard, occur on 1,231 acres along the Green River within the project area (Map 37); potential habitats, or areas that meet the broad habitat criteria for the species, have not been assessed because the habitat is not well defined and occupied and suitable habitats are inaccessible (BLM 2002c; USFWS 2011d). Erosion and soil movement associated with pipeline, well-pad, and road development appear to be the main impacts to the species where the plant occurs on steep slopes below these activities.

3.12.1.1.1.2 Shrubby Reed-mustard

Shrubby reed-mustard occurs in the Uinta Basin in Duchesne and Uintah counties. This member of the mustard family is a perennial, clump-forming herb that produces yellow flowers that bloom from May through June. Shrubby reed-mustard grows along semi-barren, white-shale layers of the Green River Formation (Evacuation Creek Member), where it is found in xeric, shallow, fine-textured soils intermixed with shale fragments and formerly overlain by clastic tuffaceous building stones (USFWS 1994b). It occurs in mixed desert shrub and pinyon-juniper communities at elevations ranging from 5,400 to 6,000 feet. There are three occupied habitat areas comprising seven known populations with an estimated total of 3,000 individuals (USFWS 2010d). One of the seven known shrubby reed-mustard populations, estimated at approximately 170 individuals, occurs on 1,449 acres in the Badland Cliffs in the southwestern portion of the project area (USFWS 2010d; Map 37). Small population size is a concern because five of the seven known populations are estimated at fewer than 250 individuals (USFWS 2010d). Winter sheep grazing is currently the principal use activity within the range of this species. Surface disturbance associated with historical alteration of habitats, existing and planned oil and gas development, and small population size are the primary threats to the species in the project area.

3.12.1.1.2 Pariette Cactus and Uinta Basin Hookless Cactus

Both Pariette cactus (*Sclerocactus brevispinus*) and Uinta Basin hookless cactus (*Sclerocactus wetlandicus*) are federally listed as threatened (USFWS 1979, 2009a). The USFWS recently found that the reclassification of Pariette cactus from threatened to endangered is warranted but precluded due to higher priority actions (USFWS 2007a, 2009a, 2010b). Pariette cactus (Heil and Porter 1994) and Uinta Basin hookless cactus (Hochstätter 1989) were formerly included in the federally threatened *Sclerocactus glaucus* (Schumann) Benson species "complex," but are now recognized by the USFWS as distinct species, each retaining its status as federally threatened (USFWS 2007a, 2009b). Separation of the *S. glaucus* species complex into three distinct species is supported by recent genetic studies (Porter et al. 2000, 2006), common garden experiments (Hochstätter 1993a; Welsh et al. 2003), and morphological characteristics (Hochstätter 1993b; Heil and Porter 2004). The former *S. glaucus* species complex populations now recognized as *Sclerocactus glaucus*, or Colorado hookless cactus, occur entirely within the upper Colorado and Gunnison River valleys of western Colorado (USFWS 1990c, 2007a) and will not be addressed here. A recovery plan for Uinta Basin hookless cactus (the *S. glaucus* species complex) was published in 1990 (USFWS 1990c), prior to the taxonomic revision of the species complex into three distinct species (USFWS 2009b). Recovery outlines were published in April 2010 for Uinta Basin hookless cactus (USFWS 2010c) and Pariette cactus (USFWS 2010b). The original recovery criteria for the *S. glaucus* species complex are no longer sufficient to address the recovery of the now separated species. Recovery plans for Uinta Basin hookless cactus and Pariette cactus are in development.

Ongoing and proposed oil and gas development is the primary threat to Pariette cactus and Uinta Basin hookless cactus from the combined impacts of road and well-pad development, fugitive dust, erosion, isolation of populations due to habitat fragmentation, impacts to pollinators and seed dispersers, increased access by off-road vehicles and illegal collectors due to an expanded road network, and pesticide and herbicide use (USFWS 1990c, 2007a, 2010a and b). A recently published study of the insect pollinators of Pariette cactus and Uinta Basin hookless cactus indicates that both cactus species require pollination for successful reproduction (Tepedino et al.

2010). Both cactus species are predominantly pollinated by ground-nesting bees (Tepedino et al. 2010). Surface disturbance impacts these pollinators and their nesting and foraging habitats by removing ground-nesting sites and by reducing plant cover and forage. Removal and degradation of bee habitats negatively impacts these cactus species by reducing the diversity and abundance of pollinators and, thereby, the plant's ability to successfully reproduce. Because there is little or no information regarding the distances that native pollinators travel from their nesting habitats to forage, it is not currently possible to define a habitat buffer distance that will protect these cactus species, their pollinators, and the pollinators' habitats.

3.12.1.1.2.1 Pariette Cactus

This member of the cactus family is a perennial that occurs as a solitary, unbranched, egg-shaped to short cylindric succulent stem usually 0.75–2.75 inches in diameter by 1–3 inches tall that produces pink to purplish flowers from late April to May (Heil and Porter 2004). Pariette cactus is distinguished from Uinta Basin hookless cactus by its spherical shape, short-hooked or absent central spines, smaller stature and flower size, and retention of juvenile vegetative characteristics in adult flowering plants (Heil and Porter 2004). The species occurs on fine soils in clay badlands derived from the Uinta Formation within sparsely vegetated salt desert shrubland dominated by shadscale, rabbitbrush, and horsebrush from 4,600 to 4,900 feet (USFWS 1990c; Heil and Porter 2004). One of the reasons for the susceptibility of Pariette cactus to irreversible population reduction is its specific requirement for soils with a high percentage of channery on the surface, which form a "desert pavement." Surface disturbance and construction cause the damage or removal of this unique soil substrate, which cannot be returned to its original state following reclamation.

Pariette cactus occurs in a single population of approximately 12,000 individuals within a 113-square-mile (72,000-acre) area from the Pariette Draw along the Duchesne–Uintah County boundary (USFWS 2006c, 2010b). The total area of potential habitat for Pariette cactus is estimated to be approximately 31,000 acres on BLM lands, and approximately 6,000 acres on Ute tribal lands (USFWS 2007a). Seventy-two percent of the species range occurs within oil and gas development projects on BLM lands (USFWS 2007a), including the Castle Peak/Eightmile Flat Oil and Gas Expansion Project (12,530 acres; BLM 2005b).Existing oil and gas development on BLM lands has directly or indirectly affected 1,891 acres of Pariette cactus habitat (BLM 2005b) and 2,095 acres within the Sand Wash and Greater Boundary Oil and Gas Field (USFWS 2006c), and the Ute Tribe has leased occupied habitat within the remaining 16% of the species range (USFWS 2007a).

The currently known distribution of potential Pariette cactus habitats is based on recent habitat and occurrence surveys in the project area (SWCA 2005b, 2006; USFWS 2011a; Map 37). The project area contains approximately 1,988 acres (2.8%) of potential Pariette cactus habitat. In addition, the project area overlaps 46 acres that the USFWS and BLM have identified as a result of the 2009 Castle Peak-Eight Mile Flat EIS as core conservation areas (referred to hereafter in this document as 2009 core conservation areas) to further recovery efforts for Pariette cactus. USFWS and BLM are currently in the process of identifying expanded core habitat areas for the cactus that would be necessary for recovery of the species. Management for those areas is also under development.

Populations of the Pariette cactus and areas of suitable habitat may occur within Uinta Basin hookless cactus occurrence areas. Additional Pariette cactus populations and suitable habitat, or areas that meet the specific habitat criteria for the species, may also be found with further surveys, particularly to the south and east of known occupied habitat (personal communication between Greg Larson, SWCA, and Bekee Megown, USFWS, 2007).

3.12.1.1.2.2 Uinta Basin Hookless Cactus

Uinta Basin hookless cactus is a federally listed threatened plant that occurs in the Uinta Basin on alluvial river terraces near the confluence of the Green, White, and Duchesne rivers, including Ouray National Wildlife Refuge and the town of Ouray, Utah, south along the Green River to the vicinity of Sand Wash, including concentrations near the mouth of Pariette Draw, and along the base of the Badlands Cliffs in southeastern Duchesne County (USFWS 1990c, 2005). The species has a potential range of approximately 460,000 acres, of which approximately 259,000 acres (56%) are on federal lands and 129,000 acres (28%) are on Ute tribal lands, with the remaining potential habitats occurring on private and state lands (USFWS 2010a). Uinta Basin hookless cactus is patchily to densely distributed within these habitat areas (SWCA 2006, 2007; Glisson 2007; UDWR 2007). The total cactus population size could be as high as 30,000 individuals based on the number of known cactus locations and population estimates at these locations (USFWS 2010a).

This member of the cactus family is a perennial that occurs as a solitary, unbranched, round-to-elongate/cylindric succulent stem usually 1.25–3.5 inches in diameter by 2–5 inches tall that produces pink to violet flowers from late April to May (Heil and Porter 2004). The Uinta Basin hookless cactus is found on river benches, valley slopes, and rolling hills of the Duchesne River, Green River, and Mancos formations (Heil and Porter 1993). The species requires xeric, fine-textured soils overlain with cobbles and pebbles. It is typically found in salt desert shrub and pinyon-juniper communities at elevations ranging from 4,300 to 6,560 feet (1,300–2,000 meters; Heil and Porter 1993, 2004; UDWR 2002a). The Uinta Basin hookless cactus occurs on a wider range of substrates than Pariette cactus; however, its fragile soil habitats are also difficult to return to their original state following reclamation.

For the purposes of this analysis, Uinta Basin hookless cactus habitats have been delineated as potential habitats encompassing approximately 98,417 acres within the project area (Map 37). . Potential habitat areas comprise the benches above the Green River, previously delineated polygons at the base of the Badland Cliffs (BLM 2002c), and known occurrences documented from recent habitat and occurrence surveys in the project area (SWCA 2005, 2006; USFWS 2011). Populations of the Uinta Basin hookless cactus and areas of potential habitat occur in unevenly distributed and patchy concentrations. The density of known individuals and suitable habitat decreases with distance from the Green River, with the exception of the Badland Cliffs concentration. The project area overlaps portions of potential Uinta Basin hookless cactus habitat for which the U.S. Forest Service and BLM are currently developing core conservation areas that would be necessary for recovery of the species. Management for those areas is also under development.

3.12.1.1.3 GRAHAM'S BEARDTONGUE

The 2006 proposed rule to consider Graham's beardtongue (*Penstemon grahamii*) for federal listing as a threatened species under the ESA (USFWS 2006a) was reinstated on June 9, 2011 (U.S. District Court of Colorado). The species' current status as proposed for federal listing under the ESA provides protections that supersede the 2008 interagency conservation agreement to protect Graham's beardtongue and its habitats, to survey and monitor for the species, and to address threats by implementing avoidance and minimization measures, as needed. A recovery plan for the species has not been developed.

Graham's beardtongue is a member of the figwort family. It is a perennial herb that grows 2–8 inches tall and has thick, leathery leaves and large, tubular, light to deep lavender flowers that bloom from late May to early June. Graham's beardtongue grows on semi-barren knolls, ridges, and steep slopes in a mix of fragmented white shale and silty clay soils of the Green River Formation. It grows in sparsely vegetated communities of pinyon-juniper, desert shrub, and Salina wild rye (*Leymus salinus*) at elevations ranging from 4,600 to 6,700 feet. This species only occurs in the Uinta Basin in Carbon, Duchesne, and Uintah counties, Utah, and in immediately adjacent Rio Blanco County, Colorado.

Graham's beardtongue occupied habitat is a discontinuous series of exposed, raw shale knolls and slopes derived from the Parachute Creek and Evacuation Creek members of the geologic Green River Formation. This species only grows directly on weathered surface exposures of the oil-shale-bearing strata in the Parachute Member and closely associated strata, making the species vulnerable to impacts if oil-shale is exploited in the future (Shultz and Mutz 1979; Neese and Smith 1982; USFWS 2005).

Based on information from the 1980s, the population of Graham's beardtongue consists of approximately 6,200 individuals in 109 locations. The westernmost Graham's beardtongue population habitat unit, the Sand Wash Unit (Unit A), occurs in the vicinity of Sand Wash in southwestern Uintah and adjacent Carbon and Duchesne counties, Utah. This population habitat unit consists of 10 separate occurrences, with a total population of 135 individuals (Shultz and Mutz 1979; USFWS 2005). This isolated unit has relatively small numbers (approximately 2% of the total species population) compared to those population habitat units in the center of the species' range. However, this portion of the species' population has minor morphological differences from the remainder of its population and may, due to geographic isolation, be genetically divergent from the remainder of the species' population (Shultz and Mutz 1979). Low population numbers and habitat fragmentation pose a threat to rare plant species' genetic diversity, and their ability to adapt to changing environmental conditions (Barrett and Kohn 1991). The effects of habitat degradation and fragmentation caused by human activities and the effects of deleterious natural phenomena, such as drought, may lead to the reduction or extirpation of small, localized populations. Five small, isolated occurrences of the Unit A population occur on 86 acres near the Sand Wash Road in the southeast corner of the project area. These occupied habitat areas are proposed critical habitat for the species by the USFWS (USFWS 2006a; Map 37).

The BLM reports that conservation stipulations for Graham's beardtongue near well locations have prevented adverse impacts to the species' habitat and possible loss of individuals (BLM 2005a). Conservation measures include moving well-pad and pipeline locations to avoid direct impacts to the species and establishment of a 300-foot avoidance buffer. Wildlife and livestock grazing may have localized effects on Graham's beardtongue; one occurrence of the species is believed to have been eradicated by livestock trampling. Other potential sources of impacts include OHV use. The species could be vulnerable to collection as a species of horticultural interest, but there is no evidence of this occurring to date. The presence of invasive exotic species has been noted in the species' habitats, primarily along roads and well site locations, and may compete with or degrade habitat quality for Graham's beardtongue.

3.12.1.1.4 Ute Ladies'-tresses

Ute ladies'-tresses (*Spiranthes diluvialis*) is a federally listed threatened species. This member of the orchid family is a perennial herb that occurs on seasonally flooded river terraces, spring-fed stream channels, lakeshores, and in human-modified and disturbed wetlands such as canals, gravel pits, and irrigated meadows (Fertig et al. 2005). Within the Uinta Basin, Ute ladies'-tresses occurs along the Green River near the confluence with the Yampa River, and along Ashley Creek, Big Brush Creek, and the upper Duchesne River and its tributaries (BLM 2005a) below 4,300 feet elevation (BLM 2006b). Ute ladies'-tresses populations require recurrent disturbance, such as seasonal flooding, grazing, or mowing, for establishment and persistence, and often occur in recently created riparian habitats such as sand bars and backwaters (USFWS 1995b).

There are currently no known occurrences of the species in the project area. However, the project area is included within the range of the species; and it is known to occur in Duchesne and Uintah counties (Fertig et al. 2005; Utah Native Plant Society 2003–2011; UDWR 2007). Potential habitats within the project area include riparian areas and alluvial cobbles or shingles backed by native cottonwoods and other native vegetation along the Green River at the mouth of Nine Mile Creek and along Nine Mile Creek. It would most likely be found in wetland or riparian meadows associated with other riparian vegetation. Map 30 identifies all riparian habitat in the Gasco project area. It should be noted that the water of the Pariette Wetlands is too alkaline to support this species (Atwood et al. 1991).

Threats to the Ute ladies'-tresses include habitat conversion and destruction from urban and road development; trampling and surface disturbance associated with recreation and livestock grazing; grazing by wildlife and livestock; alteration of the hydrology of wetland habitats from development, flood control, and withdrawal; and competition and habitat alteration by invasive species (Fertig et al. 2005). These activities may reduce the suitability of the habitat for pollinators through altered structure and composition of the vegetation, and ultimately reduce pollinator availability (Fertig et al. 2005). Additional potential impacts to the Ute ladies'-tresses include drought and collection for horticultural use.

3.12.1.2 THREATENED, ENDANGERED, AND CANDIDATE WILDLIFE SPECIES

3.12.1.2.1 MEXICAN SPOTTED OWL (MSO)

The Mexican spotted owl (*Strix occidentalis lucida)* is federally listed as a threatened species. It is one of three subspecies of spotted owl occurring in the United States. Its range extends from the canyons of Utah and Colorado south into the mountains of Arizona, New Mexico, west Texas, and south into Mexico. The Mexican spotted owl (MSO) does not occur uniformly throughout this range, but in isolated pockets of canyon or mountain habitat. In the northern part of its range, including south and central Utah, MSO habitat is defined by steep-walled, rocky canyons where birds have generally been found nesting in caves or cliff ledges (USFWS 1995). The primary threats to the owl identified in its recovery plan (USFWS 1995) are habitat loss and habitat alteration. Specific threats to its habitat include natural and human caused impacts that prevent use of nesting sites.

MSO pairs breed sporadically and do not nest every year. When breeding, nest clutch size is among the lowest of North American owls, with the female laying 1–3 eggs. Reproductive patterns vary across its range. In the project area, courtship usually begins in March and eggs are laid in late March or early April. Eggs are incubated entirely by the female, which lasts for about 30 days. Eggs usually hatch in early May, with nestlings fledging 4–5 weeks later and then dispersing in mid-September to early October (personal communication between Frank Howe, UDWR, and George Weekley, SWCA, 2007). Spotted owls feed mainly on rodents but also consume rabbits and some other vertebrates, including birds and reptiles, and insects (UDWR 2002a).

In 2005, a habitat assessment survey was conducted in order to delineate and rate polygons of MSO nesting habitat in the Vernal FO (SWCA 2005). MSO nesting habitats were ranked according to presence of five primary constituent elements (PCEs) identified in the Environmental Assessment for Designation of Critical Habitat for the Mexican Spotted Owl (USFWS 2004), which assess: 1) water availability, 2) topographic diversity, 3) prey availability, 4) nesting site availability, and 5) tree cover or roosting site availability (SWCA 2005). Dominant vegetation, slope, and aspect were also assessed at each survey point (SWCA 2005). Each of the PCEs was given a score from 0 to 3, and the total score of the 5 PCEs was then used to determine a habitat ranking of excellent (10–14, and must exhibit all five PCEs), good (8–12), fair (6–8), poor (3–6), or unsuitable (1–3; SWCA 2005).

The BLM requires that suitable habitat polygons that have been rated as “fair,” “good,” or “excellent” habitat for MSO located within 0.5 mile of the proposed project disturbance be surveyed for two years prior to project initiation, according to USFWS survey protocol. Mexican spotted owl habitats in the project area (see Map 40) include 5,140 acres of poor habitat, 480 acres of fair habitat, and 1,753 acres of good habitat along the Green River corridor and Nine Mile Canyon (SWCA 2005). MSO detections were made in Jack Canyon in 2004 and in Water Canyon in the southeastern corner of the project area in 2007 (personal communication between Hope Hornbeck, SWCA, and Bekee Megown, USFWS, 2007). Critical habitat for the MSO occurs immediately to the south of the project area at the confluence of the Green River and Nine Mile and Desolation canyons (USFWS 2007b).

Potential impacts to the MSO and its habitat include forest fire; timber harvest; encroachment by humans for development, recreational, and educational uses of habitat; and degradation of riparian habitat due to grazing and water withdrawals (58 CFR 14248).

3.12.1.2.2 GREATER SAGE-GROUSE

Widespread declines in greater sage-grouse (*Centrocercus urophasianus*) populations throughout the West led to a petition to list the species as threatened under the ESA. On March 5, 2010, the USFWS published a finding in the *Federal Register* (50 CFR 17) that, based on accumulated scientific data and new peer-reviewed information and analysis (USFWS 2010a), the greater sage-grouse warrants the protection of the ESA but that listing the species is precluded by the need to address higher priority species first. The greater sage-grouse was placed on the candidate list for future action, meaning the species will not receive statutory protection under the ESA at this time, and states will continue to be responsible for managing the bird.

The greater sage-grouse is currently included on the Utah Sensitive Species List because of its limited distribution in Utah and because of recent decreases in its population size (UDWR 2006a). Utah Partners in Flight identifies it as a priority species (Parrish et al. 2002), and the USFWS has listed it as a bird of conservation concern. A management plan (UDWR 2002b) has been developed to facilitate greater sage-grouse recovery efforts.

The greater sage-grouse is found in the sagebrush foothills, mountain valleys, and plains of the Intermountain West. Nests are shallow depressions lined with grass or twigs, and are usually located under sagebrush. The principal sage-grouse winter food is sagebrush leaves. During the summer, greater sage-grouse feed on the leaves and fruiting heads of sagebrush; the flower heads of clovers, dandelions, grasses, and other plants; and various insects (Kauffman 1996; UDWR 2002b).

Greater sage-grouse feed almost exclusively on sagebrush in the winter (Connelly et al. 2000; Patterson 1952) and are therefore mostly restricted to sagebrush habitats during that season. Because sage-grouse need to access sagebrush, sage-grouse winter habitat tends to exist on south- to west-facing slopes that are less than 10% grade and in windswept areas (Beck 1977; Crawford et al. 2004) where the height of sagebrush exceeds the depth of snow.

Occupied habitat in the greater sage-grouse‘s range has declined by approximately 60% from the historical extent; population declines have closely paralleled the decrease in habitat (Rowland 2004). Although urban expansion and the conversion of native habitat to agricultural may account for most historical habitat loss, recent population declines (within the last three decades) are largely attributed to decreasing suitability of sagebrush steppe habitat, resulting in the loss and fragmentation of sage-grouse habitat. Invasive non-native plants—particularly cheatgrass—have dramatically shifted the structure and species composition in many areas. Cheatgrass has also influenced changes in fire frequency and severity within sagebrush habitats, leading to a shift from shrublands to grasslands, and reducing the quality of sage-grouse habitat (UDWR 2002b, 2003a). Since 1967, the number of male sage-grouse on known breeding grounds in Utah has declined by approximately 50%, with recent declines attributed to habitat loss and fragmentation from agricultural encroachment, oil and gas development, overgrazing, drought, and West Nile virus (UDWR 2002b). Brood counts and harvest data show a similar downward trend.

Approximately 84,647 acres of potential greater sage-grouse brooding habitat and 38,747 acres of potential greater sage-grouse wintering habitat exist in the project area (UDWR 2001b). There is one known lek located in the project area with a 2-mile buffer that encompasses 8,032 acres, although it has not been active for several years (UDWR 2006a).

3.12.1.2.3 WESTERN YELLOW-BILLED CUCKOO

The western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) is a candidate for federal listing across its range, and is the only yellow-billed cuckoo subspecies that occurs in Utah. Historically, the range of the western yellow-billed cuckoo included all states west of the Rocky Mountains, and extended into southern British Columbia at the northern extent, and into the northwestern states of Mexico at the southern limit. The cuckoo population and range have been largely diminished since the subspecies was first described in 1877 (Parrish et al. 1999). Currently, the range of the cuckoo is limited to disjunct fragments of riparian habitats from northern Utah, western Colorado, southwestern Wyoming, and southeastern Idaho southward into northwestern Mexico and westward into southern Nevada and California. Cuckoos are long-range migrants that winter in northern South America in tropical deciduous and evergreen forests (Parrish et al. 1999 and references therein).

Yellow-billed cuckoos are one of the latest summer migrants to arrive and breed in Utah. They arrive in extremely late May or early June and breed in late June through July. Cuckoos typically start their southerly migration by late August or early September. Yellow-billed cuckoos feed almost entirely on large insects, including tent caterpillars, grasshoppers, beetles, cicadas and katydids, and occasionally lizards, frogs, and the eggs of other birds, and rarely on berries and fruits (Parrish et al. 1999 and references therein).

