Chapter 3

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CHAPTER 3
AFFECTED ENVIRONMENT

3.1 INTRODUCTION

The purpose of this chapter is to describe the existing biological, physical, and socioeconomic characteristics of the planning area, including human uses that could be affected by implementing the alternatives described in Chapter 2. Discussions of topic areas are divided into resources, resource uses, special designations, support needs, and social and economic conditions. Each topic area includes both a description of current conditions and a characterization of trends (which express the direction of change between the present and some point in the past).

Certain types of resources that may be present in other planning areas, such as cave and karst resources (which describes significant caves as mandated by the Federal Cave Resources Protection Act of 1988), do not exist in the GJFO and are therefore not covered in this section. Information from broad-scale assessments was used to help set the context for the planning area. The information and direction for BLM resources and resource uses has been further broken down into fine-scale assessments and information. The level of information presented in this chapter is sufficient to assess potential effects discussed in Chapter 4, based on the alternatives presented in Chapter 2.

Acreage figures and other numbers are approximated using Geographic Information Systems (GIS) technology and do not reflect exact measurements or precise calculations.

The planning area includes all lands, regardless of jurisdiction, within the GJFO boundaries. However, the BLM makes decisions on only those lands and federal mineral estate that it administers (the decision area).

3.2 RESOURCES

This section contains a description of the biological and physical resources of the GJFO and follows the order of topics addressed in Chapter 2, as follows:

- Air;
- Climate;
- Geology;
- Soil Resources;
- Water Resources;
- Vegetation;
- Fish and Wildlife;
- Special Status Species;
- Wild Horses;
- Wildland Fire Management;
- Cultural Resources;
- Paleontological Resources;
- Visual Resources; and
- Lands with Wilderness Characteristics.

3.2.1 Air

This section describes air quality in the region potentially affected by the alternatives described in Chapter 2. Air pollutants addressed include criteria pollutants, hazardous air pollutants, greenhouse gases, and compounds that could impair visibility or contribute to atmospheric deposition.

Air pollution control programs are based on a combination of federal and state legislation. The Clean Air Act (42 United States Code [USC] §§ 7401−7642) is the primary federal legislation, with state legislation providing additional air quality management authority. The Clean Air Act established the principal framework for national, state, and local efforts to protect air quality in the US. Under the Act, the Environmental Protection Agency (EPA) has set time-averaged standards known as national ambient air quality standards (NAAQS) for six air pollutants considered to be key indicators of air quality: carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), two categories of particulate matter (particulate matter with an aerodynamic diameter of 10 microns or less [PM_{10}] and particulate matter with an aerodynamic diameter of 2.5 microns or less [$PM_{2.5}$]), ozone, and lead. Ozone is typically not emitted directly from emission sources; rather, it is created by chemical reactions between ozone precursors, including oxides of nitrogen (NO_x) and volatile organic compounds. Therefore, the EPA also regulates emissions of volatile organic compounds. States may adopt their own ambient air quality standards,

but they must be at least as stringent as the national standards. Colorado has adopted the NAAQS as its state standards with the addition of a more stringent sulfur dioxide standard.

Criteria air pollutants may have local effects, regional effects, or local and regional effects. Oxides of nitrogen and volatile organic compounds are precursors for producing photochemical smog (ozone) and secondary particulate matter. Ozone (including its precursors), $PM_{2.5}$, and sulfur dioxide are considered regional air pollutants, typically affecting air quality on a regional scale. Pollutants such as carbon monoxide and lead are considered local, typically accumulating close to their emission sources. PM_{10} can be considered both a regional and local air pollutant, depending on the particular source of emissions and meteorological conditions. In addition, long-range transport of nitrogen dioxide, PM_{10}, $PM_{2.5}$, and sulfur dioxide can contribute to regional visibility degradation, as well as atmospheric deposition at sensitive areas (such as national parks and wilderness areas) many miles downwind of individual emission sources.

In addition to criteria pollutants, the Clean Air Act regulates toxic and hazardous air pollutants that are known or suspected to cause cancer or other serious health effects or adverse environmental impacts. EPA has issued rules covering 80 categories of major industrial sources as well as categories of smaller sources that emit hazardous air pollutants. Controls are usually required at the source to limit the release of these air toxics into the atmosphere.

Section 176(c) of the Clean Air Act requires that federal actions in nonattainment and maintenance areas conform to the appropriate state implementation plan. A state implementation plan is a plan developed at the state level that provides for the implementation, maintenance, and enforcement of NAAQS and is enforceable by the EPA. The EPA has promulgated rules establishing conformity analysis procedures for transportation-related actions and for other general federal agency actions (40 CFR Parts 6, 51, and 93). The EPA general conformity rule requires preparation of a formal conformity determination document for federal agency actions that are undertaken, approved, or funded in federal nonattainment or maintenance areas when the total net change in direct and indirect emissions of nonattainment pollutants (or their precursors) exceed specified thresholds. Air quality in the planning area is currently in attainment for all national and state ambient air quality standards. General Conformity requirements will not apply unless the area is designated as a nonattainment area for any of the criteria pollutants during the life of the plan.

Air Quality Indicators

Air quality in a geographic area is defined by its visual appearance and measured concentrations of air pollutants. These characteristics can be affected by naturally occurring phenomena such as wind, temperature, humidity, geographic features, vegetation, and wildfire. Air quality characteristics can also be affected

by anthropogenic phenomena such as industrial and agricultural activities, fossil fuel combustion, and prescribed fire. Specific air quality indicators include:

- Measured ambient concentrations of criteria air pollutants and hazardous air pollutants;
- Measured ambient concentrations of visibility impairing pollutants, primarily nitrate and sulfate aerosols;
- Measured concentrations of atmospheric deposition compounds in precipitation and surface waters; and
- The classification of air quality or visibility in specific areas as designated in the Clean Air Act or by state, federal, or tribal agencies with responsibility for managing air resources.

Criteria Air Pollutants

The EPA has established primary and secondary NAAQS for six criteria air pollutants. Primary ambient air quality standards define levels of air quality necessary, with an adequate margin of safety, to protect the public health. Secondary ambient air quality standards define levels of air quality necessary to protect the public welfare from known or anticipated adverse effects of a pollutant. Concentrations of air pollutants greater than the national standards represent a risk to human health. Criteria pollutants include carbon monoxide, nitrogen dioxide, ozone (O_3), particulate matter (PM_{10} and $PM_{2.5}$), sulfur dioxide, and lead (Pb).

Colorado Ambient Air Quality Standards (CAAQS) and NAAQS identify maximum limits for criteria air pollutant concentrations at all locations to which the public has access. The CAAQS and NAAQS are legally enforceable standards. Concentrations above the CAAQS and NAAQS represent a risk to human health that by law, require public safeguards be implemented. State standards must be at least as protective of human health as federal standards and may be more restrictive than the federal standards, as allowed by the CAA.

EPA regulates emissions of oxides of nitrogen (NO_x) and volatile organic compounds, which are precursors for producing photochemical smog (ozone) and secondary particulate matter and, along with $PM_{2.5}$ and sulfur dioxide, are considered to be regional air pollutants affecting air quality on a regional scale. Pollutants such as carbon monoxide and lead accumulate close to their emission sources and are considered to be local pollutants. PM_{10} is considered both a regional and local air pollutant, depending on the source of emissions and meteorological conditions. In addition, long-range transport of nitrogen dioxide, PM_{10}, $PM_{2.5}$, and sulfur dioxide can also contribute to regional visibility degradation and atmospheric deposition (acid rain) at sensitive areas such as national parks and wilderness areas many miles downwind of the individual emission sources.

Air pollutant concentration monitoring networks in Colorado include the State & Local Air Monitoring System (SLAMS), special purpose monitoring, and industrial site monitoring. SLAMS stations are typically located in urban or residential areas or areas of high industrial development and are operated to establish compliance with criteria pollutant concentration standards. Special purpose and industrial site monitors are used to gather additional air quality data or to determine compliance with air permit conditions.

Table 3-1, Applicable Ambient Air Quality Standards and Existing Representative Concentrations for the Planning Area, provides an overview of applicable CAAQS and NAAQS and recent representative pollutant concentrations measured in the planning area and at nearby sites. Further discussion of pollutant concentrations in the GJFO is included in Section 3.1.1.2.

Table 3-1
Applicable Ambient Air Quality Standards and Existing Representative Concentrations for the Planning Area

Pollutant	Background Levels[1]	Averaging Time	NAAQS		CAAQS (μg/m³)
			Standard	Primary or Secondary[2]	
Carbon Monoxide	1.0 ppm	1-hour[1]	35 ppm (40,000 μg/m³)	P	--
Carbon Monoxide	1.0 ppm	8-hour[3]	9 ppm (10,000 μg/m³)	P	--
Lead	0.04 μg/m³	Calendar quarter	0.15 μg/m³	P,S	--
Lead	N/A	Rolling 3-month average	0.15 μg/m³	P,S	--
Nitrogen Dioxide	0.049 ppm	1-hour[4]	100 ppb (188 μg/m³)	P	--
Nitrogen Dioxide	0.005 ppm	Annual	0.053 ppm (100 μg/m³)	P,S	--
PM_{10}	30 μg/m³	24-hour[5]	150 μg/m³	P,S	--
PM_{10}	10 μg/m³	Annual	--	--	--
$PM_{2.5}$	12 μg/m³	24-hour[6]	35 μg/m³	P,S	--
$PM_{2.5}$	5 μg/m³	Annual[7]	12 μg/m³	P	--
$PM_{2.5}$	5 μg/m³	Annual[7]	15 μg/m³	S	--
					--
Ozone	145 μg/m³	8-hour[8]	0.075 ppm (147 μg/m³)	P,S	--
Sulfur Dioxide	0.012 ppm	1-hour[9]	075 ppb (196 μg/m³)	P	--
Sulfur Dioxide	0.009 ppm	3-hour[3]	0.5 ppm (1300 μg/m³)	S	700[1]
Sulfur Dioxide	0.005 ppm	24-hour[3][10]	0.14 ppm (365 μg/m³)	P	--

Table 3-1
Applicable Ambient Air Quality Standards and Existing Representative Concentrations for the Planning Area

Pollutant	Background Levels[1]	Averaging Time	NAAQS		CAAQS ($\mu g/m^3$)
			Standard	Primary or Secondary[2]	
Sulfur Dioxide	0.002 ppm	Annual[10]	0.03 ppm	P	--

(1) Background data source; CO: American Soda, Parachute 2007-2009(CDPHE 2011); : Industrial, urban in Grand Junction 2001 (BLM 2008c); NO_2: Southern Ute, 1 mile NE of Ignacio, 2006-2008 (CDPHE 2011): PM_{10}: Energy Fuels, 2008-2009 (CDPHE 2011); $PM_{2.5}$: Based on S. Ute, 7571 Hwy 5505, 2009-2010 (CDPHE 2011); Ozone: Based on Mesa Verde 2003 for 1-hour and CASTNET in Mesa Verde, Canyonlands, and Gothic for 8-hour: SO_2; 1-hour: Holcim Portland, 2007-2009, SO_2: 3-hour, 24-hour and annual: Unocal 1983-84 (CDPHE 2011); ppm: parts per million.
(2) Primary standards set limits to protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.
(3) Not to be exceeded more than once per year.
(4) To attain this standard, the three-year average of the 98th percentile daily maximum 1-hour concentrations must not exceed 100 parts per billion (ppb).
(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 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 $\mu g/m^3$ (became effective December 17, 2006).
(7) 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 $\mu g/m^3$.
(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 (became effective May 27, 2008).
(9) To attain this standard, the three-year average of the 99th percentile daily maximum 1-hour concentrations must not exceed 75 ppb.
(10) In accordance with 40 CFR §50.4 "National primary ambient air quality standards for sulfur oxides", the SO_2 24-hour and annual NAAQS remains in effect until one year after the effective date of the designation of that area, pursuant to section 107 of the Clean Air Act, for the SO_2 NAAQS set forth in §50. 17 (SO_2 1-hour standard). Designations for the 1-hour SO_2 NAAQS in Colorado have not occurred.

Hazardous Air Pollutants

Hazardous air pollutants are those pollutants that are known or suspected to cause cancer or other serious health problems, such as chronic respiratory disease, reproductive disorders or birth defects. The EPA has classified 189 air pollutants as hazardous air pollutants, including formaldehyde, benzene, toluene, ethyl-benzene, xylene, and n-hexane. EPA has not established ambient air quality standards for hazardous air pollutants. However inhalation reference concentrations developed by EPA and other state and federal agencies are often used to estimate the risk of health effects such as chronic inhalation illness and cancer from human exposure to certain hazardous air pollutants.