Yellow-billed cuckoos are considered a riparian obligate and are usually found in large tracts of cottonwood/willow habitats with dense subcanopies below 33 feet. These areas are typically characterized by a dense subcanopy or shrub layer (regenerating canopy trees, willows, or other riparian shrubs) within 333 feet of water (Parrish et al. 1999). Cottonwoods are the most common overstory species, and the nesting-habitat overstory is characterized by large, gallery-forming trees (33–90 feet) or developing trees (10–27 feet) (Parrish et al. 1999). In Utah, nesting habitats are found at low to mid-elevations (2,500–6,000 feet). Cuckoos appear to require large tracts (100–200 acres) of contiguous riparian nesting habitat; however, cuckoos are not strongly territorial and home ranges could overlap during the breeding season (Parrish et al. 1999).

Threats to the yellow-billed cuckoo include habitat loss due to conversion to agricultural and other uses, dams and river flow management, stream channelization and stabilization, livestock grazing, and pesticide use (USFWS 2006d). Available breeding habitats for cuckoos have also been substantially reduced in size and quality by changes in watershed hydrology from groundwater pumping and the replacement of native riparian habitats by invasive nonnative plants, particularly tamarisk (USFWS 2006d). Nonnative plant species impact yellow-billed cuckoo habitat by altering plant community structure, species composition and diversity, and cover density (USFWS 2006d). The species potentially occurs within 1,212 acres identified by remote sensing as native riparian (woody wetland) habitats within the project area (see Map 27).

3.12.1.3 Threatened, Endangered, and Candidate Fish Species

The bonytail chub, Colorado pikeminnow, humpback chub, and razorback sucker are federally listed as endangered under the ESA. All of these fish are Colorado River system endemics, and could be negatively affected by the Proposed Action's impacts to the Green River. Threats to these Colorado River endangered fish identified in their recovery plans include extensive water development in the basin, streamflow regulation, habitat modification, competition with and predation by nonnative fish species, stream alterations, pesticides and other pollutants, and hybridization (USFWS 1990a, 1990b, 1991, 1999). Water development has led to depletion of instream flows, altered flow regimes, and fragmented habitat (USFWS 1998).

The BLM is a participant in the Upper Colorado River Endangered Fish Recovery Program (UCRRP), a cooperative agreement among federal agencies, water users, energy distributors, and environmental groups to recover the bonytail and other rare native fish in the upper Colorado River basin. This agreement includes provisions for instream flow protection, habitat restoration, reduction of nonnative fish species, research, monitoring, and management.

3.12.1.3.1 Bonytail Chub

The bonytail chub (*Gila elegans*) is a rare minnow species native to the Colorado River system of the western U.S. and northern Mexico. The distribution and numbers of the bonytail have declined over the last century, and few bonytail still exist in the wild. The near extinction of the bonytail is attributed to alteration of natural flow regimes, habitat loss/alteration, and competition with/predation by exotic fishes in the Colorado River system (Sigler and Sigler 1996). Bonytail are now federally listed and Utah state-listed as endangered, and efforts to reestablish the species are underway (USFWS 2002a). The bonytail is an opportunistic feeder, eating insects, zooplankton, algae, and plant matter. Its preferred habitat includes eddies, pools, and backwaters near swift current in large rivers. Many bonytail are now produced in fish hatcheries, with the offspring released into the wild when they are large enough to survive in the altered Colorado River system environment (USFWS 2002a; UDWR 2002a).

The bonytail is historically and currently known to occur in the Green River. Specifically, the bonytail has recently been found at the confluence of the Yampa and Green rivers on the Utah–Colorado border, in Dinosaur National Monument, in Desolation/Gray Canyon (including Coal Creek Rapid and adjacent Coal Creek), and at the confluence of the Green and Colorado rivers (USFWS 2002a). Critical habitat for this species is designated approximately 9 river miles downstream from the project area at Sumner's Amphitheater (Section 5 T12S R18E).

The species' population size has been difficult to measure. In recent years, a total of 100 individuals have been identified in the above-mentioned locations (USFWS 2002a). A recovery plan was published for this species in 1990 and revised in 2002 (USFWS 1990a, USFWS 2002a).

3.12.1.3.2 Colorado Pikeminnow

The Colorado pikeminnow (*Ptychocheilus lucius*, formerly known as the Colorado squawfish) is a large minnow native to the Colorado River system of the western U.S. and northern Mexico. The current range of the Colorado pikeminnow has been reduced due to flow regulation, habitat loss, migration barriers (i.e., dams), and the introduction of nonnative fishes (Sigler and Sigler 1996). The species now exists only in the upper Colorado River system. The Colorado pikeminnow is both federally listed and Utah state-listed as endangered. There is a recovery plan in place for this species (USFWS 2002b). Adult Colorado pikeminnows prefer medium to large rivers, where they can be found in habitats ranging from deep, turbid rapids to flooded lowlands. Spawning has been documented in canyons in the Yampa and Green rivers, and is associated with declining flows in June, July, or August and with warm average water temperatures. Slow-moving backwaters serve as nursery areas for young pikeminnows. The Colorado pikeminnow is primarily piscivorous, but smaller individuals will also feed on insects and other invertebrates (UDWR 2002a).

The Colorado pikeminnow is endemic to the Colorado River basin. Reproductive populations are known to exist in the Green River, the lower Duchesne River, and the lower White River (USFWS 2002b). The population in the Green and Yampa rivers has been estimated at 6,000–8,000 adults (UDWR 2003a). Due to flow regulation, habitat loss, migration barriers such as dams, and the introduction of nonnative fishes, the current range and numbers of the Colorado pikeminnow are much reduced (Sigler and Sigler 1996).

The length of the Green River on the eastern border of the project area has been designated as critical habitat for the Colorado pikeminnow (USFWS 1994a), which encompasses 6,772 acres of 100-year floodplain on the Green River. A recovery plan for the Colorado pikeminnow was published in 1991 and revised in 2002 (USFWS 1991, 2002b).

3.12.1.3.3 Humpback Chub

The humpback chub (*Gila cypha*) is a rare minnow native to the upper Colorado River system of the western U.S. and northern Mexico. Humpback chub originally used fast, deep, white-water areas of the Colorado River and its major tributaries. Alterations of flow regimes have changed the turbidity, volume, current speed, and temperature of the water in those rivers, reducing the distribution and numbers of this species (Sigler and Sigler 1996). In Utah, humpback chub are now confined to a few white-water areas in the Colorado, Green, and White Rivers. Because of the severe declines in humpback chub numbers and distribution, the species is both federally listed and Utah state-listed as endangered. There is a recovery plan in place for this species (USFWS 2002c).

Humpback chub primarily eat insects and other invertebrates, but algae and fishes are occasionally consumed. The species spawns during the spring and summer in shallow, backwater areas with cobble substrate. Young humpback chub remain in these slow, shallow, turbid habitats until they are large enough to move into whitewater areas (UDWR 2002a).

The humpback chub is endemic to warm water river systems in the Colorado River basin. It is found in Desolation Canyon of the Green River, south of the project area. Approximately 1,500 individuals are thought to exist in that population (USFWS 2002c). Critical Habitat for this species is designated approximately 9 river miles downstream from the project area at Sumner's Amphitheater (Section 5 T12S R18E). A recovery plan was published for this species in 1990 and amended in 2002 (USFWS 1990b, USFWS 2002c).

3.12.1.3.4 Razorback Sucker

The razorback sucker (*Xyrauchen texanus*) is a federally listed and Utah state-listed endangered fish native to the Colorado River system of the western U.S. and northern Mexico. Razorback sucker habitat and populations have been greatly impacted by human disturbance during the last century. The species is now extremely rare in Utah and throughout its range. Major impacts to the razorback sucker include impoundments of rivers in the Colorado River system and competition and predation from nonnative fish species (Sigler and Sigler 1996). Adult razorback suckers prefer warm water rivers and are typically associated with deep runs, eddies, backwaters, and off-channel areas in spring; shallow runs and pools associated with sandbars in summer; and slow runs, pools, and eddies in winter. Spawning occurs in the spring with rising water levels and increasing temperatures in flooded areas over rocky runs and gravel bars. Razorback suckers are known to exhibit seasonal migrations and long-distance movements to use optimal habitat (USFWS 1998, 2002d). The razorback sucker primarily consumes algae, zooplankton, and other aquatic invertebrates. There is a recovery plan in place for this species (USFWS 2002d).

The razorback sucker is found in warm water reaches of rivers in the Colorado River basin, including the Green River, White River, and lower Duchesne River. The species population in the middle Green River is estimated at approximately 100 individuals. Populations in the White River are small, and their distributions are limited by the Taylor Draw Dam. Razorback sucker are found in small aggregations at the mouth of the Duchesne River during spring runoff (USFWS 2002d). The major impacts to the razorback sucker populations are competition and predation by nonnative fish species and impoundments of rivers in the Colorado River system, which impede natural flows, alter temperature regimes, and constrain fish movements (Sigler and Sigler 1996).

The length of the Green River on the eastern border of the project area has been designated as critical habitat for the razorback sucker (USFWS 1994a), which encompasses 6,772 acres of 100-year floodplain on the Green River. A recovery plan for this species was published in 1998 and amended in 2002 (USFWS 1998, USFWS 2002d).

3.12.2 BLM Sensitive Species

The BLM has adopted a list of “sensitive species“ based on several criteria. By rule, wildlife species that are federally listed, candidates for federal listing, or for which a conservation agreement is in place automatically qualify for the Utah Sensitive Species List. The additional species on the Utah Sensitive Species List, “species of concern,” are those species for which there is credible scientific evidence to substantiate a threat to continued population viability. The BLM has created its own list of sensitive plant species, while it has deferred to and adopted the list for sensitive animal species created by the UDWR (2006a).

Appendix D displays BLM sensitive species with potential to occur in Duchesne and Uintah counties. Because of a lack of suitable habitat in the project area, 11 plant and 12 wildlife species have been eliminated from detailed analysis; justification for elimination is also provided in Appendix D. The habitat requirements and food sources for the seven plant, nine wildlife, and three fish species with potential and suitable habitat in the project area or in the Green River corridor that could be impacted by the Proposed Action are described below.

3.12.2.1 Sensitive Plant Species

3.12.2.1.1 Untermann Daisy

The Untermann daisy (*Erigeron untermannii*) is endemic to Duchesne County, Utah, and is listed as a sensitive species by the State of Utah and the BLM. This member of the sunflower family is a small perennial herb with white flowers that bloom from May to June. It is found in pinyon-juniper, mountain mahogany, limber and bristlecone pine, and sagebrush communities. It grows in calcareous shale and sandstones of the Uinta and Green River formations at elevations ranging from 7,000 to 7,800 feet (Utah Native Plant Society 2003–2011; BLM 2005a).

Little is known about the exact habitat requirements for this species; however, suitable habitat may exist within 46,059 acres of the project area based on the vegetation, soil, and elevation associations described above (Map 37).

Threats to the species are poorly defined. Based on the threats to other special status plants occurring on similar soils in the project area, they are likely to include direct mortality or habitat loss and habitat fragmentation due to oil and gas development, mineral and building material development, road development, off-road vehicle travel, and grazing.

3.12.2.1.2 Sterile Yucca

Sterile yucca (*Yucca sterilis*) is endemic to Duchesne and Uintah counties, and is listed as a sensitive species by the State of Utah and the BLM. It is a member of the agave family and produces yellow to cream-colored flowers, but is not known to produce fruit. This species reproduces vegetatively through underground stems that give rise to new plants. Sterile yucca is found in salt desert shrub, juniper, sagebrush, and shadscale communites at elevations of 4,800 to 5,800 feet in sandy soils (Utah Native Plant Society 2003–2011). Little is known about the exact habitat requirements for this species; however, 8.4 acres of known habitat exist in the project area (Map 37). In addition to the 8.4 acres of known habitat, additional potential habitat for sterile yucca is present in the project area.

Threats to the species are poorly defined. Based on the threats to other special status plants on similar soils in the project area, they are likely to include direct mortality or habitat loss and habitat fragmentation due to oil and gas development, mineral and building material development, road development, OHV travel, and grazing.

3.12.2.1.3 Graham's Catseye

Graham's catseye (*Cryptantha grahamii*) is endemic to Duchesne and Uintah counties, and is listed as a sensitive species by the State of Utah and the BLM. It is a long-lived perennial and a member of the borage family. Graham's catseye inhabits mixed desert shrub, sagebrush, pinyon-juniper, and mountain brush communities on Green River shale at elevations of 5,000 to 7,400 feet (Utah Native Plant Society 2003–2011). Little is known about the exact habitat requirements for this species; however, it has been observed within the project area (Map 37) based on general locations in herbarium records (personal communication between Aaron Roe, BLM, and Janet Guinn, SWCA, October 2011).

Threats to Graham's catseye are poorly defined. Based on the threats to other special status plants occurring on similar soils in the project area, they are likely to include direct mortality or habitat loss and habitat fragmentation due to oil and gas development, mineral and building material development, road development, OHV travel, and grazing.

3.12.2.1.4 BARNEBY'S CATSEYE

Barneby's catseye (*Cryptantha barnebyi*) is a member of the borage family and a perennial herb that is endemic to the Uinta Basin. It is listed as a sensitive species by the State of Utah and the BLM. Barneby's catseye habitat consists of barren white shale knolls of the Green River Formation in shadscale, rabbitbrush, sagebrush, and pinyon-juniper communities at elevations from 6,000 to 7,900 feet (Natureserve.org 2011; Welsh et al. 2008). Little is known about the exact habitat requirements for this species; however, based on project area vegetation and elevation, it has the potential to occur. There are currently no known locations of this species within the project area, nor any BLM-identified potential or suitable habitat polygons.

Threats to the species are poorly defined. Based on the threats to other special status plants occurring on similar soils in the project area, they are likely to include direct mortality or habitat loss and habitat fragmentation due to oil and gas development, mineral and building material development, road development, OHV travel, and grazing.

3.12.2.1.5 GOODRICH'S BLAZINGSTAR

Goodrich's blazingstar (*Mentzelia goodrichii*), a member of the stickleaf family, is endemic to southern Duchesne County, along the escarpment of Willow and Argyle canyons. It is listed as a sensitive species by the State of Utah and the BLM. Habitat for this plant consists of steep, white, marly calciferous shale of the Green River Formation in scattered limber and pinyon pine, Douglas-fir, mountain mahogany, and rabbitbrush communites, at elevations of 8,100 to 8,800 feet (Utah Native Plant Society 2003–2011). Little is known about the exact habitat requirements for this species; however, based on project area vegetation and elevation, it has the potential to occur in the project area. There are currently no known locations of this species within the project area, nor any BLM-identified potential or suitable habitat polygons.

Threats to the species are poorly defined. Based on the threats to other special status plants occurring on similar soils in the project area, they are likely to include direct mortality or habitat loss and habitat fragmentation due to oil and gas development, mineral and building material development, road development, OHV travel, and grazing.

3.12.2.1.6 GOODRICH'S COLUMBINE

Goodrich's columbine (*Aquilegia scopulorum* var. *goodrichii*), a member of the buttercup family, is endemic to Duchesne County. It is listed as a sensitive species by the State of Utah and the BLM. Habitat for Goodrich's columbine consists of Green River shale ridges in association with bristlecone pine, limber pine, Salina wildrye, mountain mahogany, pinyon, and Douglas-fir communities, at elevations of 7,400 to 9,400 feet (personal communication between Aaron Roe, BLM, and Janet Guinn, SWCA, October 2011). Little is known about the exact habitat requirements for this species; however, based on project area vegetation and elevation, it has the potential to occur. There are currently no known locations of this species within the project area, nor any BLM-identified potential or suitable habitat polygons.

Threats to the species are poorly defined. Based on the threats to other special status plants occurring on similar soils in the project area, they are likely to include direct mortality or habitat loss and habitat fragmentation due to oil and gas development, mineral and building material development, road development, OHV travel, and grazing.

3.12.2.1.7 Duchesne Greenthread

The Duchesne greenthread (*Thelesperma pubescens* var. *caespitosum*) is a member of the sunflower family and is endemic to Duchesne County. It is listed as a sensitive species by the State of Utah and the BLM. Habitat consists of white shale slopes and ridges of the Green River Formation, at elevations of approximately 5,900 feet (Utah Native Plant Society 2003–2011). Little is known about the exact habitat requirements for this species; however, based on project area vegetation and elevation, it has the potential to occur. There are currently no known locations of this species within the project area, nor any BLM-identified potential or suitable habitat polygons.

Threats to the species are poorly defined. Based on the threats to other special status plants occurring on similar soils in the project area, they are likely to include direct mortality or habitat loss and habitat fragmentation due to oil and gas development, mineral and building material development, road development, OHV travel, and grazing.

3.12.2.2 Sensitive Wildlife Species

3.12.2.2.1 White-tailed Prairie Dog

The white-tailed prairie dog (*Cynomys leucurus*) is a Utah state species of concern and a BLM sensitive species. The primary population complexes in Utah are the Cisco Complex in Grand County, and the Coyote Basin Complex, part of which is located in the project area. The white-tailed prairie dog is one of three prairie dog species found in Utah, occurring in the northeastern section of the state. The species is also found in parts of Colorado, Wyoming, and Montana. The white-tailed prairie dog has been petitioned for listing under the ESA, and the UDWR has also placed the white-tailed prairie dog on its latest revision of the Utah Sensitive Species List (UDWR 2006b).

The white-tailed prairie dog is a Utah state species of special concern. Threats to this species include historic and current prairie dog control measures (widespread eradication due to its status as an agricultural pest); habitat fragmentation and degradation; and the Sylvatic plague, an introduced disease that dramatically increases mortality rates within colonies and can result in rapid population declines and local extirpations (Parrish et al. 2002).

Similar to other prairie dogs, white-tailed prairie dogs form colonies and spend much of their time in underground burrows, often hibernating during the winter. The white-tailed prairie dog's diet is composed of grasses and bulbs. In turn, the white-tailed prairie dog is the main food source of the Utah population of the endangered black-footed ferret, which was reintroduced to the Coyote Basin of northeastern Utah in 1998. They are also a major food source for the ferruginous hawk. Primary threats to white-tailed prairie dog populations include Sylvatic plague, oil and gas exploration and development, habitat fragmentation and degradation, recreational target shooting, poisoning, and OHV use (Center for Native Ecosystems 2006; UDWR 2003a).

Approximately 15,661 acres of prairie dog habitat is located primarily in the northeast portion of the project area (BLM 2003).

3.12.2.2.2 BIG FREE-TAILED BAT

The big free-tailed bat (*Nyctinomops macrotis*) is a BLM sensitive species, and is also listed as sensitive by the State of Utah due to its limited distribution (UDWR 2000a). This migratory species occurs primarily in the southern half of the state and at far north as north-central Utah (UDWR 2000a) in rocky and woodland habitats, and roosts in caves, mines, old buildings, and rock crevices from 4,297 to 9,200 feet elevation (UDWR 2004). However, the species is known to stray to unexpected locations far from its breeding range, and there is evidence that it may occur as far north as the Wyoming boundary in eastern Utah (UDWR 2000a):

> Bogan and Cryan (2000) reported a specimen of *N. macrotis* from 3 miles west of Jackson, Teton County, Wyoming, which is approximately 103 miles north of the northeast corner of Rich County, Utah. This western Wyoming record may represent wandering, but it is also suggestive of the possibility that this species occurs throughout eastern Utah in proper habitat. High cliffs, such as this bat uses for roosts, are present along many stretches of the Green River in Utah, north (upstream) along its course all the way to the Wyoming border, and may provide suitable roosts for *N. macrotis*.

The wintering habits of big free-tailed bats in Utah are unknown, but it is presumed to migrate out of Utah for the winter. Potential habitats in Utah include lowland riparian, desert shrub, and montane forests; and high cliffs, which bats may use for roosting, and which occur along the Green River. The species has been captured in Utah in desert areas dominated by blackbrush (*Coleogyne ramosissima*), creosote bush (*Larrea tridentata*), sandsage (*Artemisia filifolia*), and snakeweed (*Gutierrezia* spp.), and in riparian habitat dominated by mesquite (*Prosopis* spp.), rabbitbrush (*Chrysothamnus* spp.), salt cedar (*Tamarix pentandra*), and water willow (*Baccharis glutinosa*) (UDWR 2000a). The primary habitat requirements of all bat species are roosts, forage, and water (Luce et al. 2004), which includes portions of the Green River corridor and Nine Mile Canyon in the project area. Potential impacts to the species from noise and reduced habitat and/or prey availability could occur from well development and associated disturbance in the project area.

Approximately 3,969 acres of potential big free-tailed bat roosting, and 129,279 acres of foraging habitat exist in the project area, based on the UDWR species description (2003) and vegetation types present in the project area (USGS 2005; discussed in Section 3.13, Vegetation). The Rocky Mountain Cliff and Canyon vegetation type is considered big free-tailed bat roosting habitat. Foraging habitat includes Colorado Plateau Mixed Low Sagebrush Shrubland, Inter-mountain Basins Big Sagebrush Shrubland, Inter-mountain Basins Greasewood Flat, Inter-mountain Basins Mat Saltbush Shrubland, Inter-mountain Basins Mixed Salt Desert Scrub, Inter-mountain Basins Montane Sagebrush Steppe, Inter-mountain Basins Semi-Desert Shrub Steppe, Invasive Southwest Riparian Woodland and Shrubland, Rocky Mountain Montane Dry–Mesic Mixed Conifer Forest and Woodland, Rocky Mountain Montane Mixed Conifer Forest and Woodland, and Rocky Mountain Lower Montane Riparian Shrubland.

3.12.2.2.3 Spotted Bat

The spotted bat (*Euderma maculatum*) is a BLM sensitive species and is listed as sensitive by the state of Utah. It inhabits a wide variety of habitats, including desert shrub, sagebrush-rabbitbrush, pinyon-juniper woodland, and ponderosa pine and montane forests (UDWR 2000a; Luce et al. 2004). In Utah, the species also uses lowland riparian and montane grassland habitats, and suitable cliff habitats appear to be necessary for roosting and hibernation sites (UDWR 2000a). The spotted bat probably occurs throughout Utah, but records from western and extreme northern Utah (except for the southwest corner) are not known (UDWR 2000a). However, the species is known to be present in all states bordering Utah, including southwestern Wyoming (Luce et al. 2004), and it is likely that the species occurs statewide (UDWR 2000a and references therein). In Utah, the spotted bat is known to occur in lowland riparian, desert shrub, sagebrush–rabbitbrush, ponderosa pine forest, montane grassland, and montane forest habitats from 2,700 to 9,200 feet (UDWR 2000a). Open meadows and riparian areas also appear to be important habitats for the species (UDWR 2000a and references therein). All spotted bat occurrences in Utah have been found in association with canyons with cracks and fissures; high, bare rock walls; and rock ridges close to permanent water (UDWR 2000a). Rocky cliffs near forest foraging sites appears to be the preferred habitat for the species, where it is confined to specific geologic features that provide small crevices or cliff opening roosting sites within approximately 25 miles of foraging habitats (Luce et al. 2004).

Potential threats to the species in the project area include noise, habitat fragmentation, and reduction of habitat and/or prey availability. Impacts associated with oil and gas exploration and development can put considerable pressure on the species (Luce et al. 2004). Seismic exploration, blasting, and road development and associated increases in traffic and access to remote habitats can disturb roosting habitat. Livestock grazing can impact the species by reducing habitat for both the bat and its preferred prey, noctuid moths, which are obligate users of riparian plant species (Luce et al. 2004). The species feeds on moths, grasshoppers, and other insects (Luce et al. 2004), and pesticide use is a potential threat to prey abundance and may also cause detrimental effects due to accumulation through the species' diet (Luce et al. 2004). Because of its specialized habitats and prey selection, the spotted bat is vulnerable to localized impacts that could reduce or isolate its characteristically small, disjunct populations (Luce et al. 2004). In addition, the spotted bat has a very low reproductive potential, and once populations are reduced they rebuild very slowly (BLM 2007). Mortality from drowning in oil reserve pits or other open impoundments of contaminated water associated with oil-drilling operations is a potential threat to all bat species (Luce et al. 2004 and references therein). Such facilities should be covered with netting and maintained to prevent access by bats (Luce et al. 2004). Injury during survey activities and collection as scientific specimens is also a potential threat (UDWR 2000a).