Visibility

Visibility can be expressed in terms of deciviews, a measure of perceived changes in visibility. One deciview is a change in visibility just perceptible to an average person, which is approximately a 10 percent change in light extinction.

To estimate potential visibility impairment, monitored aerosol concentrations are used to reconstruct visibility conditions for each day monitored. These daily values are then ranked from clearest to haziest and divided into three categories to indicate the mean visibility for all days (average), the 20 percent of days with the clearest visibility (20 percent clearest), and the 20 percent of days with the worst visibility (20 percent haziest). Visibility can also be defined by standard visual range measured in miles, and is the farthest distance at which an observer can see a black object viewed against the sky above the horizon; the larger the standard visual range, the cleaner the air.

Since 1980, the Interagency Monitoring of Protected Visual Environments (IMPROVE) network has measured visibility in national parks and wilderness areas. The Clean Air Act amendments of 1977 designated 156 areas (primarily national parks and wilderness) as federally mandated Class I areas accorded strict levels of air quality protection. There are six IMPROVE stations in Colorado, but none are located within the GJFO RMPPA.

Atmospheric Deposition

Atmospheric deposition refers to processes in which air pollutants are removed from the atmosphere and deposited into terrestrial and aquatic ecosystems. Air pollutants can be deposited by either wet precipitation (via rain or snow) or dry (gravitational) settling of particles and adherence of gaseous pollutants to soil, water, and vegetation. Much of the concern about deposition surrounds the secondary formation of acids and other compounds from emitted nitrogen and sulfur species such as nitrogen oxides (NO_x) and sulfur dioxide, which can contribute to acidification of lakes, streams, and soils and affect other ecosystem characteristics, including nutrient cycling and biological diversity.

Substances deposited include:

- Acids, such as sulfuric (H_2SO_4) and nitric (HNO_3), sometimes referred to as acid rain
- Air toxics, such as pesticides, herbicides, and volatile organic compounds
- Heavy metals, such as mercury
- Nutrients, such as nitrates (NO_{3-}) and ammonium (NH_{4+})

Rain, snow, cloud water, particle settling, and gaseous pollutants complicate the accurate measurement of atmospheric deposition. Deposition varies with precipitation and other meteorological variables, such as temperature, humidity, winds, and atmospheric stability, which, in turn, vary with elevation and time. The National Atmospheric Deposition Program is an interagency sponsored network of monitoring stations that measures wet atmospheric deposition. The Clean Air Status and Trends Network (CASTNET) is an interagency network of monitoring stations managed by EPA that measures dry deposition.

Classification of Areas for Prevention of Significant Deterioration and Visibility

Section 162 of the Clean Air Act includes provisions for the Prevention of Significant Deterioration (PSD) of air quality. The goal of the PSD program is "to preserve, protect and enhance the air quality in national parks, national wilderness areas, national monuments, national seashores and other areas of special national or regional natural, recreation, scenic or historic value." A classification system was established identifying allowable amounts of additional air quality degradation which would be allowed above legally established baseline levels. PSD increments have been established for nitrogen dioxide, sulfur dioxide and PM_{10}.

PSD Class I areas have the greatest limitations, with a very limited amount of additional degradation allowed. National parks greater than 6,000 acres and wilderness areas greater than 5,000 acres that were in existence as of Aug. 7, 1977 were automatically designated as Class I areas under the PSD program. In addition, Section 164(a) and 164(c) give states and tribes, respectively, the right to designate other areas as PSD Class I areas.

The remainder of the nation (excluding non-attainment and maintenance areas) is designated as PSD Class II, where moderate deterioration and controlled growth is allowed. PSD Class III areas allow for maximum growth and degradation up to the NAAQS, however no areas have been designated Class III. Areas that have violated NAAQS are designated non-attainment or maintenance areas, and additional growth and degradation are severely limited in these areas until they are brought back into compliance with the standard.

Section 169A of the Clean Air Act required the Secretary of the Department of Interior and other Federal land managers, including the National Park Service, US Fish and Wildlife Service, Bureau of Land Management, and US Forest Service, to review all mandatory federal Class I areas and identify those where visibility was an important value. The EPA was then responsible for promulgating this list of federally mandated Class I areas for visibility, which includes 156 national parks and wilderness areas (all of which are also PSD Class I areas). These areas are afforded special protection with regards to visibility and cannot be downgraded to Class II.

There are 12 federally mandated Class I areas for visibility in Colorado; these areas are also PSD Class I areas. In addition, the State of Colorado has designated the Colorado National Monument (which is outside the RMPPA) and Dinosaur National Monument (north of the RMPPA in the White River Field Office) as Class I areas for sulfur dioxide only. The nearest Class I areas are at the Flat Tops and Maroon Bells Wilderness Areas and the wilderness portion of Black Canyon National Park, all located approximately 50 kilometers or more outside the RMPPA.

Greenhouse Gases

Concentrations of certain gases in the earth's atmosphere have been identified as being effective at trapping heat reflected off the earth's surface thereby creating a "greenhouse effect." As concentrations of these greenhouse gases increase, the earth's surface warms, the composition of the atmosphere changes, and global climate is affected. Concentrations of greenhouse gases have increased dramatically in the earth's atmosphere in the past century. The most prevalent greenhouse gas compounds are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone, and water vapor. The EPA has determined that six greenhouse gases are air pollutants and subject to regulation under The Clean Air Act: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. carbon dioxide, methane, and nitrous oxide are produced naturally by respiration and other physiological processes of plants, animals, and micro-organisms; by decomposition of organic matter; by volcanic and geothermal activity; by naturally occurring wildfires; and by natural chemical reactions in soil and water. These pollutants are also produced by anthropogenic sources including fossil fuel combustion, methane venting, and other industrial sources. Greenhouse gas emissions and climate change are discussed further in Chapter 4.

Current Conditions

Ozone and particulate matter are the air pollutants of greatest concern not only within the planning area but also to downwind sites such as Class I and sensitive Class II areas that lie outside of the planning area. Ozone is seldom released directly into the atmosphere but is formed by complex chemical reactions that occur in the presence of sunlight. The atmospheric chemical reaction processes that produce ozone also produce chemically formed particulate matter (secondary $PM_{2.5}$) and acidic compounds. Combustion processes and evaporation of volatile organic compounds are the major emission sources for ozone forming precursors. Combustion processes are the major source of emissions for nitrogen oxides. Common fuel combustion sources include fuel combustion in motor vehicles, fuel combustion in industrial processes, agricultural burning, prescribed burning, and wildfires. Common sources of volatile organic compounds include venting and emissions from industrial sources, paints, solvents, liquid fuels, or liquid chemicals. Biogenic (natural) sources are also a source for volatile organic compound emissions. The major emission source categories for suspended particulate matter include combustion sources (fuel combustion in motor vehicles and industrial processes, agricultural burning, prescribed burning, and wildfires); soil disturbance by construction equipment, agricultural and forestry equipment, recreational vehicles, or other vehicles and equipment; mining and other mineral extraction activities; and wind erosion from exposed soils and sediments. Secondary particulate matter can also be formed by the types of atmospheric chemical reactions that produce ozone and acidic compounds.

Air Pollutant, Visibility, and Deposition Monitoring in the Planning Area

Various state and federal agencies monitor air pollutant concentrations, visibility, and atmospheric deposition throughout Colorado, and there are 5 criteria pollutant monitors in the planning area. **Table 3-2**, Air Quality Monitoring Sites in or Near the Planning Area, lists the available air quality monitoring sites in the planning area and at other nearby sites.

Table 3-2
Air Quality Monitoring Sites in or Near the Planning Area

County	Monitor Site Name	Type of Monitor	Parameters	Location	
				Latitude	Longitude
Mesa	South Ave. Grand Junction	SLAMS	PM_{10}, PM2.5	39.0638	-108.5612
	Pitkin Ave. Grand Junction	SLAMS	PM_{10}, CO	39.0643	-108.5616
	Hwy 141 Grand Junction	Special Purpose Regulatory Monitor	PM_{10}	39.0625	-108.4574
	Palisade	SLAMS	O_3	39.1306	-108.3138
	Colorado National Monument	NPS 2B-Tech (non-regulatory)	O_3	39.1067	-108.7411
Pitkin	White River National Forest – WHR11	IMPROVE	PM2.5, NO3, NH4, nitric acid, SO4, SO2, and meteorology	39.1536	-106.8209
Garfield	Gothic Site – GTH161	CASTNET/ NADP	NO3, NH4, nitric acid, SO4, SO2	38.9564	-106.9858

As shown in **Table 3-2**, CDPHE operates several criteria pollutant monitors, including PM_{10} and $PM_{2.5}$, in Grand Junction as part of the SLAMS network. The PM_{10} monitor located at Hwy 141 and D Road in Grand Junction is a Special Purpose regulatory monitor. The US Forest Service operates an IMPROVE monitor in the White River National Forest in Pitkin County (in the Colorado River Valley Field Office RMP planning area). The NPS operates a non-regulatory monitor within the Colorado National Monument. The closest CASTNET and National Acid Deposition Program (NADP) National Trends Network (NTN) site is the Gothic site located in northern Gunnison County within the Gunnison Field Office and measures wet and dry atmospheric deposition of nitrogen, sulfur, and various metals.

Trends

Criteria Pollutant Monitoring

Ambient criteria air pollutant concentrations of carbon monoxide, lead, NO_x, PM_{10}, $PM_{2.5}$, ozone, and sulfur dioxide are shown in **Table 3-1**. These data were provided by CDPHE-APCD as representative of existing conditions the RMPPA. The results of other pollutant monitoring performed in the RMPPA for pollutants of particular regional interest are discussed below. The examination of these data indicates that the current air quality for criteria pollutants in the planning area is considered good overall.

Ozone observations were available at two sites in the RMPPA: Palisade and Colorado National Monument. Both sites meet the current 0.075 parts per million (ppm) 8-hour ozone NAAQS in all years since the monitors were activated. Attainment or nonattainment of the ozone NAAQS is determined by the ozone design value that is defined as the fourth highest daily maximum 8-hour ozone concentrations averaged over three consecutive years. **Table 3-3**, Fourth Highest Daily-Maximum 8-hour Ozone Concentrations and 8-hour Ozone Design Values (DV) at the Palisade and Colorado National Monument Sites Within the Planning Area, lists the fourth highest daily maximum 8-hour ozone for each year of monitoring operation and the ozone design values at the two sites in the RMPPA. The highest ozone design value recorded in the planning area was 0.067 ppm at the Palisades monitoring site for the three-year period ending in 2010. This is well below the current ozone NAAQS of 0.075 ppm.

Table 3-3
Fourth Highest Daily-Maximum 8-hour Ozone Concentrations and 8-hour Ozone Design Values (DV) at the Palisade and Colorado National Monument Sites Within the Planning Area

Year	Palisade Ozone Concentrations (ppm)		Colorado National Monument Ozone Concentrations (ppm)	
	4th High	DV	4th High	DV
2011	0.066	0.066	0.068	0.063
2010	0.068	0.067	0.065	0.063
2009	0.064		0.058	0.064
2008	0.070		0.067	
2007	n/a		0.067	

Recent ozone monitoring data from air monitors located in Rangely, Colorado, and in the Uinta Basin in Utah indicate periods of elevated winter ozone concentrations north and west (upwind) of the planning area. The Rangely monitor measured fourth-highest 8-hour average concentrations of 88 parts per billion (ppb) in 2011 and 91 ppb in 2013, both above the 75 ppb NAAQS. This data is not yet final and is provided for informational purposes; EPA and CDPHE

would make any regional non-attainment determinations. In Utah's Uinta Basin (located in eastern Utah and a portion of western Colorado), 8-hour daily maximum winter ozone exceedances have been measured at the Ouray and Redwash monitoring stations between 2009 and 2011. This winter ozone pattern is similar to ozone monitoring observations made in other oil and gas fields, including the Upper Green River Basin and Jonah-Pinedale Anticline in Wyoming. The EPA issued a final rule on April 30, 2012, designating Duchesne and Uintah counties in Utah as an ozone unclassifiable area. Sweetwater county and portions of other counties in Wyoming were designated as an ozone nonattainment area. The current scientific consensus is that the photochemical processes that form tropospheric ozone in the presence of nitrogen dioxide 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. The higher concentrations of ozone precursors in these regions have been linked to increased emissions from oil and gas development activities.