Approximately 3,969 acres of potential spotted bat roosting habitat, and 192,832 acres of potential foraging habitat exist in the project area, based on the UDWR species description (2003) and vegetation types present in the project area (USGS 2005; discussed in Section 3.13, Vegetation). The Rocky Mountain Cliff and Canyon vegetation type is considered spotted bat roosting habitat. Vegetation types included in foraging habitat include Colorado Plateau Mixed Bedrock Canyon and Tableland, Colorado Plateau Mixed Low Sagebrush Shrubland, Colorado Plateau Pinyon-Juniper Shrubland, Colorado Plateau Pinyon-Juniper Woodland, Inter-mountain Basins Big Sagebrush Shrubland, Inter-mountain Basins Greasewood Flat, Inter-mountain Basins Mat Saltbush Shrubland, Inter-mountain Basins Mixed Salt Desert Scrub, Inter-mountain

Basins Montane Sagebrush Steppe, Inter-mountain Basins Semi-Desert Shrub Steppe, Invasive Southwest Riparian Woodland and Shrubland, Rocky Mountain Cliff and Canyon, Rocky Mountain Lower Montane Riparian Shrubland, Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland, Rocky Mountain Montane Mixed Conifer Forest and Woodland.

3.12.2.2.4 Burrowing Owl

The burrowing owl (*Athene cunicularia*) is a Utah state species of concern because it is less abundant than historically documented, and statewide distribution has been greatly reduced (UDWR 2011). In Utah, the species is uncommon during summer in suitable habitat throughout the state. Habitat includes open grasslands, prairies, sagebrush steppe, desert scrub, and other open situations, such as golf courses, cemeteries, and airports. Burrowing owl individuals, nest sites, and suitable habitat have been identified within project area boundaries.

Burrowing owls are tolerant of human activity and have been known to make their homes in cow pastures, fields surrounding airports, ranch and farm land, or in close proximity to highways. In addition, the owls are prey for larger raptors, foxes, and coyotes. It eats mainly terrestrial invertebrates, but also consumes a variety of small vertebrates, including small mammals, birds, frogs, toads, lizards, and snakes. The nest is in a mammal burrow, usually that of a prairie dog, ground squirrel, or badger; if a mammal burrow is not available the owls will sometimes excavate their own nest burrow (Kaufman 1996; UDWR 2002a). Degradation of habitat and the decline of prairie dog species across the western United States are the primary threats to healthy burrowing owl populations. Urban sprawl, conversion of prairie land, road collisions, and exposure to insecticides and other harmful chemicals have negatively impacted owl populations (Sheffield 1997; James et al. 1990; UDWR 2003b).

Four known burrowing owl nests are located primarily in the northern portion of the project area, as are approximately 15,661 acres of prairie dog habitat, which is suitable habitat for burrowing owl (BLM 2003).

3.12.2.2.5 Ferruginous Hawk

The ferruginous hawk (*Buteo regalis*) is a Utah state species of concern, a bird of conservation concern, and a Partner in Flight species. Population numbers are declining across the species' range, and some small, local populations have disappeared in recent years. Primary threats to the species include loss of prey base, removal of nesting trees, and excessive human disturbance during the breeding season (Parrish et al. 2002; UDWR 2003a).

The life history of the species is poorly understood; however, density and productivity of ferruginous hawk populations have been found to be closely associated with cycles of prey abundance (Dechant et al. 1999). The nesting and overwintering dynamics of the species within Utah are also largely unknown (UDWR 2003a).

Ferruginous hawks are extremely sensitive to human disturbance, especially during courtship and incubation periods (Parrish et al. 2002). The primary threats to ferruginous hawk nest productivity and population viability include the human disturbance inherent in mining, gas and oil development; removal of nesting trees; conversion of shrubland habitats to agriculture; and prey base reduction associated with degradation of shrubland habitat. Disturbance to nest sites by OHV use and other recreational activities is also an important threat (Parrish et al. 2002; UDWR 2003a).

In Utah, the ferruginous hawk nests at the edge of juniper habitat, open desert, and grassland habitat in the western, northeastern, and southeastern portions of the state. They have experienced a decline across much of their range and have been extirpated from some of their former breeding grounds in Utah. The ferruginous hawk eats prairie dogs and other rodents (UDWR 2002a).

A total of 57 ferruginous hawk nests have been documented in the project area (BLM 2006f, SWCA 2006, UDWR 2006c), with 13,862 acres within 1/2 mile of a nest site. In addition, approximately 146,294 acres of potential ferruginous hawk foraging habitat exists in the project area, based on the UDWR species description (2003) and vegetation types present in the project area (USGS 2005; discussed in Section 3.13, Vegetation). Vegetation types that are considered foraging habitat include Agriculture, Colorado Plateau Mixed Low Sagebrush Shrubland, Colorado Plateau Pinyon-Juniper Shrubland, Inter-mountain Basins Big Sagebrush Shrubland, Inter-Mountain Basins Greasewood Flat, Inter-mountain Basins Mat Saltbush Shrubland, Inter-Mountain Basins Mixed Salt Desert Scrub, Inter-mountain Basins Montane Sagebrush Steppe, Inter-Mountain Basins Semi-Desert Grassland, Inter-mountain Basins Semi-Desert Shrub Steppe, Invasive Annual Grassland, Rocky Mountain Alpine-Montane Wet Meadow, and Southern Rocky Mountain Montane-Subalpine Grassland.

3.12.2.2.6 BALD EAGLE

The bald eagle (*Haliaeetus leucocephalus*) was formerly listed as threatened in the lower 48 states under the ESA, and was delisted on July 9, 2007 (USFWS 2007d). The species is protected under the Bald Eagle and Golden Eagle Protection Act (Eagle Act of 1940) and the Migratory Bird Treaty Act (MBTA). Threats to the bald eagle identified in its recovery plan (USFWS 1983) include loss of breeding and wintering habitat, human disturbance leading to breeding failure, the effects of organo-chlorine compounds (direct mortality and thin eggshells, which prevent successful hatching), as well as shooting, poisoning, electrocution, and trapping.

In Utah, bald eagles primarily nest in cottonwood-dominated riparian areas. Individuals nest in large trees or snags with sturdy branches in areas that provide adequate food (fish and carrion) and access to open water. During non-breeding periods, especially during winter, bald eagles are relatively social and roost communally in sheltered stands of trees. Wintering areas are commonly associated with open water, though other habitats can be used if food resources such as rabbit or deer carrion are readily available. In the lower 48 states, bald eagles generally avoid areas with nearby human activity and development. Despite the recovery of bald eagle populations in recent decades, only nine nest sites were known in Utah as of 2007 (USFWS 2007d).

Suitable nesting and roosting habitat occurs along the eastern edge of the project area in the Green River riparian corridor. Aerial surveys conducted by the BLM in 2005 documented 11 roosting sites within project area boundaries, for a total of 4,230 acres within 1/2 mile of known roosting sites. Additionally, 1,698 acres of potential roosting and/or nesting (riparian) habitat exists within the project area, and bald eagles have been observed using the winter roosts. Although suitable bald eagle nesting, roosting, and foraging habitat exists in the Green River corridor adjacent to the project area (UDWR 2002a), no nests are known in the area.

3.12.2.2.7 Short-eared Owl

The short-eared owl (*Asio flammeus*) is a Utah state species of special concern. The primary threat to the species is conversion of large, open grassland and shrubland habitats to agriculture. Habitat conversion typically leads to declines in vole and other small mammal populations that short-eared owls depend upon as their primary food source (Dechant et al. 1999). The species breeds in the northern half of Utah, mostly in the northwestern portion of the state, but occurs throughout Utah during non-breeding periods (UDWR 2003 and references therein). The species is less common in eastern Utah. However, local breeding status can be difficult to assess due to the species' tendency to breed opportunistically in response to high rodent densities (UDWR 2003b). Nevertheless, there is some concern that short-eared owl populations are declining, and dramatic population decline has been noted along the Wasatch Front (UDWR 2003b and references therein).

The short-eared owl is a medium-sized owl that frequently flies during daylight, especially at dusk and dawn, as it forages for rodents. This owl is usually found in grasslands, shrublands, and other open habitats. It is nomadic, often choosing a new breeding site each year, depending on local rodent densities. The breeding range covers the northern half of the United States and all of Canada (Ehrlich et al. 1988). In winter, some birds migrate as far south as southern Mexico, though many remain in the vicinity of their breeding grounds as year-round residents. This owl nests beginning in April on the ground in a small depression excavated by the female (Ehrlich et al. 1988).

Vegetation types that are considered potential wintering habitat include Agriculture, Colorado Plateau Mixed Low Sagebrush Shrubland, Colorado Plateau Pinyon-Juniper Shrubland, Inter-mountain Basins Big Sagebrush Shrubland, Inter-mountain Basins Greasewood Flat, Inter-mountain Basins Mat Saltbush Shrubland, Inter-mountain Basins Mixed Salt Desert Scrub, Inter-mountain Basins Montane Sagebrush Steppe, Inter-mountain Basins Semi-Desert Grassland, Inter-mountain Basins Semi-Desert Shrub Steppe, Invasive Annual Grassland, Rocky Mountain Alpine-Montane Wet Meadow, and Southern Rocky Mountain Montane-Subalpine Grassland. Approximately 146,294 acres of potential wintering habitat exists for this species in the project area. This calculation is based on the UDWR species description (2002b) and vegetation types present in the project area (USGS 2005; discussed in Section 3.13, Vegetation).

3.12.2.2.8 Lewis's Woodpecker

The Lewis's woodpecker (*Melanerpes lewis*) is listed as a BLM sensitive species because of its limited distribution within the state and recent range-wide decreases in population size. This woodpecker is a permanent resident to western North America and, in Utah, is found primarily in the riparian habitats of the Uinta Basin and along the Green River. In Utah, the species is widespread, but is an uncommon nester along the Green River. Breeding by this species has been observed in Ouray and Uintah counties, and along Pariette Wash (Kingery 1998, UNHP 2002). The species' occurs in pine forests, riparian areas, and pinyon-juniper woodlands. Breeding from mid-May through mid-August occurs in ponderosa pine and cottonwood woodlands in stream bottoms and farm areas. In Utah, the species inhabits agricultural lands and urban parks, montane and desert riparian woodlands, and submontane shrub habitats. This woodpecker usually feeds on flying insects in open areas interspersed with trees in the spring and summer. It feeds primarily on fruits and nuts in the fall and winter. It is adversely affected by loss of habitat from water development and agricultural practices, and may be increasingly affected by competition for nest cavities from non-native bird species (UDWR 2011).

Approximately 41,529 acres of Lewis's woodpecker habitat exists in the project area, based on the UDWR species description (2003) and vegetation types present in the project area (USGS 2005; discussed in Section 3.13, Vegetation). Vegetation types that are considered Lewis's woodpecker habitat include Agriculture, Colorado Plateau Pinyon-Juniper Shrubland, Colorado Plateau Pinyon-Juniper Woodland, Rocky Mountain Gambel Oak-Mixed Montane Shrubland, Rocky Mountain Lower Montane Riparian Shrubland, and Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland.

3.12.2.2.9 Mountain Plover

In addition to being listed as a BLM sensitive species, the mountain plover (*Charadrius montanus*) is listed as a Utah Partners in Flight (UPIF) priority species (Parrish et al. 2002), and a Utah Natural Heritage Program Critically Imperiled S1 species (UDWR 2010). The species is also listed as a bird of conservation concern for the USFWS Mountain-Prairie Region (USFWS 2008). Mountain plover was originally proposed as threatened under the ESA in 1999, but the proposal was withdrawn in 2003. The proposed rule for listing was reinstated in 2010, and it was determined that the species does not warrant protection under the ESA in May 2011 (USFWS 2011c). The principal threat to mountain plovers in Utah is loss of habitat due to oil and gas development (UDWR 2011).

Most of the mountain plover breeding range is in Colorado, Montana, and Wyoming. However, one known breeding population exists in Utah on Myton Bench in Duchesne County. In Utah, individuals in this population have shown consistent site fidelity, returning to the same breeding site year after year (Manning and White 2001). However, the population is suspected to have greatly declined in recent years, with no new breeding bird sightings since 2002 (UDWR 2011).

In the project area, approximately 22,500 acres have been identified as known mountain plover breeding habitat. Utah mountain plovers tend to differ in habitat choice from the traditional shortgrass prairie habitat generally associated with the species, preferring instead a shrub-steppe habitat type. Breeding birds in this region are found among white-tailed prairie dogs (*Cynomys leucurus*) and near roadways or oil well pads (Manning and White 2001).

3.12.2.3 Sensitive Fish Species

The three sensitive fish species described below do not occur in the project area. However, water withdrawals from the Green River basin and increased sedimentation resulting from road and well-pad construction could affect water levels and quality in the Green River and other potential fish habitat within the Uinta Basin (UDWaR 1999).

3.12.2.3.1 Roundtail Chub

The roundtail chub (*Gila robusta*) is a fairly large minnow native to the Colorado River system of the western United States. The species prefers large rivers, and is most often found in murky pools near strong currents in the mainstem Colorado River, and in the Colorado River's large tributaries. Although locally common in places, roundtail chub have been reduced in numbers and distribution due to flow alteration and the introduction of exotic fishes. Consequently, the roundtail chub is included on the Utah Sensitive Species List (UDWR 2011a).

Roundtail chub eat terrestrial and aquatic insects, mollusks, other invertebrates, fishes, and algae. The species spawns over areas with gravel substrate during the spring and summer. Eggs are fertilized in the water, and then drop to the bottom where they adhere to the substrate until hatching about 4–7 days later (UDWR 2011a).

3.12.2.3.2 Flannelmouth Sucker

The flannelmouth sucker (*Catostomus latipinnis*) is native to the Colorado River system of the western United States and northern Mexico. In Utah, the species occurs in the mainstem Colorado River, as well as in many of the Colorado River's large tributaries. Flannelmouth suckers are usually absent from impoundments. In recent times, Utah flannelmouth sucker populations have been reduced in both numbers and distribution, primarily due to flow alteration, habitat loss/alteration, and the introduction of nonnative fishes. Consequently, the species is included on the Utah Sensitive Species List (UDWR 2011a).

Flannelmouth suckers are benthic (bottom-dwelling) fish that primarily eat algae, although invertebrates and many types of plant matter are also consumed. The species spawns in streams over gravelly areas during the spring and early summer. Flannelmouth suckers prefer large rivers, where they are often found in deep pools of slow-flowing, low-gradient reaches (UDWR 2011a).

3.12.2.3.3 Bluehead Sucker

The bluehead sucker (*Catostomus discobolus*) is native to parts of Arizona, Idaho, New Mexico, Utah, and Wyoming. Specifically, the species occurs in the upper Colorado River system, the Snake River system, and the Lake Bonneville basin. In Utah, bluehead suckers have been reduced in numbers and distribution due to flow alteration, habitat loss/alteration, and the introduction of nonnative fishes. Consequently, the bluehead sucker is included on the *Utah Sensitive Species* List (UDWR 2011a).

The bluehead sucker is a benthic (bottom-dwelling) species with a mouth modified to scrape algae (the primary food of the bluehead sucker) from the surface of rocks. Members of the species spawn in streams during the spring and summer. Fast-flowing water in high-gradient reaches of mountain rivers are considered important habitats for bluehead sucker (UDWR 2011a).

3.12.3 Other Special Status Species

3.12.3.1 Raptors

There are a number of raptor species with the potential to occur in the project area. Several of these species are protected under the MBTA, which is discussed below in Section 3.12.3.2, Migratory Birds. Special habitat needs for raptor species include the protection of nest sites, foraging areas, and roosting or resting sites. Half-mile buffer zones, with the exception of a 1-mile buffer zone for peregrine falcon, are recommended around raptor nest sites during the early spring and summer, when raptors are raising their young. Electrocution from power lines and mortality due to environmental contaminants continue to threaten some raptor species in the project area.

Biologists from the BLM, the UDWR, and SWCA have identified 156 raptor nests in the project area. These include nests for burrowing owl (*Speotyto cunicularia*), ferruginous hawk (*Buteo regalis*), golden eagle (*Aquila chrysaetos*), kestrel (*Falco sparvarius*), prairie falcon (*Falco mexicanus*), red-tailed hawk (*Buteo jamaicensis*), and unknown buteo (*Buteo* spp.). The majority of nests were found in the northern half of the project area; specific nest locations are not mapped in this document to ensure the integrity of the nests and safety of their inhabitants. Assuming that 1/2 mile constitutes the area around each single nest, the sum of these buffered nesting areas totals 37,900 acres across the project area. There are currently 129 miles of roads within 1/2 mile of raptor nests in the project area.

Other raptor species with potential to occur in the project area are Cooper's hawk (*Accipiter cooperi*), the great horned owl (*Bubo virginianus*), the northern harrier (*Circus cyaneus*), the peregrine falcon (*Falco peregrinus*), the rough-legged hawk (*Buteo lagopus*), Swainson's hawk (*Buteo swainsoni*), and the turkey vulture (*Cathartes aura*).

3.12.3.1.1 Golden Eagle

The golden eagle (*Aquila chrysaetos*) is protected by the Bald Eagle and Golden Eagle Protection Act and the MBTA. This species ranges throughout western North America in open, mountainous county, and is quite common in Utah (UDWR 2007). The breeding season occurs from late February to March, with nests constructed on cliffs or in large trees (UDWR 2007). The species is sensitive to disturbance to its nesting area; nests are usually a minimum of 1/2 mile apart, and average territory size is approximately 20–55 square miles (NatureServe 2007). The species primarily eats rabbits, marmots, and ground squirrels, but may also eat insects, snakes, birds, juvenile ungulates, and carrion (NatureServe 2007). A positive correlation between breeding success and jackrabbit abundance has been reported in Utah (NatureServe 2007).

Suitable nesting and roosting habitat occurs along the eastern edge of the project area in the Green River riparian corridor. A total of 30 golden eagle nests have been documented in the project area (BLM 2006f, UDWR 2006c), with 11,690 acres within 1/2 mile of a nest site.

3.12.3.1.2 Peregrine Falcon

The peregrine falcon (*Falco peregrinus*) is listed as a Utah Natural Heritage Program Species of Conservation Concern, and is protected by the MBTA. The species was formerly listed as threatened in the lower 48 states under the ESA, and was de-listed in 1999 (*Federal Register* Notice, Vol. 64, No. 164, August 25, 1999). Threats to the peregrine falcon include loss of wetland habitat of primary prey, the effects of organo-chlorine compounds (direct mortality and thin eggshells, which prevent successful hatching), as well as shooting, poisoning, and trapping (NatureServe 2007). The population in North America suffered tremendous losses leading to the peregrine's listing as an endangered species primarily because of pesticide contamination (especially DDT).

The peregrine falcon is found all over the world. This species is still relatively uncommon in Utah; however, it has become more abundant throughout its range in recent years (UDWR 2007). It inhabits narrow canyons and mountains and open areas, and is frequently found near bodies of water preying upon water birds. Its prey throughout the West includes a variety of birds and bats, which are captured in flight (UDWR 2007). Peregrines primarily nest on cliff ledges, where they scrape a bowl-shaped nest in the substrate.

Suitable nesting and roosting habitat for peregrine falcons occurs along the eastern and southern edges of the project area in the Green River riparian corridor. Impacts to this species are analyzed along with other raptors in Section 3.12.3.1, Raptors.

3.12.3.2 Migratory Birds

The MBTA (16 U.S.C. 703–712) prohibits killing migratory birds (including raptors) or destroying their nests and eggs without a permit. This statute applies to all migratory birds in the U.S. with the exception of a few exotic species, such as the European starling and house sparrow. Executive Order 13186 directs federal agencies taking actions that are likely to have a measurable adverse effect on migratory birds to undertake a number of procedures in support of the MBTA. To comply with this order, federal agencies must ensure that environmental analyses required by NEPA evaluate the effects of plans and actions on migratory birds, with emphasis on species of concern.

There are a variety of neotropical, wading and waterfowl, and other migratory birds with the potential to occur in the project area. Potential occurrence is based on habitat (vegetation) types occurring across the project area (Table 3-26) and the bird species that tend to use these habitat types (most species use more than one habitat [UDWR 2003a]). The total acreage of migratory bird habitat, 206,826 acres, is the sum of the acreages of each relevant habitat type within the project area. Migrating birds often have special habitat needs. The UDWR (2002b) has identified that many migrants rely on riparian corridors for nesting and migration purposes in arid country. The project area includes 1,698 acres of riparian habitat, primarily along the Green River and in the Pariette Wetlands.

Table 3-26. Acres and Percentage of Unfavorable Migratory Bird Habitat in the Project Area Due to Existing Roads

Habitat (Vegetation) Type	Associated Migratory Bird Species	Acres in Project Area	Acres Unfavorable Habitat in Project Area Due to Existing Roads	Percentage Unfavorable Habitat in Project Area Due to Existing Roads
Scrub/Shrub	Black-chinned hummingbird, black-throated gray warbler[1, 2], black-throated sparrow, Brewer's sparrow[2], common raven, gray flycatcher, green-tailed towhee, horned lark, loggerhead shrike[2], mountain plover[2], sage sparrow[1, 2], sage thrasher, Virginia's warbler[1, 2]	119,091	73,910	62%
Evergreen Forest	Black-throated gray warbler[1, 2], black-chinned hummingbird, Brewer's sparrow[2], broad-tailed hummingbird[2], common raven, gray flycatcher, Virginia's warbler[1, 2]	30,430	14,883	49%

Table 3-26. Acres and Percentage of Unfavorable Migratory Bird Habitat in the Project Area Due to Existing Roads

Habitat (Vegetation) Type	Associated Migratory Bird Species	Acres in Project Area	Acres Unfavorable Habitat in Project Area Due to Existing Roads	Percentage Unfavorable Habitat in Project Area Due to Existing Roads
Barren Lands	Common raven, horned lark	29,659	14,088	47%
Grasslands/ Herbaceous	Brewer's sparrow[2], common raven, gray flycatcher, green-tailed towhee, horned lark, loggerhead shrike[2], mountain plover[2], sage sparrow[1, 2], sage thrasher, vesper sparrow, western kingbird	14,562	9,357	64%
Woody Wetland and Open Water	American white pelican, Brewer's sparrow[2], black-chinned hummingbird, black-necked stilt, broad-tailed hummingbird[2], Canada goose, cinnamon teal, common raven, egret, gadwall, heron, horned lark, loggerhead shrike[2], mallard, pintail, sage sparrow[1, 2], sandhill crane, sandpiper, white-faced Ibis, yellow-breasted chat	8,031	5,184	65%
Disturbed and Agricultural Land	Broad-tailed hummingbird[2], loggerhead shrike[2], black-chinned hummingbird, common raven, horned lark, house finch, vesper sparrow, western kingbird, sandhill crane	5,053	3,689	73%
Total		**206,826**	**121,111**	**59%**

[1]Birds of Conservation Concern (BCC) species.
[2]Partners in Flight (PIF) species.

Common neotropical migrants and other small bird species with potential to occur in the project area include the black-chinned hummingbird (*Archilochus alexandri*), black-throated sparrow (*Amphispiza bilineata*), Brewer's sparrow (*Spizella breweri*), common raven (*Corvus corax*), gray flycatcher (*Empidonax wrightii*), green-tailed towhee (*Chlorura chlorura*), horned lark (*Eremophila alpestris*), house finch (*Carpodacus mexicanus*), loggerhead shrike (*Lanius ludovicianus*), sage sparrow (*Amphispiza belli*), sage thrasher (*Oreoscoptes montanus*), vesper sparrow (*Poocetes gramineus*), western kingbird (*Tyrannus verticalis*), and yellow-breasted chat (*Icteria virens*).