Table 3-4, Second Highest Annual 1-hour and 8-hour Carbon Monoxide Concentrations at Grand Junction, lists the second highest observed 1-hour and 8-hour carbon monoxide concentrations for the past 10 years at Grand Junction. Since 2004, the Grand Junction monitor has been located at 645 ¼ Pitkin Avenue, which is along the eastbound Interstate 70 business loop. The observed carbon monoxide statistics are well below the 1-hour (35 ppm) and 8-hour (9 ppm) standards for carbon monoxide in each of the past 10 years. There is a general trend towards lower maximum concentrations.

Table 3-4
Second Highest Annual 1-hour and 8-hour Carbon Monoxide Concentrations at Grand Junction

Year	1-hour CO (ppm)	8-hour CO (ppm)
2011	1.8	1.1
2010	1.7	1.1
2009	2.3	2.2
2008	6.8	1.5
2007	2.8	1.8
2006	2.8	1.7
2005	2.7	2.0
2004	3.7	2.1
2003	5.6	3.3
2002	5.7	3.6

$PM_{2.5}$ is monitored at 650 South Avenue in Grand Junction, located a block to the south of business loop Interstate 70. Attainment or nonattainment of the $PM_{2.5}$ NAAQS is determined by the $PM_{2.5}$ value where the $PM_{2.5}$ NAAQS has an annual threshold of 15 µg/m³ and a 24-hour threshold of 35 µg/m³. The annual $PM_{2.5}$ value is defined as the three-year average of annual average $PM_{2.5}$

concentrations averaged over three consecutive years. The 24-hour $PM_{2.5}$ design value is defined as the 98th percentile 24-hour $PM_{2.5}$ concentrations averaged over three consecutive years. **Table 3-5**, 98th Percentile 24-Hour $PM_{2.5}$ Concentrations and 24-Hour $PM_{2.5}$ Design Values at Grand Junction, lists the 24-hour $PM_{2.5}$ observations for each of the past 10 years at the 98th percentile and the 24-hour $PM_{2.5}$ design values (listed for the last year in the three-year average) at the South Avenue monitoring site in Grand Junction. Samples were collected every third day.

Table 3-5
98th Percentile 24-Hour $PM_{2.5}$ Concentrations and 24-Hour $PM_{2.5}$ Design Values at Grand Junction

Year	24-hour $PM_{2.5}$ at 98th Percentile ($\mu g/m^3$)	24-hour $PM_{2.5}$ Design Value ($\mu g/m^3$)
2011	22	33.3
2010	37	34.3
2009	41	30.7
2008	25	25.0
2007	26	22.7
2006	24	24.7
2005	18	23.3
2004	32	26.0(1)
2003	20	N/A
2002(2)	16	N/A

(1) Based on 2-year average
(2) Data excluded. Not enough observations (20- 24-hour observations)

In 2009 and 2010, Grand Junction's 24-hour $PM_{2.5}$ at the 98th percentile exceeded the 35 $\mu g/m^3$; $PM_{2.5}$ NAAQS level. However, the 24-hour $PM_{2.5}$ design values (i.e., 3-year running averages) for years ending in 2010 and 2011 were 34.3 and 33.3 $\mu g/m^3$ which does not violate but is close to the 24-hour $PM_{2.5}$ NAAQS standard of 35 $\mu g/m^3$. **Diagram 3-1**, Time Series of 24-hour $PM_{2.5}$ Design Value Concentrations, displays a time series of the 24-hour $PM_{2.5}$ design values centered on the year. The blue points represent 3-year averages while the orange points are limited to 2-year averages. The linear trend line (excluding 2-year averages) shows $PM_{2.5}$ increasing over time; the rate is slower, but still increasing when including the 2-year averages (not shown). Grand Junction is still in attainment for 24-hour $PM_{2.5}$, but care must be taken to ensure that the attainment status can be achieved in the future given the increasing concentration trend and close proximity of the 24-hour $PM_{2.5}$ design values to the NAAQS.

The annual average $PM_{2.5}$ concentration and annual $PM_{2.5}$ design values at Grand Junction are well within the 15 $\mu g/m^3$ annual $PM_{2.5}$ NAAQS for all years, as shown in **Table 3-6**, Annual $PM_{2.5}$ Concentrations at Grand Junction.

Diagram 3-1
Time Series of 24-hour $PM_{2.5}$ Design Value Concentrations

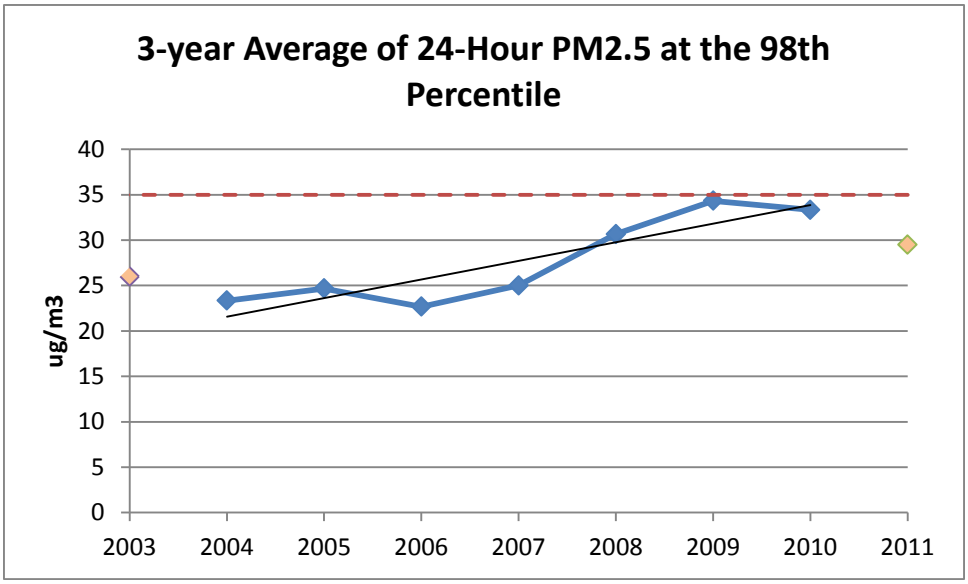


Table 3-6
Annual $PM_{2.5}$ Concentrations at Grand Junction

Year	Annual $PM_{2.5}$ ($\mu g/m^3$)	Annual $PM_{2.5}$ Design Value ($\mu g/m^3$)
2011	7.1	8.6
2010	9.0	9.2
2009	9.6	9.4
2008	9.1	9.4
2007	9.5	9.2
2006	9.7	9.5
2005	8.4	9.2
2004	10.4	9.6[1]
2003	8.8	N/A
2002[2]	12.0	N/A

[1] Based on 2-year average
[2] Data excluded due to insufficient observations.