Because of the arid climate of the Uinta Basin, migration routes are often associated with riparian corridors and wetland or lake stopover areas. The most important waterfowl habitats within the project area are the Green River riparian corridor and the Pariette Wetlands. The Canada goose (*Branta canadensis*), Cinnamon teal (*Anas cyanoptera*), gadwall (*Anas strepera*), Mallard (*Anas platyrhynchos*), and pintail are the most common waterfowl species observed in these areas. Black-necked stilts (*Himantopus mexicanus*), egrets (*Egretta* spp.), herons (*Ardea* spp.), and various sandpipers are the more common wading birds seen. Other kinds of birds less frequently observed are American white pelican *(Pelacanus erythrorhynchos*), American bittern (*Botaurus lentiginosus*), Sandhill crane (*Grus canadensis*), and white-faced ibis *(Plegadis chihi*).

The USFWS has identified Birds of Conservation Concern (BCC) that occur in various bird conservation regions (BCRs) throughout North America (USFWS 2002e). Partners in Flight, a cooperative effort between federal, state, and local governments, conservation groups, industry, and academics, has developed Bird Conservation Plans (BCPs) for a variety of migratory bird species identified in North America and the neotropics. The BCC and PIF species are noted in Table 3-26.

For most migratory birds, road noise causes disturbance that can lead to various detrimental effects (Forman et al. 2003). Various studies have attempted to determine the distance to which various species are affected by road disturbance. Clark and Karr (1979) found that red-winged blackbird and horned lark populations in croplands were half as large at a distance of 1,000 feet from county roads than at 1,600 feet from the same roads. Other studies of populations near roads with varied widths and traffic levels found behavioral effects up to 9,200 feet away (Forman et al. 2003). It is assumed that if birds avoid the buffer areas around roads—which in some cases might otherwise be considered high-quality habitat—their densities increase in areas away from roads, causing increased competition for resources.

A spatial analysis was conducted to approximate the current acreage of affected migratory bird habitat due to the ecological effects of roads. For this analysis, the potential area of impact consisted of a 1,300-foot buffer along each side of all existing roads. This buffer distance is an average based on applicable literature (Clark and Karr 1979; Donovan et al. 1995; Forman et al. 2003) and was applied to all potential migratory bird habitats (206,826 acres) in the project area. Total acreages of unfavorable habitat (due to fragmentation) were calculated for each vegetation type occurring within the project area, and for the relevant bird species associated with those vegetation types. There are 560 miles of existing roads affecting 121,111 acres (59%) of migratory bird species habitat in the project area. Table 3-26, above, details the acres and percentages of unfavorable habitat due to existing roads for each species within the project area.

3.13 VEGETATION

3.13.1 REGIONAL OVERVIEW

Vegetation in the project area provides direct economic benefits such as livestock grazing, as well as indirect benefits such as wildlife cover, browse, and nesting habitat for a variety of wildlife species. Vegetation also functions in the hydrologic cycle as a dynamic interface between the soil and atmosphere. It intercepts precipitation, retards overland flow, retains soil water and nutrients (root absorption), and transports water and nutrients back to the atmosphere via stems and leaves (evapotranspiration). Vegetation also has aesthetic value and enhances the scenic vistas within the project area.

The State of Utah is divided into five major ecoregions determined by geographic and climatic similarity. The project area occurs entirely within the Colorado Plateau ecological province. Vegetation across the project area ranges from desert shrub to conifer forest. The distribution of vegetation types in the project area is primarily influenced by soil type, elevation, precipitation, and topography, but also by land management activities. Descriptions of the identified vegetation types, including their associated plant species and general locations within the project area, are provided below. The described vegetation associations are intermixed throughout the project area (Map 27).

Land cover vegetation type descriptions and maps were derived from the Southwest Regional Gap Analysis Project (SWReGAP) (USGS 2005). SWReGAP has produced a seamless land cover map for the Southwest Region, which was used to assess the vegetation in the project area. Although SWReGAP data are available at a relatively coarse scale (30-m pixels), they allow a complete assessment of the impacts of each alternative across the entire project area at a level of analysis appropriate to this programmatic EIS.

3.13.2 Vegetation Types

Twenty-five National Land Cover Description (NLCD) vegetation types are present in the project area (Table 3-27). Detailed descriptions of these vegetation types, including species associated with them, are available online from the SWReGAP website at http://ftp.nr.usu.edu/swgap/data/atool/files/swgap_legend_desc.pdf (USGS 2005). These 25 vegetation types can be grouped into nine approximate National Land Cover Classes within the project area (see Table 3-27 and Map 27). In order of abundance, they are Scrub/Shrub, Evergreen Forest, Barren Lands, Grasslands/Herbaceous, Woody Wetland, Disturbed and Agricultural Land, Other, Developed, and Emergent Herbaceous Wetland. All descriptions below are derived from the SWReGAP Land Cover Descriptions (USGS 2005).

Table 3-27. Acres of National Land Cover Description Vegetation Types in the Project Area

National Land Cover Class	National Land Cover Description	Acres in Project Area
Scrub/Shrub	Colorado Plateau Mixed Low Sagebrush Shrubland	56,632
	Colorado Plateau Pinyon-Juniper Shrubland	9,718
	Inter-mountain Basins Big Sagebrush Shrubland	13,242
	Inter-mountain Basins Mat Saltbush Shrubland	1,054
	Inter-mountain Basins Mixed Salt Desert Scrub	38,440
	Rocky Mountain Gambel Oak–Mixed Montane Shrubland	5
	Total Scrub/Shrub	**119,091 (58%)**
Evergreen Forest	Colorado Plateau Pinyon-Juniper Woodland	30,103
	Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland	288
	Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland	40
	Total Evergreen Forest	**30,431 (15%)**

Table 3-27. Acres of National Land Cover Description Vegetation Types in the Project Area

National Land Cover Class	National Land Cover Description	Acres in Project Area
Barren Lands	Colorado Plateau Mixed Bedrock Canyon and Tableland	23,732
	Rocky Mountain Cliff, Canyon, and Massive Bedrock	3,969
	Inter-mountain Basins Shale Badland	1,958
	Total Barren Lands	**29,659 (13%)**
Grasslands/ Herbaceous	Inter-mountain Basins Semi-Desert Shrub Steppe	10,297
	Inter-mountain Basins Semi-Desert Grassland	2,024
	Inter-mountain Basins Montane Sagebrush Steppe	1,439
	Southern Rocky Mountain Montane-Subalpine Grassland	802
	Total Grasslands/Herbaceous	**14,562 (7%)**
Woody Wetland	Inter-mountain Basins Greasewood Flat	6,149
	Rocky Mountain Lower Montane Riparian Woodland and Shrubland	1,212
	Total Woody Wetland	**7,361 (3.6%)**
Disturbed and Agricultural Land	Disturbed Oil Well	25
	Invasive Annual Grassland	4,373
	Invasive Southwest Riparian Woodland and Shrubland	486
	Agriculture	163
	Total Disturbed and Agricultural Land	**5,047 (2.4%)**
Other	Open Water	**667 (0.3%)**
Developed	Developed, Open Space-Low Intensity	**6 (<0.1%)**
Emergent Herbaceous Wetland	Rocky Mountain Alpine–Montane Wet Meadow	**3 (<0.1%)**

3.13.2.1 Scrub/Shrub

The Scrub/Shrub class accounts for more than half of the vegetation (58%) in the project area, and totals approximately 119,091 acres. Areas supporting scrub/shrub vegetation receive low annual precipitation (8–20 inches), which results in very little moisture available for plant growth. Elevations range from 4,800 to 6,000 feet. Soils are often very saline or alkaline and vary in moisture availability from drier, well drained areas to areas where the water table is near the surface (MacMahon 1988). In the project area, dominant shrub species include basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*), Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), black sagebrush (*Artemisia nova*), Bigelow sage (*Artemisia bigelovii*), antelope bitterbrush (*Purshia tridentata*), shadscale (*Atriplex confertifolia*), rabbitbrush (*Chrysothamnus viscidiflorus* and *Ericameria nauseosa*), horsebrush (*Tetradymia* spp.), and sagewort (*Artemisia frigida*). These habitats may be codominated by semiarid grasses, including Indian ricegrass (*Achnatherum hymenoides*), threeawn (*Aristida purpurea*), blue grama (*Bouteloua gracilis*), needle-and-thread (*Hesperostipa comata*), sandberg bluegrass (*Poa secunda*), and bluebunch wheatgrass (*Pseudoroegneria spicata*). Dominant tree species include pinyon pine (*Pinus edulis*), Utah juniper (*Juniperus osteosperma*), and/or Rocky Mountain juniper (*Juniperus scopulorum*). At higher elevations, associated species may include sagebrush (*Artemisia* spp.), greenleaf manzanita (*Arctostaphylos patla*), mountain mahogany (*Cercocarpus* spp.), and Gambel oak (*Quercus gambelii*). The six scrub/shrub vegetation types that occur in the project area (see Table 3-27) are described below.

3.13.2.1.1 Colorado Plateau Mixed Low Sagebrush Shrubland

This ecological system also occurs in the Colorado Plateau, Tavaputs Plateau, and Uinta Basin in canyons, gravelly draws, hilltops, and dry flats at elevations generally below 6,000 feet. Soils are often rocky, shallow, and alkaline. These shrublands and steppe habitats are dominated by sagebrush and semiarid grasses, and they are the most prevalent vegetation cover classes in the project area, covering approximately 56,632 acres, or one quarter, of the project area.

3.13.2.1.2 Colorado Plateau Pinyon-Juniper Shrubland

This ecological system occurs in dry mountains and foothills of the Colorado Plateau region including from the Western Slope of Colorado to the Wasatch Range. It is typically found at lower elevations ranging from 5,000 to 8,000 feet. This vegetation cover type covers 9,718 acres within the project area, and it occurs at higher elevations than Great Basin Pinyon-Juniper Woodland.

3.13.2.1.3 Inter-mountain Basins Big Sagebrush Shrubland

This ecological system occurs throughout much of the western U.S., typically at elevations between 5,000 and 7,500 feet in broad basins between mountain ranges, plains, and foothills. Soils are typically deep, well drained, and non-saline. The Inter-mountain Basins Big Sagebrush Shrubland type covers 13,242 acres within the project area.

3.13.2.1.4 Inter-mountain Basins Mat Saltbush Shrubland

This ecological system occurs on gentle slopes and rolling plains on Mancos Shale in the northern Colorado Plateau and Uinta Basin and on arid, wind-swept basins and plains across parts of Wyoming. Substrates are shallow, typically saline, alkaline, fine-textured soils. These landscapes typically support dwarf shrublands composed of relatively pure stands of shadscale. The Inter-mountain Basins Mat Saltbush Shrubland type covers 1,054 acres within the project area.

3.13.2.1.5 Inter-mountain Basins Mixed Salt Desert Scrub

This widespread shrub-steppe system is dominated by perennial grasses and forbs and occurs throughout much of the northern Great Basin and Wyoming. Soils are typically deep and nonsaline, often with a microphytic crust. Shrubs may increase following heavy grazing and/or with fire suppression. There are 38,440 acres of the Inter-mountain Basins Mixed Salt Desert Scrub type within the project area.

3.13.2.1.6 Rocky Mountain Gambel Oak–Mixed Montane Shrubland

These shrublands are most commonly found along dry foothills and low mountain slopes in the Colorado Plateau including the Uinta and Wasatch ranges from approximately 6,500 to 9,500 feet in elevation, and are often situated above pinyon-juniper woodlands. The vegetation is typically dominated by Gambel oak alone or codominant with serviceberry (*Amelanchier* spp.), big sagebrush, and mountain mahogany. Only five acres are classified as Rocky Mountain Gambel Oak–Mixed Montane Shrubland in the project area.

3.13.2.2 Evergreen Forest

The Evergreen Forest class accounts for 30,431 acres (15%) of the vegetation in the project area. This vegetation class occurs where rainfall averages less than 30 inches per year (15–24 inches), with summer "monsoons" during the growing season contributing substantial moisture. Dominant tree species include pinyon pine, Utah juniper and/or Rocky Mountain juniper, Douglas fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), Engelmann spruce (*Picea engelmannii*), blue spruce (*Picea pungens*), ponderosa pine (*Pinus ponderosa*), and quaking aspen (*Populus tremuloides*). The variable understory may be dominated by desert shrubs, cold deciduous shrubs, graminoids, or it may be absent. Associated species include manzanita, kinnikinnick (*Arctostaphylos uva-ursi*), Oregon grape (*Mahonia repens*), big sagebrush, mountain mahogany, bitterbrush (*Purshia* spp.), Gambel oak, Utah snowberry (*Symphoricarpos oreophilus*), Oregon boxleaf (*Paxistima myrsinites*), Rocky Mountain maple (*Acer glabrum*), bigtooth maple (*Acer grandidentatum*), water birch (*Betula occidentalis*), ninebark (*Physocarpus malvaceus*), and huckleberry (*Vaccinium* spp.). Graminoid and forb species include blue grama, fringed brome (*Bromus ciliatus*), Geyer's sedge (*Carex geyeri*), Ross' sedge (*Carex rossii*), bluebunch wheatgrass, sweet cicely (*Osmorhiza berteroi*), and meadow-rue (*Thalictrum* spp.). The three evergreen forest vegetation types that occur in the project area (see Table 3-27) are described below.

3.13.2.2.1 Colorado Plateau Pinyon-Juniper Woodland

This vegetation type occurs in dry mountains and foothills of the Colorado Plateau region including from the Western Slope of Colorado to the Wasatch Range. These woodlands are typically found at lower elevations ranging from 5,000 to 8,000 feet on warm, dry sites on mountain slopes, mesas, plateaus, and ridges. This system occurs at higher elevations than do the Great Basin Pinyon-Juniper Woodland and Colorado Plateau shrubland systems. There are 30,103 acres of the Colorado Plateau Pinyon-Juniper Woodland type within the project area.

3.13.2.2.2 Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland

This is a highly variable ecological system of the montane zone of the Rocky Mountains that consists of mixed conifer forests occurring on all aspects at elevations ranging from 4,000 to 11,000 feet. There are 288 acres of the Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland within the project area.

3.13.2.2.3 Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland

These are mixed conifer forests that occur from the Rocky Mountains west into the ranges of the Great Basin, occurring predominantly in cool ravines and on north-facing slopes. Elevations range from 4,000 to 11,000 feet. Occurrences of this system are found on lower and middle slopes of ravines; along stream terraces; in moist, concave topographic positions; and on north- and east-facing slopes. The Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland type covers only 40 acres of the project area.

3.13.2.3 Barren Lands

The Barren Lands class accounts for 29,659 acres (13%) of the vegetation cover in the project area. Common species include pinyon pine, ponderosa pine, juniper, mountain mahogany, and other short-shrub and herbaceous species. Characteristic tree species may also include Douglas fir, limber pine (*Pinus flexilis*), quaking aspen, white fir, and subalpine fir (*Abies lasiocarpa*). Scattered shrub species include oceanspray (*Holodiscus* spp.), currant (*Ribes* spp.), ninebark, fivepetal cliffbush (*Jamesia americana*), Oregon grape, skunkbush sumac (*Rhus trilobata*), and serviceberry, and harsher soil conditions support saltbush (*Atriplex corrugata* and *Atriplex gardneri*) and sagebrush. The three Barren Lands vegetation types that occur in the project area (see Table 3-27) are described below.

3.13.2.3.1 Colorado Plateau Mixed Bedrock Canyon and Tableland

The distribution of this ecological system is centered on the Colorado Plateau where it is composed of barren and sparsely vegetated landscapes on steep cliff faces, narrow canyons, and open tablelands of predominantly sedimentary rocks, such as sandstone, shale, and limestone. The vegetation is characterized by very open tree canopy or scattered trees and shrubs with a sparse herbaceous layer. The Colorado Plateau Mixed Bedrock Canyon and Tableland type covers 23,732 acres of the project area.

3.13.2.3.2 Rocky Mountain Cliff, Canyon, and Massive Bedrock

This barren and sparsely vegetated system is found from foothill to subalpine elevations on steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock types. There may be small patches of dense vegetation, but the type typically includes scattered trees and/or shrubs. Soil development is limited, as is herbaceous cover. The Rocky Mountain Cliff, Canyon, and Massive Bedrock type covers 3,969 acres of the project area.

3.13.2.3.3 Inter-mountain Basins Shale Badland

This widespread ecological system of the intermountain western U.S. is composed of barren and sparsely vegetated substrates typically derived from marine shales, but it also includes substrates derived from siltstones and mudstones (clay) with a high rate of erosion and deposition. Landforms are typically rounded hills and plains that form a rolling topography. The Inter-mountain Basins Shale Badland type covers 1,958 acres within the project area.

3.13.2.4 Grasslands/ Herbaceous

The Grasslands/Herbaceous class accounts for 14,562 acres (7%) of vegetation in the project area. Dominant species include saltbush, big sagebrush, rabbitbrush, Mormon tea (*Ephedra nevadensis*), hopsage (*Grayia spinosa*), winterfat (*Krascheninnikovia lanata*), bud sagebrush (*Picrothamnus desertorum*), and horsebrush. The herbaceous layer varies from sparse to moderately dense and is dominated by perennial graminoids including Indian ricegrass, blue grama, thickspike wheatgrass (*Elymus lanceolatus* ssp. *lanceolatus*), galleta (*Pleuraphis* spp.), threeawn, needle-and-thread, fescue (*Festuca* spp.), pinegrass (*Calamagrostis rubescens*), oatgrass (*Danthonia* spp.), and bluebunch wheatgrass. At higher elevations, common shrubs may include snowberry, serviceberry, and squaw apple (*Peraphyllum ramosissimum*). These large-patch grasslands are intermixed with matrix stands of spruce and fir, lodgepole pine, ponderosa pine, and aspen forests. The four grasslands/herbaceous vegetation types that occur in the project area (see Table 3-27) are described below.

3.13.2.4.1 Inter-mountain Basins Semi-Desert Shrub Steppe

This extensive ecological system includes open-canopied shrublands of typically saline basins, alluvial slopes, and plains across the intermountain western U.S. Substrates are often saline and calcareous, medium- to fine-textured, alkaline soils, but they can include some coarser-textured soils. The vegetation is characterized by a typically open to moderately dense shrubland composed of one or more *Atriplex* species, with a sparse to moderately dense herbaceous layer dominated by perennial grasses. The Inter-mountain Basins Semi-Desert Shrub Steppe type covers 10,297 acres of the project area.

3.13.2.4.2 Inter-mountain Basins Semi-Desert Grassland

This widespread ecological system occurs throughout the intermountain western U.S. on dry plains and mesas at approximately 4,750–7,600 feet in elevation. These grasslands occur in lowland and upland areas and may occupy swales, playas, mesa tops, plateau parks, alluvial flats, and plains, but sites are typically xeric. The dominant perennial bunch grasses and shrubs within this system are all very drought-resistant. The Inter-mountain Basins Semi-Desert Grassland type covers 2,024 acres within the project area.

3.13.2.4.3 Inter-mountain Basins Montane Sagebrush Steppe

This ecological system includes sagebrush communities occurring at montane and subalpine elevations across the western U.S. from 3,300 feet to over 9,850 feet in the southern Rockies. In many areas, frequent wildfires maintain an open herbaceous-rich steppe condition, although at most sites shrub cover can be more than 40% with high grass and forb cover. The Inter-mountain Basins Montane Sagebrush Steppe type covers 1,439 acres of the project area.

3.13.2.4.4 Southern Rocky Mountain Montane-Subalpine Grassland

This Rocky Mountain ecological system typically occurs between 7,200 and 9,850 feet on flat to rolling plains and parks or on lower sideslopes that are dry, but it may extend up to 11,000 feet. The Southern Rocky Mountain Montane-Subalpine Grassland type covers 802 acres of the project area.

3.13.2.5 Woody Wetland

The Woody Wetland class accounts for 7,361 acres (3.6%) of vegetation cover in the project area. This system usually occurs as a mosaic of multiple communities, with open to moderately dense shrublands often surrounded by mixed salt desert scrub. Vegetation is typically dominated by a variety of shrubs including greasewood (*Sarcobatus vermiculatus*), saltbush, or winterfat, with Utah serviceberry (*Amelanchier utahensis*), mountain mahogany, Utah snowberry, and soapweed (*Yucca glauca*) at higher elevations. The herbaceous layer, if present, is usually dominated by graminoids including alkali sacaton (*Sporobolus airoides*), saltgrass (*Distichlis spicata*), common spikerush (*Eleocharis palustris*), grama, muhly (*Muhlenbergia* spp.), and bluebunch wheatgrass. Fires play an important role in this system because the dominant shrubs usually have a severe dieback, and fire suppression may have allowed an invasion of trees into some of these shrublands. In many cases sites are too xeric for tree growth. The two Woody Wetland vegetation types that occur in the project area (see Table 3-27) are described below.

3.13.2.5.1 Inter-mountain Basins Greasewood Flat

This ecological system occurs throughout much of the western U.S. in intermountain basins and extends onto the western Great Plains. It typically occurs near drainages on stream terraces and flats or may form rings around more sparsely vegetated playas. Sites typically have saline soils and a shallow water table. They may flood intermittently but remain dry for most growing seasons. The Inter-mountain Basins Greasewood Flat type occurs on 6,149 acres of the project area.

3.13.2.5.2 Rocky Mountain Lower Montane Riparian Woodland and Shrubland

This ecological system is found in the foothills, canyon slopes, and lower mountains of the Rocky Mountains and on outcrops and canyon slopes in the western Great Plains. These shrublands occur between 5,000 and 9,500 feet in elevation and are usually associated with exposed sites, rocky substrates, and dry conditions, all of which limit tree growth. The Rocky Mountain Lower Montane Riparian Woodland and Shrubland type occurs on 1,212 acres of the project area.

3.13.2.6 Disturbed and Agricultural Land

The Disturbed Land class accounts for 5,047 acres (2.4%) of the project area. The three cover types are Disturbed Oil Well, Invasive Annual Grassland, Invasive Southwest Riparian Woodland and Shrubland, and Agriculture. The SWReGAP database indicates 25 acres of disturbed vegetation or otherwise barren areas that are associated with dispersed oil well sites, but this area has increased since SWReGAP was assembled. The Invasive Annual Grassland type covers approximately 4,373 acres within the project area. These areas are dominated by introduced annual grass species such as cheatgrass (*Bromus tectorum*) and California brome (*Bromus carinatus*). The Invasive Southwest Ripararian Woodland and Shrubland type covers 486 acres and is dominated by tamarisk (*Tamarix* spp.) and Russian olive (*Elaeagnus angustifolius*).

Agriculture is an aggregated land cover type that includes both pasture/hay, areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops. Pasture/Hay vegetation accounts for more than 20% of total vegetation. Cultivated crop areas include areas used for the production of annual crops. Crop vegetation also accounts for more than 20% of total vegetation. Agriculture cover types also include all land being actively tilled. Agriculture occurs on 163 acres within the project area.

3.13.2.7 Other

Under the class of Other, there are 667 acres of open water in the project area.

3.13.2.8 Developed

The Developed class accounts for six acres of the project area and includes the Developed, Open Space–Low Intensity cover type. Open Space–Low Intensity includes areas with a mixture of construction materials, but is mostly vegetation in the form of lawn grasses. Impervious surfaces (pavement) account for less than 20% of total cover. Developed–Low Intensity includes areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20–49% of total cover. The Developed, Open Space-Low Intensity type occurs on six acres of parking and recreational facilities for the Pariette Wetlands within the project area.

3.13.2.9 Emergent Herbaceous Wetland

Rocky Mountain Alpine Montane Wet Meadow is the only vegetation type within the Emergent Herbaceous Wetland class. These are high-elevation communities found throughout the Rocky Mountains and intermountain regions between 3,300 and 11,800 feet in elevation. These systems are dominated by herbaceous species found on wetter sites with very low-velocity surface and subsurface flows. They occur as large meadows in montane or subalpine valleys; as narrow strips bordering ponds, lakes, and streams; and along toe-slope seeps. This system often occurs as a mosaic of several plant associations, often dominated by graminoids, including reedgrass (*Calamagrostis stricta*), sheep sedge (*Carex illota*), smallwing sedge (*Carex microptera*), black alpine sedge (*Carex nigricans*), tufted hairgrass (*Deschampsia caespitosa*), fewflower spikerush (*Eleocharis quinqueflora*), and Drummond's rush (*Juncus drummondii*). Herbaceous species include white marsh marigold (*Caltha leptosepala*), heartleaf bittercress (*Cardamine cordifolia*), alpine yellowcress (*Rorippa alpina*), and globeflower (*Trollius laxus*). Wet meadows are tightly associated with snowmelt and typically not subjected to high-disturbance events such as flooding. The Rocky Mountain Alpine-Montane Wet Meadow type occupies only three acres of the project area.

3.13.3 Invasive and Noxious Weeds

Potential and existing populations of invasive plant species in and near areas of high human activity are of particular management concern in the project area. Human activities, OHV and vehicle use, construction activities, soil disturbance, wind, wildlife movement, and domestic livestock grazing can all increase the spread and establishment of noxious weeds. Noxious weeds are identified and recognized by the federal government, the state, and local counties. Noxious and invasive weeds of particular concern in the project area include cheatgrass, halogeton (*Halogeton glomeratus*), Russian thistle (*Salsola iberica*), salt cedar (*Tamarix ramosissima*), Russian olive (*Elaeagnus angustifolia*) and perennial pepperweed (*Lepidium latifolium*).

As discussed in Section 3.13.2.6, Disturbed and Agricultural Land, the SWReGAP database (USGS 2005) indicates that 4,373 acres, or 2.11%, of the project area can be characterized as an invasive annual grassland of cheatgrass (see Table 3-27). However, this invasive plant species may occur in other vegetation types as well. Cheatgrass occurs primarily in the northeast corner and in the middle of the project area, where it has obtained a widespread distribution from ridge tops to washes.

Halogeton, the most abundant weed species in the project area, is a native of Asia that has rapidly invaded millions of acres in the western U.S., and is ideally suited to the alkaline soils and arid environments within this project area. Halogeton establishes on disturbed soils, and is typically kept out of healthy plant communities through competition (personal communication between Jessie Salix, BLM, and Tamara Naumann, NPS, November 2007). Halogeton produces toxic oxalates that are especially poisonous to sheep, although cattle may also be affected.

Russian thistle occurs throughout the project area on disturbed soils, but is less common than cheatgrass and halogeton. It also is well adapted to the arid environment within the project area.

Invasive Southwest Riparian Woodland and Shrubland type derived from the SWReGAP database includes 486 acres, or 0.23%, of the project area (see Table 3-27). Introduced riparian woody species such as tamarisk and Russian olive dominate this vegetation type in the northeast corner in Pariette Draw and along the east side of the project area by the Green River. Washes throughout the project area also have isolated tamarisk populations. Tamarisk and Russian olive are both designated noxious weeds of Uintah County.

Perennial pepperweed is found along the Green River corridor and up washes in adjacent side canyons. Originally a native of southern Europe and western Asia, it often occurs concurrently with the Invasive Southwest Riparian Woodland and Shrubland type. In 1998, it was mapped in Four Mile Wash, and was observed in Sandwash and Pariette Draw in 2006. Perennial pepperweed is a state-designated noxious weed.

3.14 VISUAL RESOURCES

The proposed project area lies within the Uinta Basin of the Colorado Plateau physiographic province. The general visual characteristics of the Uinta Basin topography west of the Green River can be described as relatively flat with wide, shallow valleys not more than a few hundred feet below the surrounding country (Stokes 1986). The landscape is composed of scenery that is typical of the central Uinta Basin: a predominance of shallow, gently rolling hills and drainages; shale-colored bluffs and steeply incised drainages near the Green River and Nine Mile Canyon; distant views of the Uinta Mountains to the north, the Roan Cliffs and Book Cliffs to the south, and the Wasatch foothills to the west. North of Nine Mile Canyon, the landscape rises from deeply incised canyons to a narrow plateau that abruptly rises to form the Bad Land Cliffs.

There is no human habitation within the project area, but oil and gas activities, structures, and surface disturbances are present in much of the project area. Modifications of the landform and vegetation, and placement of structures on the land, are most prevalent in the northern and central portions of the project area and development is also progressing south in the project area. However, there are still areas in the vicinity of Nine Mile Canyon and the Green River that are mostly undeveloped and exhibit a natural landscape. Lands north of Nine Mile Canyon and south of the Wrinkle Road, and lands north of Sand Wash, including the Green River, are parts of an area inventoried and found to have natural landscape character and an appearance of naturalness (BLM 2007a). Although most of these lands are not being managed to protect natural landscapes, they are large, roadless, and sparsely developed. The lands around Nine Mile Canyon and the Green River exhibit these landscape characteristics (see Map 28). Visual Resource Management objectives are discussed below.

The project area is vegetated by plants typical of the desert shrub, sagebrush, and pinyon-juniper woodland vegetation groups in the area: pinyon pine, juniper, shadscale, winterfat, saltbush, halogeton, rabbitbrush, ephedra, sagebrush, and perennial grasses (for a detailed description of resident vegetation, see Section 3.13, Vegetation).

3.14.1 Visual Resources Management (VRM)

The project area lies within BLM-administered public land that has been inventoried and is managed for its visual resources. The BLM uses a Visual Resource Management (VRM) system to inventory and manage visual resources on public lands. The primary objective of VRM is to manage visual resources so that the quality of scenic (visual) values is protected (BLM 1992). The VRM system uses four classes (and their associated visual resource objectives) to describe the different degrees of surface disturbance or modification allowed on the landscape (see Table 3-28 below). The classes are visual ratings that describe an area in terms of visual quality, viewer sensitivity to the landscape (i.e., the public's perception of the importance of scenery and scenic quality within an area), and the distance from which a viewer would be likely to observe an area (BLM 1986). The area's BLM-designated VRM class and visual resource objectives can be used to analyze and determine the visual impacts of proposed activities on the land, and to gauge the amount of disturbance an area can tolerate before it exceeds the visual objectives of its VRM class (BLM 1980).

Table 3-28. BLM Visual Resource Management (VRM) Class Objectives

VRM Class	VRM Objective
Class I	The objective of this class is to preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and should not attract attention.
Class II	The objective of this class is to 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. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.
Class III	The objective of this class is to 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 found in the predominant natural features of the characteristic landscape.

Table 3-28. BLM Visual Resource Management (VRM) Class Objectives

VRM Class	VRM Objective
Class IV	The objective of this class is to provide for management activities, which require major modification 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 repeating the basic elements of the landscape.

Source: BLM (1992).

The Vernal RMP manages the BLM-administered lands in the project area under VRM Class I, II, III, and IV objectives. The designation of these management classes was based on resource use of the area, the area's visual quality and viewer sensitivity, the level of use by the public, and the type of visitor use that the area receives (BLM 1992). Public visitation within the proposed project area is not high; however, areas adjacent to the project area (Nine Mile Canyon and the Green River corridor), are high-quality recreational and scenic destinations (see Section 3.8.2, Recreational Opportunities).

The proposed project area would encompass approximately 177,520 acres and the number of acres of each VRM class tabulated below in Table 3-29.

Table 3-29. VRM Designations in the Project Area

VRM Class	Acres of Project Area	Percent of Project Area
I	257	0.1
II	13,273	7.5
III	47,529	26.8
IV	116,461	65.6
Total	**177,520**	**100**

3.14.2 Key Observation Points (KOPs) and Contrast Analysis

The BLM uses the VRM system and the four VRM classes to determine the visual impacts of proposed activities on BLM-administered public land. The VRM system is also used to determine the level of disturbance an area can tolerate before it exceeds the visual objectives of each VRM class. The method that the BLM uses to determine whether proposed projects conform to VRM class objectives is a contrast rating system that evaluates the effects of proposed projects on visual resources.

Contrast rating is done from critical viewpoints, known as key observation points (KOPs), which are usually found along commonly traveled routes such as highways, access roads, or trails. A KOP can either be a single point of view that an observer/evaluator uses to rate an area or panorama, or it can describe a series of sequential views that may be experienced from a linear feature (e.g., along a roadway, trail, or river corridor). Factors considered in selecting KOPs are as follows: the angle of observation or slope of the proposed project area; the number of viewers of the project area; the length of time that the project is in view; the relative size of the project;

the season of use; and light conditions. The evaluator rates the degree of visual contrasts based on form, line, color, and texture changes between the existing visual character of the landscapes and how the landscapes would look after project disturbance. The contrast ratings, recorded on a BLM contrast rating worksheet (BLM Form 8400-4) during a site visit to the KOP, can then be used to determine whether or not the level of disturbance associated with the proposed project would exceed the VRM objectives for that area (BLM 1986).

Public views of the proposed project area, as described in the Proposed Action, would be from public travel routes and recreational use areas within the vicinity of the project area. The proposed project area's most visually sensitive locales are within and north of Nine Mile Canyon (VRM Class II and Class III) and within the Green River corridor (VRM Class I and Class II). Accordingly, KOPs were selected to represent the effects of the Proposed Action within these areas, as well as from the Green River corridor bluffs looking into the project area.

Seven KOPs were selected using the selection criteria described above, and each KOP is described in detail below. The KOP locations within Nine Mile Canyon and along Wrinkle and Sand Wash roads were determined from an ArcView® GIS viewshed analysis that showed the proposed well sites that would be visible from the Nine Mile Canyon access road and along Wrinkle and Sand Wash roads. It should be noted that the Nine Mile Canyon access road is gated and fenced near the turnoff for the Cottonwood Canyon petroglyph sites, and some potentially visible proposed well sites would be located near the access road. But because these sites are not accessible to the public and/or located on private or state lands, it is not appropriate to locate KOPs in these areas.

3.14.2.1 KOP 1—Green River Shoreline

KOP1 is located on the western shore of the Green River, within the river's riparian corridor, and this location is designated as VRM Class II. This KOP was chosen because it provides representative views of drilling and production activity and facilities by recreationists along the river corridor. This area is characterized by dense stands of tamarisk and cottonwood. The view is to the northwest, where proposed well-pad development would be constructed. The foreground topography is flat, and foreground views are generally obstructed by the dense shoreline vegetation. Middle ground views are dominated by the rugged upper slopes of the shale cliffs and bluffs that overlook the river corridor, with other middle ground features obscured by vegetation. Background views are obscured by the close proximity to and the height of the river corridor cliffs and slopes (see Figure 1 in Appendix C).

3.14.2.2 KOP 2—Fourmile Bottom

This viewpoint is at a point along the Green River floodplain where the Fourmile Bottom access road provides public access to and from the Green River and opportunities for camping and other recreational activities along the river (see Figure 2 in Appendix C). This location was chosen as a KOP because 1) the aforementioned access road and riverside recreational opportunities would allow the public to potentially view gas exploration and development activities within the VRM Class II area, and 2) under the Proposed Action, well pads would be located near this potential public viewing area. The views are to the southwest, west, and northwest along the Fourmile Bottom access road, looking up the river bluffs toward the proposed project area. Foreground views are of the smooth-to-moderately textured gray- and buff-colored shale slopes and bluffs that define the western edge of the river's floodplain, the dense bright green riparian vegetation on the floodplain, and the dull green, uniformly sparse vegetation along the slopes. The middle ground comprises indistinct views of the slopes and hills behind the Green River floodplain. Background views to the west are blocked by the close proximity of the hills and bluffs near the river. Views west and southwest are of mostly undeveloped lands inventoried and found to have natural character (BLM 2007a). All the foreground views and much of the middle ground views are managed under VRM II objectives.

3.14.2.3 KOP 3—West of Blind Canyon

The point of view from this KOP is to the north within Nine Mile Canyon along the canyon's access road, looking up a shallow, steep canyon toward the location of a proposed well development (see Figure 3 in Appendix C). This KOP was selected because 1) it lies along the Nine Mile Canyon access road, and 2) because well pads are proposed for drilling in this area. The viewshed along the access road and views north are designated as VRM Class III. Foreground views comprise a variety of vegetation forms, colors, and patterns interspersed with changes in soil color. Immediate foreground views are of dense sagebrush and light-colored soil near the road that make a gradual transition to regular clumps of low shrubs and darker tan soils at the far edge of the foreground view. The foreground views are defined by the base of the canyon's steep cliffs. Middle ground views are of the canyon's steep cliffs, ledges, and rock outcrops. These features create moderate to strong color, form, and texture contrasts with the soil and vegetation features that form the floor of the canyon. The cliffs are generally dark brown to tan, blocky, and massive. Dark green vegetation grows along the upper cliff ledges and along the canyon ridgeline. Variations in coloring of the rock strata at the far edge of the middleview create interesting color contrasts and, in combination with the converging canyon walls, tend to draw the viewer's attention toward the top-center of the canyon. As with the other KOPs, a strong line is created by the color contrast between the uniformly intense blue sky and the color, form, and texture variations of rock and vegetation along the ridgeline. There are no background views because the access road runs close to the base of this canyon, which obscures any distant views of features that lie behind the canyon. The view north and northeast from this KOP features a mostly undeveloped landscape inventoried and found to have natural character (BLM 2007a).

3.14.2.4 KOP 4—Wild Horse Bench

The views from the Wild Horse Bench KOP are to the west looking across the Green River floodplain into the project area (see Figure 4 in Appendix C). The KOP is on an access road that passes along the edge of an escarpment that defines the eastern edge of the Green River floodplain on the far (east) side of the river from the project area. This KOP was chosen because 1) it provides clear, unobstructed views of potential visual impacts within the proposed project area, 2) the locale is a high point near the Green River bluffs with views of the designated VRM Class II river corridor and floodplain and VRM Class IV areas beyond the river corridor, and 3) because of potential public OHV access to the river near this viewpoint. Foreground views are dominated by uniformly sparse vegetation, interspersed with occasional juniper trees, growing along the eroded shale slopes that drop down toward the floodplain. The slopes are gray and buff-colored and fine-to-medium textured, and present a low contrast when compared with other foreground views that comprise the surrounding landscape.

Middle ground views are of the Green River and the river floodplain, the far side cliffs and escarpments, and the edge of the plateau that generally defines the eastern edge of the proposed project area. This view results from the contrasts between the river and surrounding landscape: the smooth, linear texture of light-colored sandbars, and green riverside vegetation and water presents a strong contrast with the surrounding arid, linear, horizontally striated, rough-textured rock in the middle ground and foreground. The river floodplain dominates the middle ground view, and the eye is immediately drawn to its features. Background views comprise gently undulating, fine-textured, muted gray hills, low mesas, and distant mountains. Human-made features in the background include occasional, indistinct dirt roads and drilling well pads. Background views southwest (>2 miles) are of mostly undeveloped landscapes inventoried and found to have natural character (BLM 2007a). The immediate foreground views and background views are designated as VRM Class IV and the middle ground views along the Green River corridor and floodplain are designated as VRM Class II.

3.14.2.5 KOP 5— Sand Wash Road

This KOP was selected because 1) it lies along a primary access road to the Green River for recreational river users (originating at State Route 40 near Myton), 2) because well pads are proposed for drilling in this area, and 3) because this locale provides unobscured views of the surrounding landscape. The viewshed along the access road where this KOP is located is designated as VRM Class III, and the KOP is situated at a point where Sand Wash Road emerges from the wash into a relatively open area (see Figure 5 in Appendix C). Foreground views dominate most of the viewscape, and landscape forms are diverse, ranging from relatively flat to gently sloping ground near the roadway to nearly vertical, rugged, rocky cliffs and rocky outcrops in the far foreground. Linear contrasts are created by horizontal bands of sedimentary rock along the cliff walls and slopes. Colors comprise buff, tan, and reddish brown colored exposed rock and soil; and gray and light and dark green-colored vegetation. Textures are coarse along the cliff and steep slopes, but fine along the road and near foreground. Vegetation is generally low-growing, thick on the lower slopes, but gradually diminishing on the upper slopes.

Middle ground views are confined to the southeastern and eastern viewing direction, because the surrounding foreground cliffs obscure most of the middle ground and background. Views are dominated by the rugged, vertical cliffs and horizontal plateau above the Green River floodplain. Rock and soil colors are similar to those described for the foreground, and vegetation colors are indistinct at this viewing distance. The linear, horizontal, and undulating plateau edge is clearly visible. As mentioned, background views are not visible because of the height of the foreground and middle ground topography.

3.14.2.6 KOP 6—Wrinkle Road

Located at the intersection of Wrinkle Road and the OHV trail leading into Franks Canyon, this KOP was chosen because 1) it is along the southern access to the Green River for river recreationists, 2) an OHV trail leads down into Franks Canyon and VRM Class II landscapes to the south, and 3) proposed wells and spur roads would be constructed along the roadway. The VRM designation for the roadway and areas to the north, west, and east are VRM Class III; however, middle ground areas to the south (and within the KOP viewscape) are designated as VRM Class II. In the foreground, views to the south are of a relatively flat plateau-like landscape interrupted by deeply incised canyons and drainages that descend toward Nine Mile Canyon (see

Figure 6 in Appendix C). Views to the east, north, and west are dominated by the rapidly rising hills and lower slopes of the Bad Land Cliffs. Horizontal, linear contrasts are created by colored rock strata along the exposed rock faces of the cliff and the hills below the cliff. A linear edge effect is created where the landscape abruptly changes from flat plateau to steep hills and slopes. This topographic change also creates a distinctive and rapid change in vegetation coverage, from dense on the flats to sparse on the slopes. Landscape colors are similar to those described for KOP 5: dark and light green, gray vegetation; reddish brown, tan, and buff-colored rock.

Middle ground views to the south and east are of the flat to undulating landscapes and upper cliffs on the far side of the Green River. Views to the west are similarly flat, but are of the incised canyons north of Nine Mile Canyon. Landscape colors are indistinct, but dominated by the vegetation colors described above for the foreground. Landscape lines are dominated by the silhouette-effect of the Green River plateau with the background sky. Textures are fine. Middle ground and background views to the north are obscured by the Bad Land Cliffs. Background views to the south and southeast show the rugged, vertical, upper cliffs of Desolation Canyon and the flat plateau of the East Tavaputs. Landscape lines, textures, and colors are indistinct from this KOP, but alternating bands of dark vegetation and tan-colored, exposed cliff rock are visible. Background views to the west are of an undulating and simple horizon, occasionally broken by patches of trees.

3.14.2.7 KOP 7—Wrinkle Road and Devils Canyon

KOP 7 is located near the head of Devils Canyon where it intersects Wrinkle Road. This locale was chosen because 1) it is representative of the western portion of the road where natural gas developments exists, 2) it is the primary southern access to the Green River for river recreationists, 3) it is where proposed well pads and spur roads would be constructed (see Figure 7 in Appendix C). The designated VRM Class for this area is VRM Class III. Foreground views and landscape features are similar to those describe for KOP 6. Additional foreground features include an increased coverage of conifers on the flats, steeper slopes and cliff tops in the southern far foreground. Deep drainages and canyons are visible and are close to the roadway, creating diversity in form, color, line, and texture. A surface-laid gas pipeline follows the road edge and a gas well pad and infrastructure, and access roads are visible in the far foreground.

Middle ground views are generally obscured to the north, west, and east by the height of the Bad Land Cliffs, but the continuous cliff escarpments continue into the middle distance to the east and west, and present a similar, but less distinct, view as described for the foreground. Views to the south are of a tilted, slightly rising plateau-like landscape dominated by a line of conifers on the horizon. Background views are similar to those described for KOP 6: indistinct views of the vertical Desolation Canyon cliffs and the horizontal Tavaputs Plateau to the east, with northern, western, and southern views entirely obscured either by the cliffs or the rising plateau above Nine Mile Canyon.

3.15 WATER RESOURCES

3.15.1 REGIONAL OVERVIEW

The project area lies within an arid to semi-arid region in the Uinta Basin of northeastern Utah. The Uinta Basin covers 6,969,600 acres (10,890 square miles) and is divided into two drainages—the north slope and the south slope of the Uinta Mountains. The north slope is bounded by the Wyoming border to the north, the Uinta Mountains to the south, the Colorado border to the east, and the Bear River Basin to the west. The south slope is bounded by the Uinta Mountains to the north, the Tavaputs Plateau and the Book Cliffs to the south, Diamond Mountain and the Colorado border to the east, and the Wasatch Mountains to the west. Kings Peak, in the Uinta Mountains, is the highest point in the basin (13,528 feet). The lowest point in the basin (4,150 feet) lies where the Green River exits the basin above its confluence with the Price River.

The north slope of the Uinta Basin is drained by the Green River. Its primary tributary, the Duchesne River, drains the south slope. The eastern portion of the Uinta Basin, including a part of Colorado, is drained by the White River, which is also a tributary to the Green River. The Utah Division of Water Resources (UDWaR) has divided the Uinta Basin into five subunits: Upper Green, Ashley/Brush, Duchesne/Strawberry, Green, and White (UDWaR 1999). The proposed project area lies in the Green subunit directly west of and including the Green River, and where the Duchesne, Uintah, and Carbon County lines meet. Pariette Draw and Eightmile Flat are in the far northeastern portion of the project area and Gilsonite Draw is in the northwestern part of the project area. The southern and northern boundaries of the project area are the Carbon County line and Nine Mile Canyon and the Pariette Bench, respectively (Map 1).

The Green subunit consists of the Tavaputs Plateau and the Green River Valley. The Tavaputs Plateau rises to the south with the dip of the Green River geologic formation on which it sits. Divides between streams are broad, and consist of a series of discontinuous cuestas formed by local sandstones and hardened limey and siliceous zones. Streams and dry washes are deeply incised in canyons with distances of half a mile to a mile between tributary drainages. The subunit is completely drained, with the largest streams (i.e., Indian Canyon Creek, Antelope Creek, and Nine Mile Creek) developing small floodplains along their lower courses. Most erosion is caused by flash floods (UDWaR 1999).

Soils within the Green subunit are highly variable. Restrictive features include water and wind erodibility, salinity, excess sodium, alkalinity, rooting depth, and droughtiness. Moderate to high water erodibility is found on 1,134 acres, and moderate to high wind erodibility is found on 36,242 acres of the project area. Moderate to high salinity is found on 16,795 acres in the project area. The majority of the project area, 146,253 acres, contains soils with moderate to high excess sodium. Similarly, moderate to high soil alkalinity is found on 152,604 acres of the project area. High risk due to low rooting depth is found on 74,288 acres. Finally, soils on 116,175 acres of the project area are considered moderately to highly droughty. Soils are discussed in more depth in Section 3.10, Soils.

3.15.2 GROUNDWATER RESOURCES

Groundwater occurs and is conveyed in underground aquifers, which may consist of unconsolidated or consolidated materials. Unconsolidated alluvial aquifers, which are usually unconfined, are generally found in recent geologic formations. Consolidated aquifers, which tend to be found in older geologic formations, are generally unconfined near outcrops and confined at greater depth beneath the earth's surface. Multiple aquifers may underlie any given location on the land surface. These aquifers may have distinct characteristics of chemical makeup and hydraulic potential and may be recharged in different locations and flow in different directions.