The maximum annual $PM_{2.5}$ design value in Grand Junction is 9.5 $\mu g/m_3$, which occurred during the 2004-2006 three-year period and is 37% below the annual $PM_{2.5}$ NAAQS.

Four monitors have sampled PM_{10} in the GJFO RMPPA. Three are located at 650 South Avenue in Grand Junction, and the fourth is located at US Highway 141 and D Road at Clifton, just east of Grand Junction.

At the South Avenue site, one sampled PM_{10} approximately once every three days; the second, about once every six days, the third was a continuous type

monitor. The second highest 24-hour PM_{10} concentration for each year is listed in **Table 3-7**, Second Highest 24-Hour PM_{10} Concentration, and was the same or higher in the monitor that was sampling at a higher frequency. In 2010, the continuous type monitor replaced a similar monitor that was located nearby at 645 ¼ Pitkin ave (I-70 Business Loop). Data from the Grand Junction Pitkin Avenue monitor (on business loop I-70) and Clifton monitor (US highway 141 and D Road) are also shown in Table 3-7. Dates with exceptional events, like wildfires, have been excluded.

Table 3-7
Second Highest 24-Hour PM_{10} Concentration

Year	Grand Junction (650 South Ave) [μg/m³]	Grand Junction (650 South Ave) [μg/m³]	Grand Junction (645 ¼ Pitkin Ave) [μg/m³]	Clifton (US Hwy 141 & D Rd) [μg/m³]
Sampling Frequency	1 in 3 days	Daily	Daily	1 in 3 days
2011	39	44	N/A	54
2010	57*	N/A	N/A	66*
2009	61	N/A	80	122
2008	103	N/A	110	96
2007	68	N/A	124	62**
2006	77	N/A	110*	N/A
2005	61*	N/A	86*	N/A
2004	60	N/A	76	N/A
2003	82*	N/A	N/A	N/A
2002	62	N/A	N/A	N/A

*Data on dates with exceptional events are excluded
** Insufficient annual samples (25 for the year)

No monitors in the Grand Junction area have exceeded the 24-hour PM_{10} NAAQS of 150 μg/m³ over the past 10 years, excluding exceptional events. The Pitkin Avenue monitor is consistently higher than the South Avenue monitor even though they are relatively close to one another. The Pitkin Avenue monitor, which is located on eastbound business loop Interstate 70, is either detecting more particulates from diesel trucks and road dust or is higher because of differences in collection methodologies.

Visibility Monitoring

An environmental concern in the US is the improvement and maintenance of visibility conditions, especially in national parks and wilderness areas. There are no such areas within the planning area; however, activities within the planning area can potentially impact Class I and sensitive Class II areas downwind of the areas administered by the GJFO. These areas include those administered by the USFS such as the Flat Tops, Eagle's Nest, Maroon Bells-Snowmass and West Elk Wilderness areas (Class I) and Raggeds, Holy Cross, Hunter-Fryingpan, and Collegiate Peaks Wilderness areas (sensitive Class II).

Because there are no IMPROVE monitors in the planning area, estimates of visibility in the area are derived from air quality and meteorological measurements from the White River National Forest IMPROVE monitor to the southeast in the adjacent Colorado River Valley Field Office RMP planning area. This document includes data from this IMPROVE monitor to provide the most representative available data for visibility in the Grand Junction Field Office RMP planning area.

Diagrams 3-2 through **3-4** (Standard Visual Range for 20th percent Cleanest Days, White River National Forest IMPROVE Site; Standard Visual Range for 20th percent Middle Days, White River National Forest IMPROVE Site; and Standard Visual Range for 20th percent Worst Visibility Days, White River National Forest IMPROVE Site) show visibility estimates for the 20 percent cleanest days, 20 percent median condition days, and the 20 percent worst days, respectively, for the White River IMPROVE site for the period 2000-2010 (IMPROVE 2012). These data indicate excellent visibility conditions with a trend toward improved visual range in this period.

Atmospheric Deposition Monitoring

The CASTNET/NADP monitoring site located nearest the planning area is the Gothic site (GTH161) located in northern Gunnison County within the Gunnison Field Office. **Diagram 3-5**, Total Annual Wet and Dry Sulfur Deposition (kilograms per hectare per year) at the Gothic CASTNET Site, provides the total (wet and dry) annual sulfur deposition (kilograms per hectare per year) and **Diagram 3-6**, Total Annual Wet and Dry Nitrogen Deposition (kilograms per hectare per year) at the Gothic CASTNET Site, provides the total annual nitrogen deposition at the Gothic CASTNET Site for the period 2000 through 2009 (EPA 2012). There are no discernible trends in these measurements over this period.

Summary of Air Quality Trends

Available air quality data for monitored criteria pollutants were examined to determine potential trends over the various periods of record. For ozone, the fourth highest 8-hour average concentrations do not indicate a trend, although design values for the two to three years available for Palisade and Colorado National Monument, respectively, show a slight downward trend. Ozone monitors outside of the planning area have shown elevated levels of ozone concentrations during the winter months. Monitored PM_{10} concentrations at both Grand Junction South Avenue monitor and the Clifton site show a steady decrease in the last three to four years. Concentrations of $PM_{2.5}$ at the South Avenue site show an increase through year 2010, with 2011 24-hour 98th percentile values considerably lower. Visibility data collected at the White River National Forest site show very good to excellent visibility, even for the 20 percent haziest days. Visibility shows a trend of improvement over the period of record. Wet and dry nitrogen and sulfur deposition data from the Gothic site show no distinct trend in atmospheric deposition over the ten-year period of record (2000 through 2009) examined in this analysis.