3.15.2.1 OCCURRENCE OF GROUNDWATER RESOURCES

An estimated 31 million acre-feet of groundwater, without regard for water quality, is stored in the upper 100 feet of saturated material in aquifers of the Uinta Basin (UDWaR 1999). The majority of this groundwater is in consolidated or bedrock aquifers. The principal aquifers associated with the project area are (from shallowest to deepest) the Uinta-Animas aquifer, the Mesaverde aquifer, and the Dakota-Glen Canyon aquifer system, as shown in Figure 3-9. Unconsolidated aquifers are less widespread in the Uinta Basin, occurring mostly in the Duchesne-Myton-Pleasant Valley area, which lies outside the project area (UDWaR 1999). In the project area, the formations comprising the Uinta-Animas aquifer extend from the ground surface to approximately 5,000–7,000 feet, as shown on Map 29, Map 38, and Figure 3-10. Water-yielding units in the Uinta-Animas aquifer commonly are separated from each other and from the underlying Mesaverde aquifer by units of low permeability claystone, shale, marlstone, or limestone. The formations comprising the Mesaverde aquifer extend to a depth of approximately 10,000–15,000 feet, and are underlain by the Mancos shale, which acts as a confining unit for lower aquifers and typically acts as a barrier to vertical groundwater flow and movement (USGS 1995). The Dakota-Glen Canyon aquifer is found at depths greater than 15,000 feet in the project area.

Wells would be drilled at depths of 5,000 to 13,000 feet to recover gas reserves from the Wasatch and Green River formations (both part of the Uinta-Animas aquifer), the Mesaverde and Mancos formations (both part of the Mesaverde aquifer), and the Blackhawk Formation.

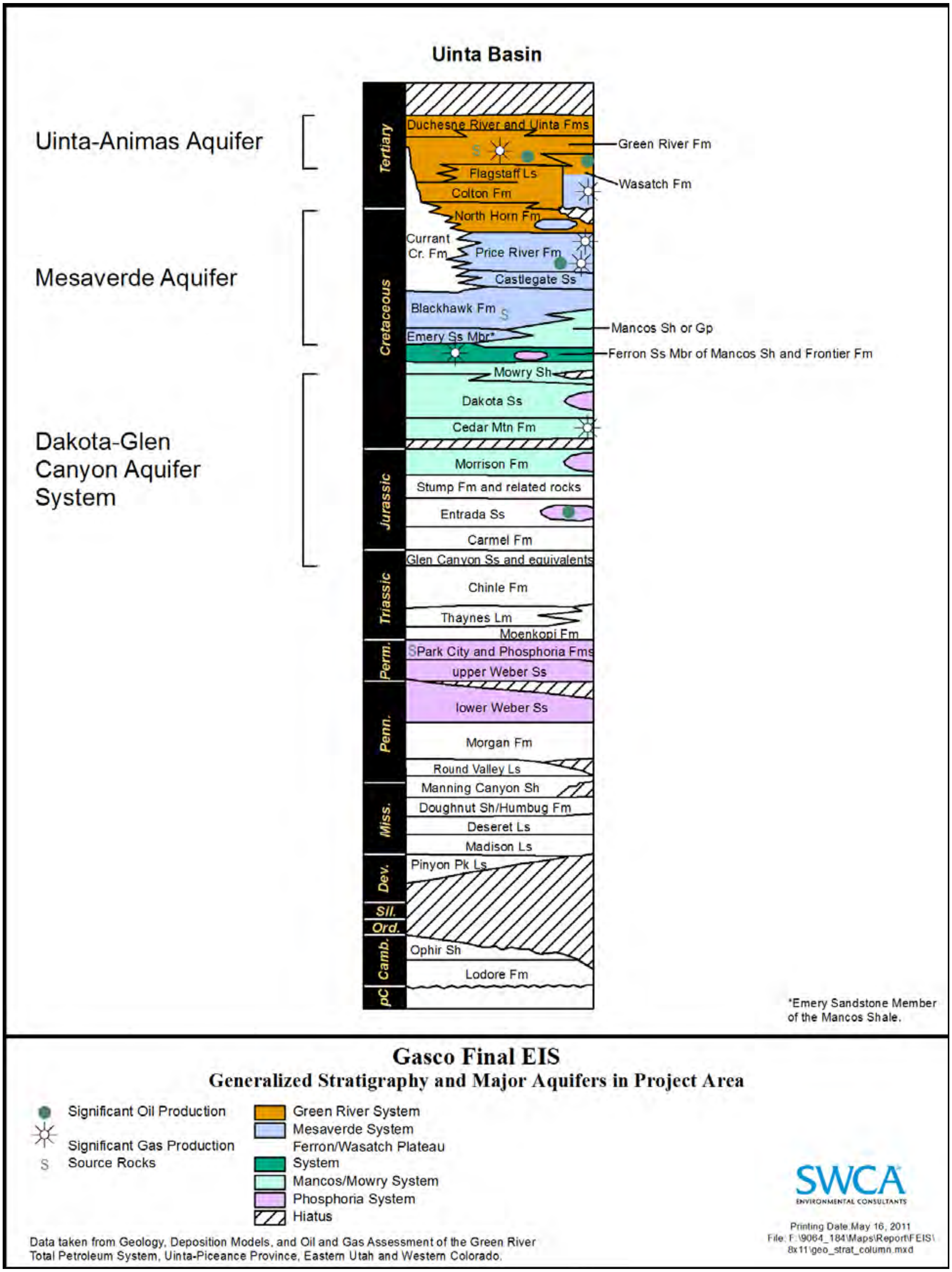


Figure 3-9. Generalized stratigraphy and major aquifers in project area.

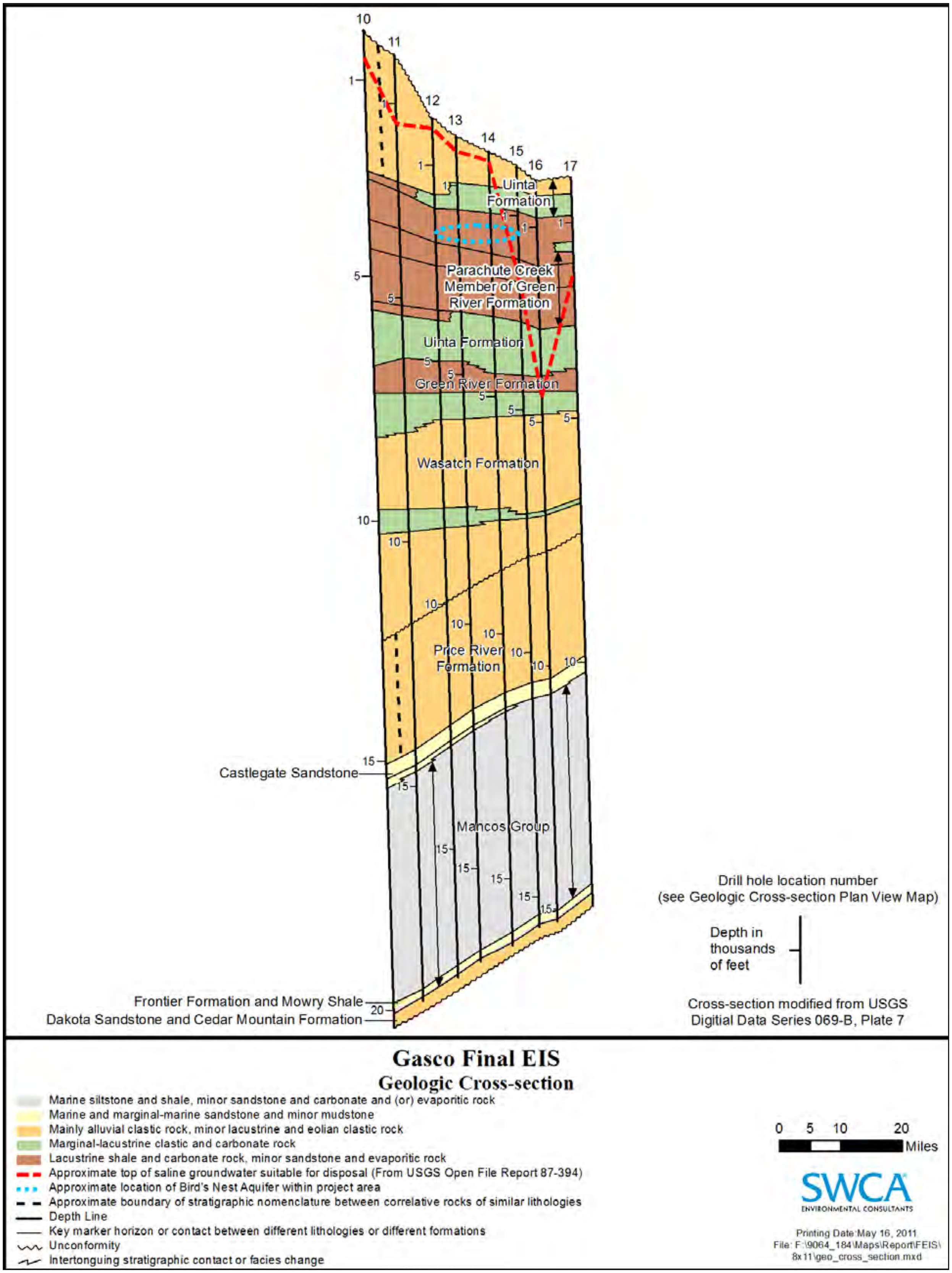


Figure 3-10. Geologic cross-section.

3.15.2.2 Recharge/Discharge of Aquifers

According to the UDWaR (1999), recharge to the consolidated bedrock aquifers occurs in a variety of ways, including

- infiltration of precipitation directly into the fractured bedrock outcrops or into the aquifer from overlying, saturated, unconsolidated deposits;
- upward leakage of groundwater from underlying formations;
- downward leakage of groundwater from overlying formations;
- seepage into the aquifers from streams flowing across outcrops, where the water table is lower than the streambed; and
- inflow of groundwater that originates outside the basin but flows into the basin

Basin-wide, the total, annual, estimated recharge to consolidated bedrock aquifers is 630,000 acre-feet divided between infiltration of precipitation (600,000 acre-feet/year), infiltration of irrigation water (20,000 acre-feet/year), and return flow from wells and springs (10,000 acre-feet/year). Subsurface inflow in the Uinta Basin is estimated to be negligible. It has been observed that approximately 80% of the total aquifer recharge occurs in the northern half of the Uinta Basin due to the fact that greater amounts of water, particularly in the form of precipitation, are available to enhance aquifer recharge in the Uinta Mountains compared to the water available in the much lower and more arid upland areas at the southern edge of the basin.

According to the UDWaR (1999), discharge of groundwater from the consolidated bedrock aquifers occurs

- at springs and seeps, including seepage into streambeds;
- at wells;
- by evapotranspiration;
- by upward leakage into the overlying formations;
- by downward leakage into underlying formations; and
- by small subsurface flows into neighboring basins.

The total, annual, estimated discharge of 630,000 acre-feet is divided among evapotranspiration in vegetated areas (246,000 acre-feet/year), seepage to streams and discharge to springs (combined 363,000 acre-feet/year) and withdrawal from wells and springs (21,000 acre-feet/year). Subsurface outflow in the Uinta Basin is estimated to be negligible.

3.15.2.3 Groundwater Quality

Dissolved-solids concentrations in water in the Uinta-Animas aquifer in the Uinta Basin generally range from 500 to 3,000 milligrams per liter (mg/L); concentrations can exceed 10,000 mg/L in some of the deeper parts of the Uinta Formation. (Water with a total dissolved-solids concentration fewer than 1,000 mg/L commonly is considered fresh water, while water containing more than 3,000 mg/L is considered “saline.” Groundwater with total dissolved-solids concentration greater than seawater [35,000 mg/L] is referred to as “brine” [Alley 2003].) Smaller dissolved-solids concentrations are prevalent near recharge areas where the water usually is a calcium or magnesium bicarbonate type. Larger dissolved-solids concentrations are more common near discharge areas, where the water generally is a sodium bicarbonate or sulfate type (USGS 1995).

Groundwater quality in the Mesaverde aquifer is highly variable. In many of the basin-margin areas, the dissolved-solids concentrations are fewer than 1,000 mg/L, however local concentrations can exceed 35,000 mg/L. Relatively fresh water tends to occur in areas of the aquifer that are recharged by infiltration from precipitation or surface water sources (USGS 1995).

In the Glen Canyon aquifer, dissolved-solids concentrations tend to be less than 1,000 mg/L where the aquifer is less than 2,000 feet below the land surface. However, where the aquifer is deeply buried, the concentration of dissolved solids can exceed 35,000 mg/L (USGS 1995).

Studies are currently ongoing to better determine the depth at which saline water occurs throughout the Uinta Basin; these data are not yet fully available (Vanden Berg 2011). Existing studies suggest that groundwater within the project area is saline, beginning at relatively shallow depths of less than 500 feet, as shown in Figure 3-10 (UDNR 1987). Available data suggest that both the Mesaverde and Dakota-Glen Canyon aquifers are likely to be saline beneath the project area (UDNR 1987). There is the potential for smaller fresh water lenses within these formations, but in general, these lenses would be considered too deep for domestic or stock use. The potential for the presence of usable non-saline groundwater occurs primarily within the Uinta-Animas aquifer formations.

Relatively few water users exist in the proposed project area. Known water rights for surface water diversions, springs, and wells are shown on Map 39 (UDWaR 2011). Of the 112 water rights identified in the project area, 32 represent groundwater uses: two are springs, and 30 are wells or water tunnels. Of the 30 wells or water tunnels, all but five are monitoring, test, or cathodic protection wells. No tribal water uses were identified in the project area (Williar 2011).

The five known groundwater users in the area are shown in Table 3-30. Groundwater quality data have been obtained for two of the wells and are summarized in Table 3-31. Available Water Quality Data for the Project Area.

Table 3-30. Known Groundwater Users in the Project Area

Water Right Number and Type	Name of Water Right Holder	Cadastral Location	Water Uses	Depth	Water Quality Data Available?
Unnamed Spring (47-1119)	BLM	T11S R17E Section 26	Stock	At surface	No
Desert Springs (47-1327)	Beavers	T10S R18E Section 18	Stock	At surface	No
Well (47-1668)	Cotton Petroleum	T10S R16E Section 28	Oil production	300–?	No
Well (47-1820)	Gasco Production Company	T9S R18E Section 29	Domestic, oil production	200–300	Yes
Well (47-1815)	Pendragon Energy Partners	T10S R18E Section 19	Oil production	2,900–4,000	Yes
Well (47-1440)	Burdick	T10S R16E Section 6	Domestic, Stock	Unknown	No
Tunnel (47-1194 and 47-1498)	Carlson	T10S R14E Section 26	Stock	Unknown	No

Table 3-31. Available Water Quality Data for the Project Area

Constituent	Units	Gasco Production Well (47-1820) 4/19/2011	Pendragon Energy Partners (47-1815) 4/19/2011
Total dissolved solids	mg/L	4,187	11,418
pH	pH Units	8.1	8.1
Conductivity	uS/cm	6,344	17,299
Temperature	F	80	70
Calcium	mg/L	4.3	7.0
Magnesium	mg/L	1.5	2.6
Barium	mg/L	0.13	0.6
Sodium	mg/L	1,393	3,538
Iron	mg/L	0.15	0.3
Manganese	mg/L	0.03	0.03
Bicarbonate	mg/L	976	5,246
Sulfate	mg/L	807	618
Chloride	mg/L	1,000	2,000
Hydrogen Sulfide (gas)	mg/L	5	5

The limited water quality data available in the project area confirm that groundwater becomes more saline with depth. The Gasco production well, which draws water from a depth of 200–300 feet, has total dissolved solids (TDS) of 4,187 mg/L, which would be considered brine. The Pendragon production well, which draws water from a depth of 2,900–4,000 feet, has TDS of 11,418, which is considered saline. However, the use of the two springs, one well, and one water tunnel for domestic uses and stock watering suggests that there may be some shallow fresh water resources in the project area.

3.15.3 Surface Water Resources

The project area lies largely within the Desolation Canyon watershed (though a small amount of the Lower Green–Duchesne watershed also lies in the project area) in the Green subunit in the southern Uinta Basin. The area in and around the project boundary is mostly drained by intermittent/ephemeral streams, though Nine Mile Creek, Pariette Draw, and the Green River are major perennial streams draining parts of the project area.

3.15.3.1 Project Area Drainages

The project area is located within five subbasins of the Desolation Canyon (Upper Pariette Draw, Lower Pariette Draw, Sheep Wash–Green River, and Lower Nine Mile Creek subbasins) and Lower Green–Duchesne watersheds (Antelope Creek subbasin). In the project area, these subbasins range in size from 18 acres to 91,786 acres. Table 3-32 provides a summary of the watershed subbasin areas (acres) within the project area, and the percentage of the project area that each subbasin makes up (Map 29).

Table 3-32. Subbasin Drainage Area (in Acres) in the Project Area, Percentage of Project Area

Subbasin Name	Drainage Area in Project Area (acres)	Percentage of Project Area
Upper Pariette Draw	23,905	12%
Lower Pariette Draw	46,668	23%
Sheep Wash–Green River	91,786	44%
Lower Nine Mile Creek	44,449	21%
Antelope Creek	18	0.009%
Total	**206,826**	**100%**

3.15.3.1.1 Antelope Creek Subbasin

While a portion of the Antelope Creek subbasin lies within the project boundary, the total acreage is very small (18 acres), and no natural gas wells are planned for the subbasin. For this reason the Antelope Creek subbasin will not be discussed further (Map 29).

3.15.3.1.2 Upper Pariette Draw Subbasin

This subbasin includes the drainage configuration of Gilsonite Draw to Wells Draw to Pleasant Valley Wash to Pariette Draw to the confluence with Castle Peak Draw (Map 29). The headwaters of Gilsonite Draw are located northwest of Wells Draw. Gilsonite Draw flows northward to its confluence with Wells Draw just north of the project boundary. The headwaters of Wells Draw are located in the Bad Land Cliffs and Fivemile Canyon areas in the western half of the project area, at an elevation of about 7,000 feet. Wells Draw flows northward for approximately 16 miles to its confluence with Pleasant Valley Wash, which eventually intersects with Pariette Draw. Castle Peak Draw joins Pariette Draw near the northeastern project boundary. The lower segments of Wells Draw show evidence of deep channel incision, unstable banks, and a lack of riparian vegetation development.

3.15.3.1.3 Lower Pariette Draw Subbasin

This subbasin includes the drainage configuration of Big Wash to Castle Peak Draw to Pariette Draw. Castle Peak Draw is an intermittently flowing drainage with a wide and sinuous channel. There is very little riparian vegetation growing in the floodplain, except along the lower 2 miles of the channel just above the confluence with Pariette Draw.

3.15.3.1.4 Sheep Wash–Green River Subbasin

This subbasin includes Sheep Wash and Petes Wash (which drains into Sheep Wash in the northeastern portion of the project area) as well as Desert Spring Wash, Four Mile Wash, and Sand Wash (which all drain directly to the Green River). The Green River is the main artery to which all water drains in this subbasin (all water from each of the other subbasins also drains to the Green River eventually). Each of the washes in this subbasin is intermittently flowing, and no gauging data are available.

3.15.3.1.5 Lower Nine Mile Creek Subbasin

This subbasin includes Nine Mile Creek (the subbasin's main artery), and tributaries draining from Petes, Gate, Weter, Blind, Daddy, Devils, Desbrough, North Franks, North Maxie, Butts, South Franks, Currant, and Olsen canyons.

3.15.3.2 Surface Water Occurrence

There are 5 perennial stream miles (Pariette Draw) and 1,040 intermittent stream miles in the project area, as identified by USGS 1:24,000 scale topographic maps. However, most of the intermittent streams shown on USGS maps in the project area do not flow regularly or for a portion of each year, and are therefore more accurately considered ephemeral streams or washes. The Green River, the largest river in the Uinta Basin, forms the eastern boundary of the project area (23 miles). Portions of Nine Mile Creek form stretches of the southern boundary of the project area to the west and east (15 miles). Pariette Draw feeds into the northeastern part of the project area and is fed by ephemeral and intermittent streams that originate within the project boundary.

Most of the water (90%) for drilling, completion, and production activities would come from sources and tributaries that contribute to Green River flows. Average annual flow in the Green River is about 4,064,290 acre-feet at Ouray, Utah (BLM 2006b). Reliable flow data exist for Pariette Draw, though flow in Pariette Draw is not salient to the project because no surface water withdrawals would be expected for Pariette Draw. There are no gauging stations on Nine Mile Creek and therefore no reliable flow data for Nine Mile Creek. Further, no surface water withdrawals would be expected for Nine Mile Creek and therefore flow in Nine Mile Creek is not salient to the project.

3.15.3.3 Surface Water Quality

State of Utah water quality use designations have been established for some of the perennial and intermittent/ephemeral streams in the project area. According to the Utah Department of Environmental Quality (UDEQ) (2002), designations for streams with established beneficial uses include the following:

- 1C–Protected for domestic purposes with prior treatment by treatment processes as required by the Utah Division of Drinking Water.
- 2B–Protected for secondary contact recreation such as boating, wading, or similar uses.
- 3A–Protected for cold water species of game fish and other cold water aquatic life, including the necessary aquatic organisms in their food chain.
- 3B–Protected for warm water species of game fish and other warm water aquatic life, including the necessary aquatic organisms in their food chain.
- 3C–Protected for nongame fish and other aquatic life, including the necessary aquatic organisms in their food chain.
- 3D–Protected for waterfowl, shore birds, and other water-oriented wildlife not included in Classes 3A, 3B, or 3C, including the necessary aquatic organisms in their food chain.
- 4–Protected for agricultural uses, including irrigation of crops and stock watering.

Beneficial use assessments have been completed by the Utah Division of Water Quality (DWQ) for the Green River, Pariette Draw (UDEQ 2004), and Nine Mile Creek (UDEQ 2006). Table 3-33 details use designations assigned to perennial and intermittent/ephemeral streams in the project area.

Table 3-33. Beneficial Use Designations for Streams in the Project Area

Use Designations	Stream
1C, 2B, 3B, 4	Green River
2B, 3A, 4	Nine Mile Creek and tributaries from confluence with Green River to headwaters
2B, 3B, 3D, 4	Pariette Draw and tributaries from confluence with Green River to headwaters

3.15.3.3.1 Surface Water Quality Standards

Water quality standards have been established by DWQ and are contained in Utah Administrative Code, Rule R317-2. These standards are intended to protect the waters of Utah and to improve the quality for each designated beneficial use. Table 3-34. lists water quality standards that are pertinent to the study area (Pariette Draw, Nine Mile Creek, and their watersheds). These standards are specific to the beneficial uses designated to waters in the study area as described in Table 3-33.

Table 3-34. Water Quality Standards for Beneficial Uses Pertinent to Pariette Draw, Nine Mile Creek, and Their Watersheds

	Domestic Water Uses	Recreation Uses		Aquatic Wildlife Uses			Agricultural Uses
Parameter	**1C**	**2A**	**2B**	**3A**	**3B**	**3D**	**4**
Physical							
pH (range)	6.5–9.0	6.5–9.0	6.5–9.0	6.5–9.0	6.5–9.0	6.5–9.0	6.5–9.0
Turbidity Increase (NTU)	--	10	10	10	10	15	--
Temperature (ºC)	--	--	--	20	27	--	--
Max Temperature Change (ºC)	--	--	--	2	4	--	--
Dissolved Oxygen [2]	--	--	--	--	--	--	--
30-day average	--	--	--	6.5	--	--	--
7-day average	--	--	--	9.5/5.0	--	--	--
1-day minimum	--	--	--	8.0/4.0	--	--	--
Total dissolved gases	--	--	--	<110%	--	--	--
Metals (dissolved, maximum mg/L)[3]							
Arsenic	0.01	--	--	--	--	--	0.1
Barium	1	--	--	--	--	--	--
Beryllium	<0.004	--	--	--	--	--	--
Cadmium	0.01	--	--	--	--	--	0.01
Chromium	0.05	--	--	--	--	--	0.1
Copper		--	--	--	--	--	0.2
Lead	0.015	--	--	--	--	--	0.1
Mercury	0.002	--	--	--	--	--	--
Selenium	0.05	--	--	--	--	--	0.5
Silver	0.05	--	--	--	--	--	--
Metals (dissolved, maximum µg/L)[3,4]							
Aluminum[5]	--	--	--	87/750	87/750	87/750	--
Arsenic (trivalent)	--	--	--	150/340	150/340	150/340	--
Cadmium	--	--	--	0.25/2	0.25/2	0.25/2	--
Chromium (hexavalent)	--	--	--	11/16	11/16	11/16	--

Table 3-34. Water Quality Standards for Beneficial Uses Pertinent to Pariette Draw, Nine Mile Creek, and Their Watersheds

	Domestic Water Uses	Recreation Uses		Aquatic Wildlife Uses			Agricultural Uses
Parameter	**1C**	**2A**	**2B**	**3A**	**3B**	**3D**	**4**
Chromium (trivalent)[6]	--	--	--	74/570	74/570	74/570	--
Copper[6]	--	--	--	9/13	9/13	9/13	--
Cyanide (free)	--	--	--	5.2/22	5.2/22	--/22	--
Iron (maximum)	--	--	--	1,000	1,000	1,000	--
Lead[6]	--	--	--	2.5/65	2.5/65	2.5/65	--
Mercury	--	--	--	0.012/2.4	0.012/2.4	0.012/2.4	--
Nickel	--	--	--	52/468	52/468	52/468	--
Selenium	--	--	--	4.6/18.4	4.6/18.4	4.6/18.4	--
Silver	--	--	--	1.6	1.6	1.6	--
Zinc[6]	--	--	--	120/120	120/120	120/120	--
Inorganics (maximum mg/L)							
Bromate	0.01	--	--	--	--	--	--
Boron	--	--	--	--	--	--	0.75
Chlorine (total residual)[4]				0.011/0.019	0.011/0.019	0.011/0.019	
Chlorite	<1.0	--	--	--	--	--	--
Fluoride[7]	1.4–2.4	--	--	--	--	--	--
Hydrogen sulfide	--	--	--	2	2	2	--
(undissociated, max. µg/L)	--	--	--	--	--	--	--
Nitrates as N	10	--	--	--	--	--	--
Total ammonia as N[8]				See footnote 8	See footnote 8	See footnote 8	
TDS[9] for irrigation	--	--	--	--	--	--	1,200
TDS[9] for stock watering	--	--	--	--	--	--	2,000
Organics (maximum ug/L)							
Benzene	2.2	--	--	51	51	51	--
Ethylbenzene	530	--	--	2,100	--	--	--
Hydrogen sulfide	--	--	--	--	--	--	--

Table 3-34. Water Quality Standards for Beneficial Uses Pertinent to Pariette Draw, Nine Mile Creek, and Their Watersheds

	Domestic Water Uses	Recreation Uses		Aquatic Wildlife Uses			Agricultural Uses
Parameter	**1C**	**2A**	**2B**	**3A**	**3B**	**3D**	**4**
Toluene	1,000	--	--	15,000	15,000	15,000	--
1,2 -Trans-dichloroethylene	100 MCL	--	--	10,000	10,000	10,000	--
1,1,1-Trichloroethane	200 MCL	--	--	--	--	--	--
1,1,2-Trichloroethane	0.59	--	--	16	16	16	--
Methane	--	--	--	--	--	--	--
Total petroleum hydrocarbons	--	--	--	--	--	--	--
Volatile organic compounds	--	--	--	--	--	--	--
Xylenes	10,000	--	--	--	--	--	--
2-Chlorophenol	81	--	--	150	150	150	--
2,4-Dichlorophenol	77	--	--	2902	2902	2902	--
2-Methyl-4,6-dinitrophenol	13	--	--	280	280	280	--
2,4-Dinitrophenol	69	--	--	5,300	5,300	5,300	--
Pollution Indicators[10]							
BOD (mg/L)	--	5	5	5	5	5	5
Total phosphorus as P (mg/L)	--	0.05	0.05	0.05	0.05	--	--
Nitrate as N (mg/L)	--	4	4	4	4	--	--

Table 3-34. Water Quality Standards for Beneficial Uses Pertinent to Pariette Draw, Nine Mile Creek, and Their Watersheds

	Domestic Water Uses	Recreation Uses		Aquatic Wildlife Uses			Agricultural Uses
Parameter	**1C**	**2A**	**2B**	**3A**	**3B**	**3D**	**4**
Bacteriological							
E. coli (30-day geometric mean (No.)/100 ml)[10]	206	126	206	--	--	--	--
E. coli (maximum (No.)/100 ml)[10]	940	576	940	--	--	--	--
Total coliform (30-day geometric mean (No.)/100 ml) (old standard)	5,000	1,000	1,000	--	--	--	5,000
Fecal coliform (30-day geometric mean (No.)/100 ml) (old standard)	2,000	200	200	--	--	--	200

[1] The temperature standard shall be at background where it can be shown that natural or un-alterable conditions prevent its attainment. In such cases, rulemaking will be undertaken to modify the standard accordingly.

[2] These limits are not applicable to lower water levels in deep impoundments. The first number in the column details when early life stages are present; the second number details when all other life stages present.

[3] The dissolved metals method involves filtration of the sample in the field, acidification of the sample in the field, no digestion process in the laboratory, and analysis by atomic absorption or inductively coupled plasma (ICP) spectrophotometry.

[4] The first number in the column is a 4-day average, and the second number is a 1-hour average. Where criteria are listed as 4-day average and 1-hour average concentrations, these concentrations should not be exceeded more often than once, every three years on the average.

[5] The criterion for aluminum will be implemented as follows: Where the pH is equal to or greater than 7.0 and the hardness is equal to or greater than 50 ppm (as CaC03 in the receiving water after mixing), the 87 µg/1 chronic criterion (expressed as total recoverable) will not apply, and aluminum will be regulated based on compliance with the 750 µg/1 acute aluminum criterion (expressed as total recoverable).

[6] Hardness-dependent criteria. 100 mg/L used. Conversion factors for ratio of total recoverable metals to dissolved metals must also be applied. In waters with hardness greater than 400 mg/L (as CaC03), calculations will assume a hardness of 400 mg/L (as CaC03).

[7] Maximum concentration varies according to the daily maximum mean air temperature (12ºC = 2.4 mg/L; 12.1–14.6ºC = 2.2 mg/L; 14.7–17.6ºC = 2.0 mg/L; 17.7–21.4ºC = 1.8 mg/L; 21.5–26.2ºC = 1.6 mg/L; and 26.3–32.5ºC = 1.4 mg/L).

[8] The following equations are used to calculate ammonia criteria concentrations:

The 30-day average concentration of total ammonia nitrogen (in mg/L as N) does not exceed more than once every three years on the average, the chronic criterion calculated using the following equations:

Fish Early Life Stages are Present: mg/L as N (Chronic) = ((0.0577/1+107.688-pH)+ (2.487/1+10PH-7.688)) * MIN (2.85, 1.45*100.028*(25-T)).

Fish Early Life Stages are Absent: mg/1 as N (Chronic) = ((0.0577/1+107.688-pH) + (2.487/1+10pH-7.688)) * 1.45*100.028* (25-MAX(T,7))).

[9] Site-specific criteria for total dissolved solids may

be adopted by rulemaking where it is demonstrated that: (a) a less stringent criterion is appropriate because of natural or un-alterable conditions; or (b) a less stringent, site-specific criterion and/or date-specified criterion is protective of existing and attainable agricultural uses; or (c) a more stringent criterion is attainable and necessary for the protection of sensitive crops.

[10] Investigations should be conducted to develop more information where these pollution indicator levels are exceeded.

3.15.3.3.2 IMPAIRMENTS

The State of Utah has determined that all segments of the Green River in the Uinta Basin are supporting designated beneficial uses. However, there are impairments to the agricultural and aquatic life beneficial uses in and downstream of the project area due to exceedances of the water quality standards for TDS, boron, se, and temperature (UDEQ 2010a, UDEQ 2010b). Due to these exceedances, Pariette Draw and Nine Mile Creek are listed on Utah's 2010 303(d) list of impaired waters and are described in greater detail in the following paragraphs. Pariette Draw was assessed as impaired for agricultural activities (use designation 4) due to boron and TDS (UDEQ 2010b). Pariette Draw was also assessed as impaired for cold water species of game fish and other warm water aquatic life (use designation 3B) due to selenium. Nine Mile Creek was assessed as impaired for cold water aquatic life (use designation 3A) due to temperature (UDEQ 2010b).

As water flows over and through soil particles and rock, soluble materials accumulate in the water. Major ions commonly found in water are sodium, calcium, magnesium, potassium, chloride, sulfate, and bicarbonate. In addition to ions, there are other dissolved substances in water, such as dissolved organic materials. The sum of all of the dissolved substances in water is TDS, and is measured in mg/L. Selenium is both an essential micronutrient and potentially detrimental element in high concentrations, which have been shown to cause mortality, deformity, and reproductive failure in fish and aquatic birds (EPA 1998). Boron is a naturally occurring trace element that is essential for the growth of crop plants and some algae, fungi, and bacteria, but can be toxic in excess.

Water quality data available for Pariette Draw are summarized in Table 3-35. The UDWQ determined that Pariette Draw is not supporting its agricultural use due to violations of water quality criteria for elevated boron and TDS concentrations (Table 3-35). Pariette Draw is also listed as not supporting its warm water fisheries and waterfowl classification due to exceeding the chronic standard for selenium.

Table 3-35. Summary of Water Quality Data for Parameters of Concern for Creeks Downstream of the Project Area in the Pariette Draw Watershed

Creek	TDS (mg/L)		Selenium (µg/L)		Boron (µg/L)	
	Pariette Draw above Flood Control Structure	Pariette Draw Confluence with Green River	Pariette Draw above Flood Control Structure	Pariette Draw Confluence with Green River	Pariette Draw above Flood Control Structure	Pariette Draw Confluence with Green River
STORET station ID	4933480[1]	4933440[1]	4933480[1]	4933440[1]	4933480[1]	4933440[1]
Standard (see Table 3-29)	1,200	1,200	4.6	4.6	750	750
Number of samples	51	95	43	72	23	52
Average	2,257	2,818	7.4	3.9	1,279	168
Minimum	684	662	1.0	0.5	421	92
Maximum	4,262	6,146	21.9	18.0	1,830	3,000
Total violations	38	87	23	18	19	51
Percentage of samples violating standard	75%	92%	52%	25%	83%	98%
Total violations 2006 to present	22	30	9	5	11	20
Percentage of violating 2006 to present	73%	100%	56%	26%	69%	100%

[1] Data from UDEQ (2010b).

Nine Mile Creek is listed for impairment of temperature for its beneficial use of a cold water fishery (Table 3-36.). Water temperature is related to and affected by a variety of factors, including riparian conditions, stream morphology, and volume of discharge. Biological and chemical processes within river systems depend on temperature, and aquatic organisms from microbes to fish depend on certain temperature ranges for their optimal health. UDEQ-designated Nine Mile Creek has a beneficial use designation of 3A to support the temperature ranges of the aquatic organisms in the creek. The water quality criterion for temperature in cold water fisheries (3A) is 20°C. UDWQ is in the process of changing the designated use for Nine Mile Creek from cold water aquatic life (use designation 3A) to warm water aquatic life (use designation 3B) (personal communication between Erica Gaddis, SWCA, and Carl Adams, UDWQ, January 2011).

Table 3-36. Summary of Data for Temperature (˚C) at Nine Mile Creek

STORET station ID	49333351
Standard (see Table 3-29)	20
Number of samples	20
Average	20.3
Minimum	12
Maximum	28
Total number of violations	10
Percent violating	50%

Source: EPA 2011

Section 303(d) of the Clea n Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR 130) require states to develop total maximum daily loads (TMDLs) for water bodies that are not meeting applicable water quality standards. TMDLs list the maximum amount of a pollutant that a water body can assimilate and still meet water quality standards. A TMDL was completed by UDWQ and approved by EPA in 2010 for TDS, selenium, and boron in the Pariette Draw watershed (UDEQ 2010b). summarizes the load reductions required for these parameters in Pariette Draw. There is not a TMDL completed for Nine Mile Creek.

Table 3-37. Summary of TMDL Load Reductions in Pariette Draw (STORET site 4933480) Required for Surface Waters Downstream of the Proposed Project

Pollutant of concern	TDS	Boron	Selenium
Water quality target	1,200 mg/l	750 µg/l	4.6 µg/l
Current load	174.77[b] tons/day	137.98[b] tons/day	0.23[b] lbs/day
Loading capacity	59.85[b] tons/day	64.68[b] tons/day	0.17[b] lbs/day
TMDL load reduction	114.91[b] tons/day	73.30[b] tons/day	0.07[b] lbs/day
Percentage reduction	65.8%	53.1%	28.1%

Source: UDEQ (2010b).
[a] Load over the 0%–30% flow percentile range.
[b] Load over the 10%–40% flow percentile range.

According to the TMDL, TDS, boron, and selenium in the area are derived primarily from natural sources. Irrigation management has resulted in artificial transport pathways of these constituents to surface waters, in addition to natural pathways. The USGS along with the Bureau of Reclamation and the BLM developed a dissolved-solids water quality model (SPARROW) specific to surface waters in the Upper Colorado River Basin (UCRB) (Kenney et al. 2009). This model relates measured chemical constituents at monitoring stations to upland catchment attributes, such as land use, land cover, or geology (Smith et al. 1997). The model is a statistical assessment based on an existing transport model and available water-quality monitoring data for the basin. Of the 22 factors considered in the model, the largest factors influencing TDS concentrations in surface waters in the UCRB are as follows:

1. **Bedrock geology.** Bedrock geology, particularly sedimentary rock formed from marine sediments, is the largest natural source of dissolved solids to streams in the UCRB (Iorns et al. 1965; Liebermann et al. 1989; U.S. Department of the Interior, 2003; Anning et al. 2007; Kenney et al. 2009). Due to its chemical composition, exposure, and erodibility, the Uinta Formation is a natural source of soluble salts (UDEQ 2010b). It contains coal-bearing beds, formed in coastal marine environments. Coal beds are a known contributor of increased TDS in surface and groundwater.

2. **Climate characteristics.** Precipitation is the major land to water transport mechanism associated with natural sources of dissolved solids. Evaporative transpiration is another mechanism that can enhance the transport of dissolved solids to streams. Evaporative transpiration is the process of transferring water to the atmosphere through evaporation of water and transpiration from plants. Vegetation consumes water containing dissolved solids from within the soil zone and transpires pure water, leaving behind the dissolved minerals. Evaporation on bare soils also removes pure water and precipitates minerals on the soil surface, which are immediately available for dissolution through precipitation and surface runoff.

3. **Irrigated agriculture.** Irrigation water and natural precipitation (in excess of soil holding capacity and plant requirements) percolates through the soils and transports these constituents into the shallow alluvial aquifer (groundwater), eventually returning to the watershed streams as base flow. Deposition of salts on the ground surface also seals the soil pores, preventing percolation and increasing the volume and velocity of runoff, leading to sheet flows and increased pollutant loading. Irrigation of agricultural lands, particularly those derived from sedimentary rocks, is the major anthropogenic source of dissolved solids in the UCRB, accounting for approximately 40% of the dissolved-solids load (Iorns et al. 1965; Liebermann et al. 1989; U.S. Department of the Interior 2003; Kenney et al. 2009). Irrigation return flows in the watershed are a potential source of salinity because they dissolve and transport soil particles and salts from fields and return them to surface waters through surface and subsurface flows.

The primary natural source of boron in the area is bedrock formed from evaporated swamps and marshes. The Uinta Basin was once covered by Uinta Lake, which eventually evaporated to marshlands before finally disappearing. Shallow groundwater transport is an important transport pathway of boron in the area (Naftz et al. 2008). Boron concentrations in groundwater are derived from leaching of rocks and soils that contain borate and borosilicate minerals. The highest boron concentrations in Pariette Draw occur from November through March, which suggests that 1) groundwater contributions are responsible for most of the boron impairment and 2) storm water runoff generally dilutes the concentrations in surface waters.

The primary sources of selenium in the Pariette Draw watershed, as noted in Utah's 2010 303(d) list, are natural sources and irrigated crops. Transport of eroded soil from the watershed, some of which has naturally high concentrations of selenium, is also an important pollutant source (UDEQ 2010b). The primary natural source of selenium in the area is found in black shale-derived soils and landscapes (UDEQ 2010b). Black shale comprises organic-rich, fine-grained sedimentary rock deposited in very low oxygen conditions. Dry conditions make irrigation necessary for nearly all crops grown in the watershed. Normal aqueous chemical processes, enhanced by seepage from irrigated agriculture in the watershed, are capable of transporting some of the naturally occurring selenium in the sediments to the stream system. Seeps in the area provide another pathway for selenium to move from groundwater to surface water.

Two USGS studies on TDS (Kenney et al. 2009 and Botu et al. 2010) do not identify surface erosion to be an important transport pathway of TDS to surface waters in the UCRB. These studies also report that surface disturbance, including disturbance related to oil and gas development, does not have a statistically significant impact on TDS concentrations in surface waters in the area. Likewise, neither surface disturbance nor oil and gas development were noted in the Pariette Draw TMDL as important factors in selenium or boron transport or surface water concentrations. The possible exception to this would be disturbance on heavily irrigated lands that have higher than normal soil concentrations of selenium or boron. The Pariette Draw TMDL states "though oil and gas well pads are prevalent in the watershed, they are not considered a major source based on observations of best management practices (BMPs) employed during site visits in the field" (UDEQ 2010b).

Sediment loading, salinity, and the trace element selenium are the most substantial water quality concerns in the project area. Current sediment loading/year to the Green River is approximately 9,684,000 tons at Jensen, Utah (BLM 2005b). There are no data on sediment loading to other perennial and intermittent waterways in or near the project area. Salinity and selenium in the Green River are of interest, but no reliable mean annual concentration data exist. Also, it is not possible to generate a reliable estimate of any possible increase in salinity and selenium concentrations in the Green River from the Proposed Action and alternatives because any increases would be a result of runoff from saline soils, which are diffuse across the landscape, with salinity and selenium concentrations varying considerably from location to location. However, it is possible to estimate the number of acres of saline soils in the project area (16,795 acres; see Section 3.10, Soils). Saline sediments that originate in the project area eventually flow into the Green River, a major tributary to the Colorado River. Colorado River salinity is a regional, national, and international issue. Control of sediment discharged from public lands is mandated by the Colorado River Basin Salinity Control Act of 1974. Proper land use is the BLM's preferred method of achieving salinity control, with the planning process being the principal mechanism for implementation. Selenium is present in quantities exceeding state limits in Pariette Draw, which receives irrigation drainage from the Pleasant Valley area near the Duchesne River north of the project area. Pariette Draw ultimately drains into the Green River in the northeastern corner of the project area (BLM 1994).

3.15.4 Wetlands and Riparian Zones

Wetlands and riparian areas comprise a small portion (1,249 acres of BLM-identified riparian areas) of the project area. Most of the riparian zones are located along the Green River, with the remainder associated with Pariette Draw and Nine Mile Creek. Utah BLM Riparian Policy (UT-93-93) is to maintain and/or improve riparian areas to Proper Functioning Condition (PFC). Accordingly, no new surface-disturbing activities are allowed within 100 m of riparian areas unless 1) there are no practical alternatives, 2) all long-term impacts can be fully mitigated, or 3) the new surface-disturbing activity would benefit or enhance the riparian area. Wetlands and riparian zones in the project area are depicted in Map 30.

3.15.5 Floodplains

There are 6,772 acres of 100-year floodplain within the project area. The floodplains include Green River, Four Mile Wash, Desert Spring Wash, Petes Wash, Sheep Wash, Sand Wash, Nine Mile Creek, Pariette Draw, Wells Draw, and four unnamed washes. Floodplain boundaries within the project area are depicted in Map 29. Floodplains are protected by Executive Order 11988. This Executive Order requires federal agencies to take action to reduce the risk of flood loss; minimize the impact of floods on human safety, health, and welfare; and to restore and preserve the natural and beneficial values served by floodplains. Major drainages in the project area determined as critical flood potential areas include Nine Mile Creek and Pariette Draw (BLM 1994).

3.16 Wildlife

The project area encompasses approximately 206,826 acres of land, including a variety of habitat types and wildlife species. There is big game (such as deer, elk, pronghorn, and bighorn sheep); mountain lions (or cougars); upland game; non-game species (such as small mammals, reptiles, and amphibians); and aquatic species. Management goals for most wildlife populations in the project area are determined primarily by the UDWR, with the exception of federally protected wildlife species, which are determined by the USFWS. The BLM Vernal FO has established habitat management objectives (BLM 1994) within the FO boundary for mule deer, Rocky Mountain elk, pronghorn, and Rocky Mountain bighorn sheep. Habitat management objectives for reptiles, amphibians, and other non-game species in the project area are limited to protecting individuals and the habitat of state sensitive, BLM sensitive, and federally listed species, and designating spatial and temporal barriers for nesting raptors (BLM 1994). Details on state sensitive, BLM sensitive, and federally listed species can be found in Section 3.12, Special Status Species.

3.16.1 Big Game

The project area is within the herd unit areas for mule deer, Rocky Mountain elk, pronghorn, and Rocky Mountain bighorn sheep. These species occur throughout the project area in areas of suitable habitat (see Table 3-38, Table 3-39, Table 3-40, and Table 3-41, and Maps 31 through 34). The BLM defines *crucial winter habitat* as the determining factor in a population's ability to maintain and reproduce itself at a certain level over the long term (BLM 1999b). Other BLM habitat designations applied to big-game species habitat areas are high-priority winter habitat, substantial winter habitat, crucial year-long habitat, limited year-long habitat, fawning habitat, and potential year-long habitat. With the exception of fawning habitat and potential year-long habitat, these habitat designations are defined in Table 3-39. Table 3-41 contains UDWR habitat definitions. No fawning habitat is present in the project area, and potential year-long habitat applies only to areas in the southern part of the project area, where Rocky Mountain bighorn sheep habitat may exist. BLM *crucial winter habitat* is the only habitat designation present in the project area that the BLM has the authority to protect through RMP resource allocations. However, analysis of impacts due to natural gas development considers all habitat designations present (UDWR and BLM), because disturbance would occur in these areas and they do offer habitat value to wildlife species.

Table 3-38. BLM-designated Big Game Habitat in the Project Area

Species	BLM Habitat Designation	Acres
Mule Deer	Crucial Winter Habitat	130
	High-Priority Winter Habitat	63,722
	Substantial Winter Habitat	32,166
	Crucial Year-long Habitat	7,795
	Limited Year-long Habitat	102,713
	Total	**206,526**
Rocky Mountain Elk	Crucial Winter Habitat	51,610
	High-Priority Winter Habitat	28,471
	Limited Winter Habitat	81,150
	Substantial Winter Habitat	45,335
	Total	**206,566**
Pronghorn	Crucial Year-long Habitat	112,902
	High-Priority Year-long Habitat	56,227
	Limited Year-long Habitat	35,890
	Substantial Year-long Habitat	227
	Fawning Habitat	0
	Total	**205,246**
Rocky Mountain Bighorn Sheep	Potential Year-long Habitat	81,123
	Total	**81,123**

Table 3-39. BLM Habitat Designation Definitions

BLM Habitat Designation	Definition
Crucial Habitat	Habitat on which the local population of a wildlife species depends for survival because no alternative ranges or habitats are available. Crucial value habitat is essential to the life history requirements of a wildlife species. Degradation or unavailability of crucial value habitat will lead to significant declines in carrying capacity and/or numbers of the wildlife species in question.
High-Priority Habitat	High-priority ranges are “intensive” use areas that, due to relatively wide distribution, do not constitute critical values but are highly important to high-interest wildlife.
Substantial Habitat	Substantial ranges are areas that provide “frequent” use by a wildlife species. These areas do not provide habitat for resident populations, although animals do consistently use these areas throughout a season.
Limited Habitat	Limited ranges are areas that provide for only “occasional” use by a wildlife species. These areas do not provide habitat for resident populations, and animals use these areas only on a limited basis.