Diagram 3-2
Standard Visual Range for 20th percent Cleanest Days, White River National Forest IMPROVE Site

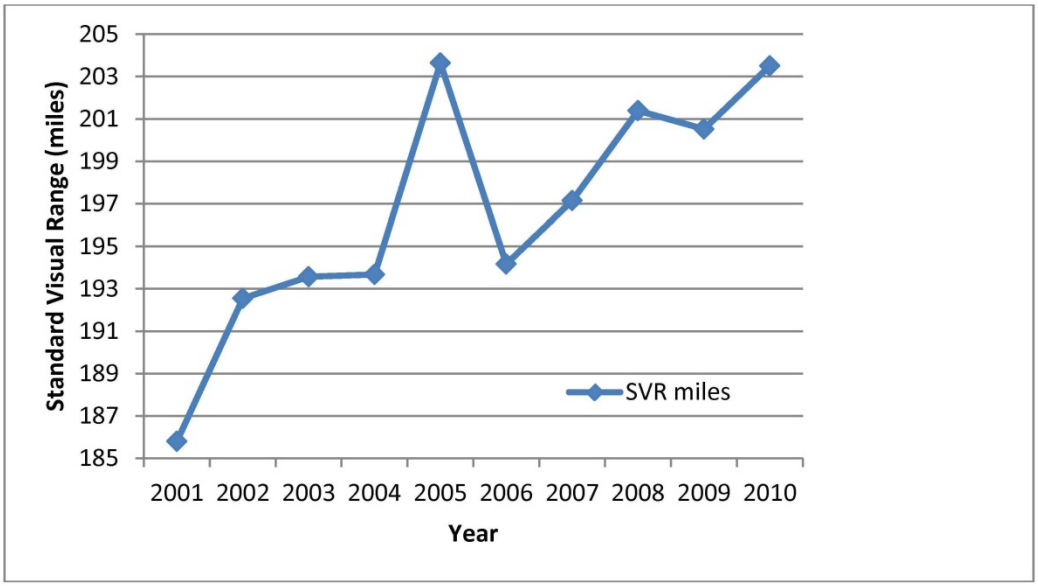


Diagram 3-3
Standard Visual Range for 20th percent Middle Days, White River National Forest IMPROVE Site

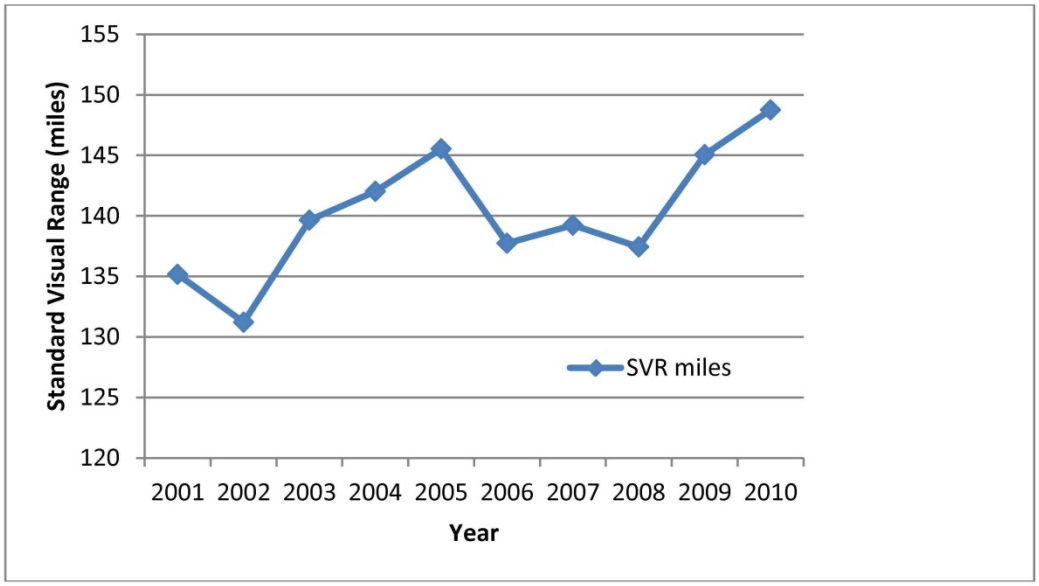


Diagram 3-4
Standard Visual Range for 20th percent Worst Visibility Days, White River National Forest IMPROVE Site

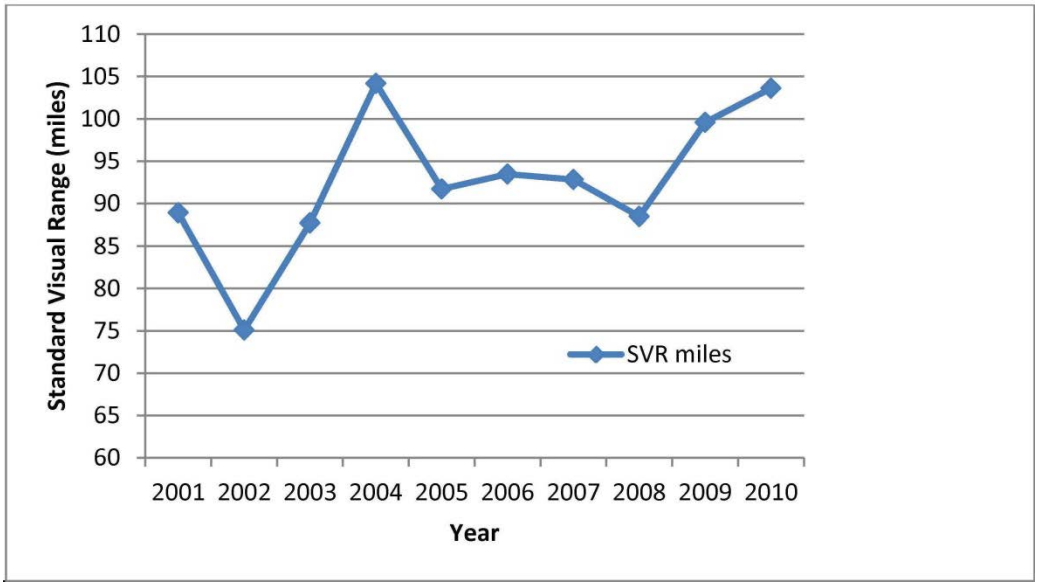


Diagram 3-5
Total Annual Wet and Dry Sulfur Deposition (kilograms per hectare per year) at the Gothic CASTNET Site