Source: Definitions provided by Brandon McDonald, BLM Vernal FO.

Table 3-40. UDWR-defined Big Game Habitat in the Project Area

Species	UDWR Habitat	Acres
Mule Deer	Crucial Spring/Fall Habitat	241
	Crucial Winter Habitat	0
	Substantial Winter Habitat	66,633
	Crucial Year-long Habitat	13,962
	Total	80,836
Rocky Mountain Elk	Crucial Summer Habitat	33
	Crucial Winter Habitat	93
	Substantial Winter Habitat	10,269
	Crucial Year-long Habitat	48,305
	Substantial Year-long Habitat	52,722
	Total	111,422
Pronghorn	Crucial Year-long Habitat	97,373
	Substantial Year-long Habitat	8,136
	Total	105,509
Rocky Mountain Bighorn Sheep	Crucial Year-long Habitat	14,852
	Substantial Year-long Habitat	24,121
	Total	38,973

Table 3-41. UDWR Habitat Definitions

UDWR Habitat Definition	Definition
Crucial Value Habitat	Habitat on which the local population of a wildlife species depends for survival because no alternative ranges or habitats are available. Crucial value habitat is essential to the life history requirements of a wildlife species. Degradation or unavailability of crucial habitat will lead to significant declines in carrying capacity and/or numbers of wildlife species in question.
Substantial Value Habitat	Habitat that is used by a wildlife species but is not crucial for population survival. Degradation or unavailability of substantial value habitat will not lead to significant declines in carrying capacity and/or numbers of the wildlife species in question.

Source: UDWR (2007).

3.16.1.1 MULE DEER

Mule deer (*Odocoileus heminonus*) occupy most ecosystems in Utah, but likely attain their greatest densities in shrublands and areas characterized by rough, broken terrain and abundant browse and cover. In the Rocky Mountains, the winter diet of mule deer consists of approximately 75% browse from a variety of trees and shrubs, and 25% forbs and grasses. In the spring and summer, browse is 50% of the diet and grasses and forbs make up the other 50% (Fitzgerald et al. 1994). In the Green River corridor, a resident mule deer population remains near the river year-round. A separate population inhabits the upland portion of the project area. Mule deer summer range habitat types for the upland population consist of spruce/fir, aspen, alpine meadows, and large grassy parks located at higher elevations. Winter range habitat primarily consists of shrub-covered, south-facing slopes, and often coincides with areas of concentrated human use and occupation. Winter range is often considered a limiting factor for mule deer in the Intermountain West. In order to move between summer and winter ranges near the project area, mule deer make short distance seasonal migrations along elevational and topographical gradients (personal communication between Pat Rainbolt, UDWR Impact Analysis Biologist, and Amanda Christensen, SWCA, March 10, 2011). Mule deer migration patterns in this area are diffuse, and cannot be defined in migratory corridors. However, maintaining connectivity between summer and winter ranges so that these movement patterns may continue is vital to maintaining healthy mule deer herds.

The size and condition of mule deer herds are usually directly correlated with the quantity and quality of their habitat. There are 206,526 acres of BLM-designated and 80,836 acres of UDWR-defined mule deer habitat in the project area (see Table 3-38 and Table 3-40). Mule deer typically occur in riparian areas (such as the Green River) during the summer, and in the southwestern portion of the project area around Nine Mile Canyon, Wells Draw, Big Wash, and Fivemile Canyon during the winter. Statewide, following the 2002 hunting season, population estimates were 280,000, which represents 66% of the long-term management objective of the UDWR (UDWR 2003a). Habitat loss and fragmentation due to human expansion and development contributes to population sizes that are chronically smaller than UDWR management objectives (UDWR 2003a). Fragmentation of mule deer habitat, and attendant impacts such as noise, human disturbance, etc., from existing roads in the project area are discussed below.

Sawyer et al. (2006) found that mule deer in western Wyoming changed winter habitat selection patterns due to natural gas development. They found that deer generally avoided areas with road densities of ≥0.16 km/km^2, even if those areas had been frequented often prior to development. The research also concluded that aversion to these areas occurred during the first year of construction and that no acclimatization occurred throughout the course of the 5-year study. In effect, the deer were being displaced from pre-development high-use areas (presumably high-quality habitat) to previously low-use areas (presumably low-quality habitat). This effect has the potential to influence survival, particularly fawn mortality, and reproduction on a population level.

Following Sawyer et al. (2006), a spatial analysis was conducted to determine habitat fragmentation from current road density in BLM-designated mule deer habitat in the project area. Road density was calculated by dividing suitable mule deer habitat into square kilometers and measuring the length of road within each square. Mule deer habitat containing 0.16 km/km^2 or more of roads (as in Sawyer et al. 2006) was considered unfavorable for mule deer due to habitat fragmentation, whereas mule deer habitat containing fewer than 0.16 km/km^2 of roads remained favorable for mule deer. There are currently 560 miles of roads in BLM-designated mule deer habitat in the project area resulting in 145,939 acres (71%) of unfavorable habitat (Table 3-42). There are currently 190 miles of roads in UDWR mule deer habitat, resulting in 49,858 acres (62%) of unfavorable habitat (Table 3-43).

Table 3-42. Miles of Roads, Acres of Unfavorable Habitat, and Percentage of Unfavorable Habitat Under Current Conditions in BLM-designated Big Game Habitat

Species	Miles of Existing Roads in BLM-designated Habitat	Acres of Unfavorable Habitat Due to Existing Roads	Percentage Unfavorable Habitat
Mule Deer	560	145,939	71%
Rocky Mountain Elk	560	124,188	60%
Pronghorn	553	n/a[1]	n/a[1]
Rocky Mountain Bighorn Sheep	169	80,523	100%

[1]No peer-reviewed data were available to allow for an analysis of habitat fragmentation for pronghorn.

Table 3-43. Miles of Roads, Acres of Unfavorable Habitat, and Percentage of Unfavorable Habitat Under Current Conditions in UDWR Big Game Habitat

Species	Miles of Existing Roads in UDWR-defined Habitat	Acres of Unfavorable Habitat Due to Existing Roads	Percentage Unfavorable Habitat
Mule Deer	190	49,858	62%
Rocky Mountain Elk	256	58,882	53%
Pronghorn	344	n/a[1]	n/a[1]
Rocky Mountain Bighorn Sheep	82	38,973	100%

[1]No peer-reviewed data were available to allow for an analysis of habitat fragmentation for pronghorn.

3.16.1.2 Rocky Mountain Elk

The Rocky Mountain elk (*Cervus canadensis*) is Utah's state animal, and is the second most abundant big game species in the state after mule deer. In 2003, the statewide elk population estimate was 58,000—below the management objective of 68,400 individuals. Elk herds were intentionally reduced in many areas between 2000 and 2003 due to widespread droughts and poor range conditions, but numbers have been allowed to climb naturally as conditions have improved over the past few seasons (UDWR 2005b). According to UDWR, the elk herd that inhabits portions of the project area consists of approximately 1,450 individuals, approximately 207% of the management objective of 700 (personal communication between Pat Rainbolt, UDWR Impact Analysis Biologist, and Amanda Christensen, SWCA, March 10, 2011).

Elk are considered generalist feeders (Fitzgerald et al. 1994). In the northern and central Rocky Mountains, grasses and shrubs compose most of their winter diet, with the former being of primary importance in the spring months (Kufeld 1973). Forbs become increasingly important in late spring and summer, and grasses again dominate in the fall. These feeding relationships may change somewhat depending on location. Associated with seasonal changes in diet are seasonal changes in habitat. The season and function of use of these habitats help distinguish various types of winter ranges, production areas (calving grounds), and/or summer range. Production or calving areas are used from mid-May through June, and typically occupy higher-elevation sites than winter range. Calving grounds are usually characterized by aspen, montane coniferous forest, grassland/meadow, and mountain brush habitats, and are generally in locations where cover, forage, and water are in close proximity (Fitzgerald et al. 1994). In western Colorado, for instance, most females calve within 660 feet of water (Seidel 1977). Along the Wasatch Front, typical Rocky Mountain elk winter range occurs between 5,500 and 7,500 feet elevation and comprises mountain shrub and sagebrush habitats. Approximately 90% of the local elk population (in and around the project area) is located in crucial winter range during an average of five winters out of ten from the first heavy snowfall to spring green-up (BLM 1994).

There are 206,566 acres of BLM-designated and 111,422 acres of UDWR elk habitat in the project area (see Table 3-38 and Table 3-40). Crucial elk winter habitat is located in the northwest corner of the project area near Gilsonite Draw, Fivemile Canyon, Wells Draw, and Big Wash (see Map 34). This crucial habitat makes up approximately 25% of the project area.

The local elk population summers west of the project area in the aspen stands of Anthro Mountain. It makes an easterly migration into and near the project area for the winter. High quality winter habitat for this population comprises the pinyon-juniper habitat type in the western portion of the project area (personal communication between Pat Rainbolt, UDWR Impact Analysis Biologist, and Amanda Christensen, SWCA, March 10, 2011). There is no major migration route within the project boundary; however, individuals do make short-distance, local, and diffuse movements within the wintering habitat.

Elk in arid environments cannot rely on forested habitats for thermal and camouflage requirements; it is likely that they depend on shrubs, topography, and areas of low human disturbance to meet these needs (Sawyer and Nielsen 2005). In Western Wyoming, Sawyer et al. (2005) found that GPS-collared elk preferred habitat farther from roads more than similar habitats near roads. In the summer, these elk were using habitat an average distance of 2.8 km from roads, and in winter they were slightly closer (1.2 km). This may be explained by the decrease in human activity on rural roads in the winter, as roads become inaccessible to vehicles.

Lyon (1983) found that elk preferentially use habitat where road densities are ≤0.62 km/km^2. This number was used as the threshold value to determine, using the same method as for mule deer, the current amount of BLM-designated elk habitat in the project area that is unfavorable due to habitat fragmentation from roads. There are currently 560 miles of roads in BLM-designated elk habitat in the project area, resulting in 124,188 acres (60%) of unfavorable habitat (see Table 3-42). There are currently 256 miles of roads in UDWR elk habitat, resulting in 58,882 acres (53%) of unfavorable habitat (Table 3-43).

3.16.1.3 PRONGHORN

Pronghorn (*Antilocapra americana*) can be found throughout the western United States, Canada, and northern Mexico. They are generally associated with open plains in desert, grassland, and sagebrush habitats where they feed mainly on browse. Pronghorn prefer to occupy areas with large tracts of flat to rolling open terrain where they rely on keen eyesight and swift movement to avoid predators. Pronghorn are often found in small groups and tend to be most active during the day.

The pronghorn populations in the Uinta Basin have been adversely affected by historic range degradation and habitat loss in the sagebrush steppe habitat type as well as periodic drought conditions (UDWR 2002a). As part of a multiyear, state-wide pronghorn relocation effort, UDWR biologists translocated 126 pronghorn in 2005 from Parker Mountain in southern Utah to the Uinta Basin, south of US-40. Fifty-eight pronghorn were moved to the Myton Bench unit, and 37 were added to the population on the East Bench. The Ute Tribe also received 30 pronghorn to help enhance their herd. In spite of these efforts, actual population numbers are approximately 27% of the management objective of 1,100 individuals (personal communication between Pat Rainbolt, UDWR Impact Analysis Biologist, and Amanda Christensen, SWCA, March 10, 2011). Pronghorn near the project area do not migrate long distances; rather, they make local and diffuse seasonal movements, which are likely influenced by food availability (personal communication between Pat Rainbolt, UDWR Impact Analysis Biologist, and Amanda Christensen, SWCA, March 10, 2011).

There are 205,246 acres of BLM-designated and 105,509 acres of UDWR pronghorn habitat in the project area (see Table 3-38, Table 3-40, and Map 31) and pronghorn can be found there year-round. The BLM employs timing stipulations for pronghorn fawning areas, though no pronghorn fawning areas have been identified within the project area. Fragmentation of pronghorn habitat may be a concern in the project area, though no peer-reviewed studies were identified that contained threshold values upon which to base spatial analyses, like those completed for mule deer and elk. However, there are 553 miles of existing roads in BLM-designated pronghorn habitat in the project area (Table 3-42). There are currently 344 miles of roads in UDWR pronghorn habitat (Table 3-43).

3.16.1.4 ROCKY MOUNTAIN BIGHORN SHEEP

Most biologists recognize three subspecies of bighorn sheep (*Ovis canadensis*), all of which are endemic to North America (Wehausen et. al. 2005). Potential habitat exists in the project area for one of the three recognized subspecies, the Rocky Mountain bighorn sheep (*O. canadensis canadensis*). Rocky Mountain bighorn sheep are generally found in the cooler mountainous regions of Canada and the western U.S., while desert bighorn sheep occupy the warmer desert regions of the southwestern U.S, primarily in Arizona, California, Nevada, and Utah.

Bighorn sheep graze on grasses and browse on shrubby plants, and often seek salt licks or natural mineral deposits to supplement their diets. They seek cover and avoid predators with agility in steep and rugged terrain. They are generally found in large herds, though they do not follow a strict dominance hierarchy. Bighorn sheep currently require separation from domestic sheep to prevent the transmission of diseases, against which they have no natural defenses (UDWR 1999b).

Bighorn sheep experienced significant declines in numbers in the early 1900s and were nearly extirpated due to disease, habitat degradation, and hunting. For the past 30 years, Utah has been involved in an aggressive program to restore bighorn sheep to their native habitats. Fifty-four Rocky Mountain bighorn sheep were transplanted into the Nine Mile, Bighorn Mountain area between 1993 and 1995. In 1999, the population size was estimated at 140 with an upward trend (UDWR 1999b). Additionally, a viable population has become established along the eastern portion of the Green River corridor. Rocky Mountain bighorn sheep currently occupy the rugged Book Cliffs terrain, south from the Uintah and Ouray Indian Reservation and eastward to Thompson Springs, Utah. The statewide estimate for the subspecies in 1999 was 800 individuals (UDWR 1999b).

BLM-designated potential year-long habitat for Rocky Mountain bighorn sheep in the project area is approximately 81,123 acres (see Table 3-38). UDWR habitat (crucial year-long and substantial year-long) in the project area is approximately 38,973 acres (see Table 3-40). This acreage is in the southern portion of the project area. As for the other big-game species found in the project area, habitat fragmentation from existing roads is a concern for Rocky Mountain bighorn sheep, and peer-reviewed habitat fragmentation thresholds were available to conduct spatial analyses to determine the extent of habitat fragmentation from existing roads in the project area.

Singer et al. (2001) found that bighorn sheep released into habitat patches of at least 158.7 km2 ± 60.3 km2 colonized an average of one neighboring patch, while bighorn sheep released in smaller patches did not colonize neighboring areas and eventually left the area. Patch colonization is a necessary precursor to reproduction and population maintenance. Bighorn sheep are more sensitive to encroachment and habitat fragmentation than are other ungulates in the project area (Singer et al. 2001). Accordingly, this analysis assumed that patch sizes smaller than 159 km2 were generally unsuitably fragmented and therefore unfavorable for bighorn sheep. There are 169 miles of existing roads in BLM-designated bighorn sheep habitat in the project area resulting in 80,523 acres (nearly 100%) of unfavorable habitat (see Table 3-42). In UDWR bighorn sheep habitat, there are currently 82 miles of roads resulting in 38,973 acres (100%) of unfavorable habitat (see Table 3-43).

3.16.2 Mountain Lion (Cougar)

The mountain lion, or cougar, likely inhabits most ecosystems in Utah. However, it is most common in the rough, broken terrain of foothills and canyons, often in association with montane forests, shrublands, and pinyon-juniper woodlands (Fitzgerald et al. 1994). Mule deer is the mountain lion's preferred prey species. Consequently, mountain lion seasonal use ranges closely parallel those of mule deer (UDWR 1999a). Home range sizes vary in relation to habitat quality. In Utah, home range size is influenced by deer and elk seasonal migration patterns. Suitable habitat is primarily determined by available prey and cover for stalking. Mountain lions often use steep slopes in widely spaced mixed conifer stands, and rarely use habitats with sparse cover such as sagebrush and slickrock (UDWR 1999a).

Mountain lions can be found year-round throughout the project area. The BLM has not established habitat objectives for mountain lions, though it is generally accepted by biologists in the agency that lions occur most often where mule deer occur. Refer to Section 3.16.1.1 (Mule Deer), Table 3-38, and Map 33 for probable mountain lion distribution and habitat acreage within the project area.

3.16.3 Upland Game

Upland game with the potential to occur in the project area include populations of chukar partridge (*Alectoris chukar*), greater sage-grouse (*Centrocercus urophasianus*), mourning dove (*Zenaidura macroura*), mountain cottontail rabbit (*Sylvilagus nuttallii*), and desert cottontail rabbit (*Sylvilagus audoboni*). Habitat for these species can be found throughout the 206,826-acre project area. Annual fluctuations for most upland game populations closely correlate with annual climatic patterns. Mild winters and early spring precipitation during the months of March, April, and May are associated with increases in upland game populations. Warm, dry weather during the early summer, especially in June, is generally considered vital for the survival of newly born young of many upland game species (UDWR 2000). Many upland game species (e.g., cottontail rabbits and mourning doves) easily adapt to human disturbance, and can often be found near disturbed/built areas such as well sites and roadsides. The greater sage-grouse, however, has experienced a long-term decline as a result of the degradation and loss of important sagebrush steppe habitat (BLM 2004a). (The greater sage-grouse is discussed further in Section 3.12, Special Status Species.) A variety of other upland game species can be found year-round throughout the project area.

3.16.4 Reptiles, Amphibians, and Other Non-game Species

Reptile and amphibian species with the potential to occur in the project area include the eastern fence lizard (*Sceloporus undulates*); the common sideblotched lizard (*Uta stansburiana*); the Great Basin gopher snake (*Pituophis melanoleucus*); the Northern leopard frog (*Rana pipiens*); the short-horned lizard (*Phrynosoma douglassii*); the wandering garter snake (*Thamnophis elegans vagrans*); the Western rattlesnake (*Crotalus viridis*); and the Western whiptail (*Cnemidophorus tigris*) (Brown et al. 1958; UDWR 2003a; USFWS 2006b). Other non-game species that may be present in the project area include the white-tailed prairie dog (*Cynomys leucurus*), which is discussed in more detail in Section 3.12, Special Status Species; black-tailed and white-tailed jackrabbits (*Lepus californicus*, *Lepus townsendii*); the ringtail cat (*Bassariscus astutus*); the striped skunk (*Mephitis mephitis*); the badger (*Taxidea taxus*); the red fox (*Vulpes vulpes*); the coyote (*Canis latrans*); the bobcat (*Lynx rufus*); various bat species (Order *Chiroptera*); the white-tailed antelope squirrel (*Ammospermophilus leucurus*); the least chipmunk (*Neotamias minimus*); Ord's kangaroo rat (*Dipodomys ordii*); the deer mouse (*Peromyscus maniculatus*); the brush mouse (*P. boylii*); and the desert woodrat (*Neotoma lepida*) (Brown et al. 1958; UDWR 2003b).

Several small mammal, amphibian, and reptile surveys have been conducted by the BLM on the land managed by the Vernal FO, including parts of the project area. Many of these non-game species are difficult to study and monitor because of low population sizes and/or secretive behavior. However, the BLM is in the process of acquiring basic habitat and population information on non-game species listed by state and federal agencies as special status species.

Small mammals, amphibians, and reptiles may have special habitat needs. Areas with the highest concentrations and diversity of these species are generally associated with riparian areas (there are 1,249 acres of BLM-identified riparian habitat in the project area). Amphibian populations are generally limited to areas with water. Small mammals and reptiles generally range farther from water into grassland, shrubland, and forested habitats (reptiles are often associated with talus slopes and rock faces), but must return periodically to water sources. Because small mammals and reptiles occur across many habitats, potential habitat for these species in the project area is equal to the project area itself (206,826 acres).

3.16.5 Aquatic Species

Aquatic habitat within the project area consists mostly of 667 acres within the Pariette Wetlands and Green River, though Nine Mile Creek is a perennial waterway along the southern edge of the project area that also provides habitat for aquatic species. In the Pariette Wetlands, catfish are the most commonly encountered fish species, though special status fish species are also present (Utah Travel Industry 2007). Nine Mile Creek supports a non-game fishery, including such species as the red shiner and speckled dace (BLM 1999c). There are also several special status fish species in the Green River: the bonytail; the Colorado pikeminnow; the humpback chub; the razorback sucker; the roundtail chub; the bluehead sucker; and the flannelmouth sucker (these species are discussed further in Section 3.12, Special Status Species). The Green River provides federally designated critical habitat for several of these fish species. Other aquatic species, including game fish such as brown and rainbow trout, also exist in the Green River.

3.17 Wilderness Characteristics

The project area overlaps approximately 39,892 acres of the 63,118-acre Desolation Canyon non-WSA lands with wilderness characteristics that were inventoried by BLM (BLM 2007) and found to have wilderness characteristics (Map 35). The Desolation Canyon non-WSA lands with wilderness characteristics are a continuation of the many features and landforms found throughout the contiguous Desolation Canyon WSA, although the Desolation Canyon WSA is not located in the project area.

Non-WSA lands with wilderness characteristics are areas having at least 5,000 acres in a natural or undisturbed condition, and provide outstanding opportunities for solitude or primitive forms of recreation. This information is documented in an April 2007 wilderness characteristics review completed by the Vernal FO (BLM 2007) and further discussed in the Vernal RMP. Within the original inventory area, 6,993 acres was reviewed in 2007 and found not to have wilderness characteristics; these acres are no longer included in the Desolation Canyon non-WSA lands with wilderness characteristics. Mineral leases have been issued, and travel routes exist within the non-WSA lands with wilderness characteristics. Approximately 54 miles of travel routes and well-pad access roads and eight gas wells currently lie within the non-WSA lands with wilderness characteristics.

The Desolation Canyon non-WSA lands with wilderness characteristics are natural in character. Although there are human-made developments (except as provided in the paragraph below), they are scattered and their individual and cumulative impact on the natural character of the area is minor. The imprints are in various stages of natural rehabilitation and are substantially unnoticeable as a whole. The expansive landscape, diverse topography, and vegetation screen intrusions from sight within the area (BLM 2007).Within the project area, two producing wells located off Little Desert Road (as well as the road itself) have been excluded from the area with wilderness character.

The Desolation Canyon non-WSA lands with wilderness characteristics are contiguous to the Desolation Canyon WSA, but are large enough to provide outstanding opportunities for solitude on its own as a large, remote area where visitors are isolated from the outside world. The vast size, configuration, numerous scenic vistas, and diversity of vegetation and landform offer the visitor many places to be alone, while providing outstanding opportunities for primitive and unconfined recreation. Most of the area is remote, and accessible only by foot, horseback, or boat (BLM 2007).

The Vernal Record of Decision (ROD) (2008) did not carry the Desolation Canyon non-WSA lands with wilderness characteristics forward as a BLM natural area for the protection, preservation, or maintenance of the wilderness characteristics. In fact, the analysis in the Vernal RMP (2008) portrays that this area was 66% leased, and under the Proposed RMP, it would have a direct loss of natural characteristics and reduction in quality of the outstanding opportunities for solitude and primitive and unconfined recreation due to sights and sounds of development. Ultimately, the RMP analysis shows that 72% of the Desolation Canyon non-WSA lands wilderness characteristics would be affected over the life of the plan by oil and gas development. A full analysis of impacts to this area and other wilderness characteristics areas in the Vernal FO is contained in the RMP. As a result, the Vernal ROD allows the Desolation Canyon non-WSA lands with wilderness characteristics to be subject to other management decisions that allow for degradation or loss of the wilderness characteristics values.

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