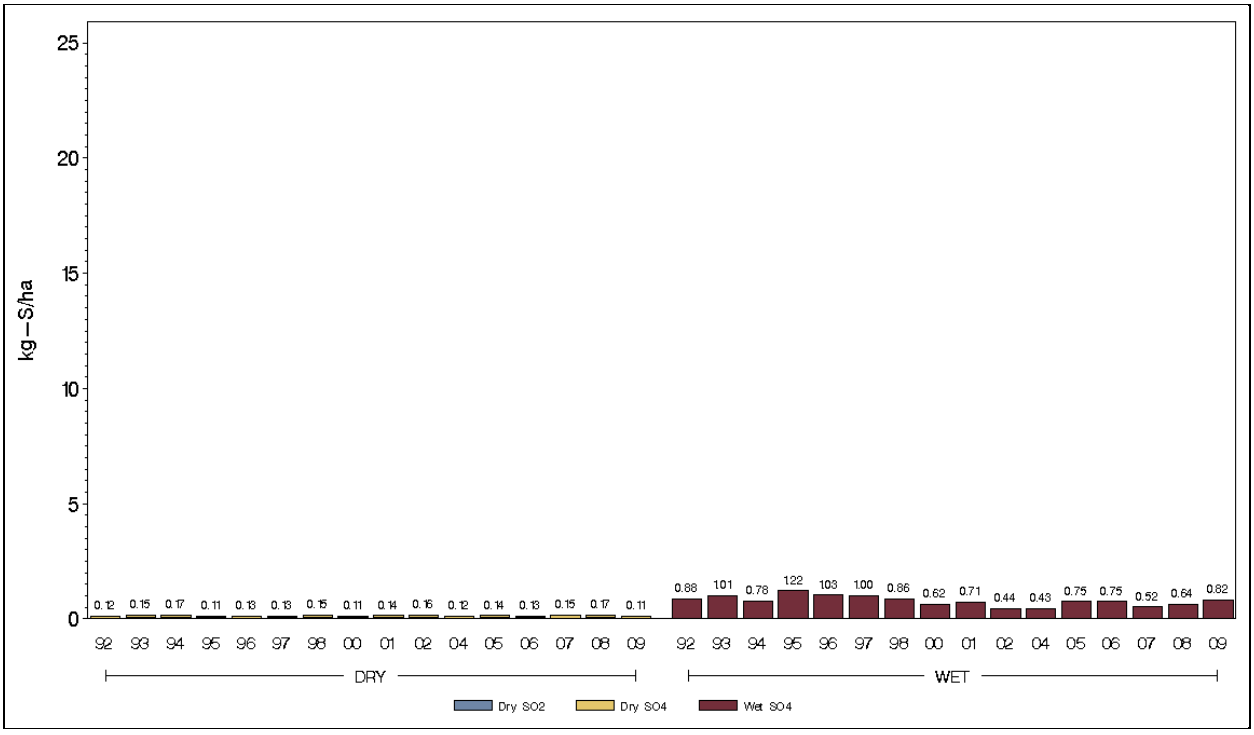
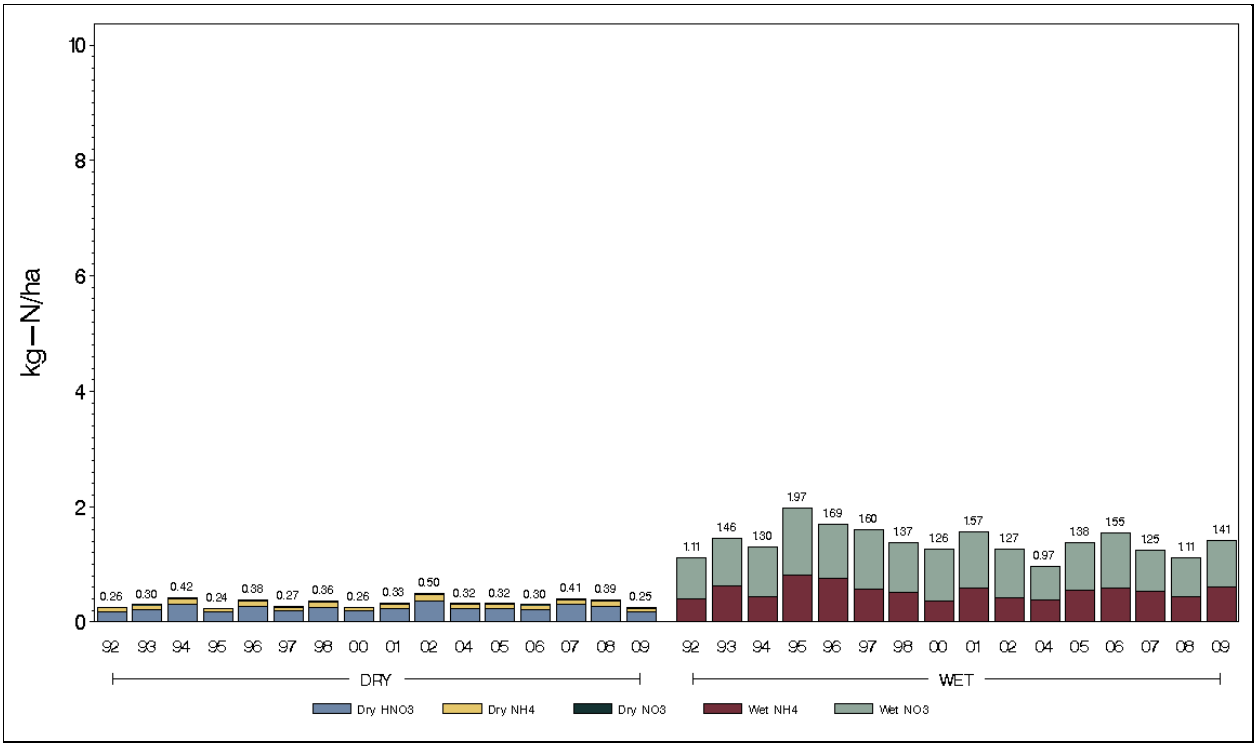


Diagram 3-6
Total Annual Wet and Dry Nitrogen Deposition (kilograms per hectare per year) at the Gothic CASTNET Site



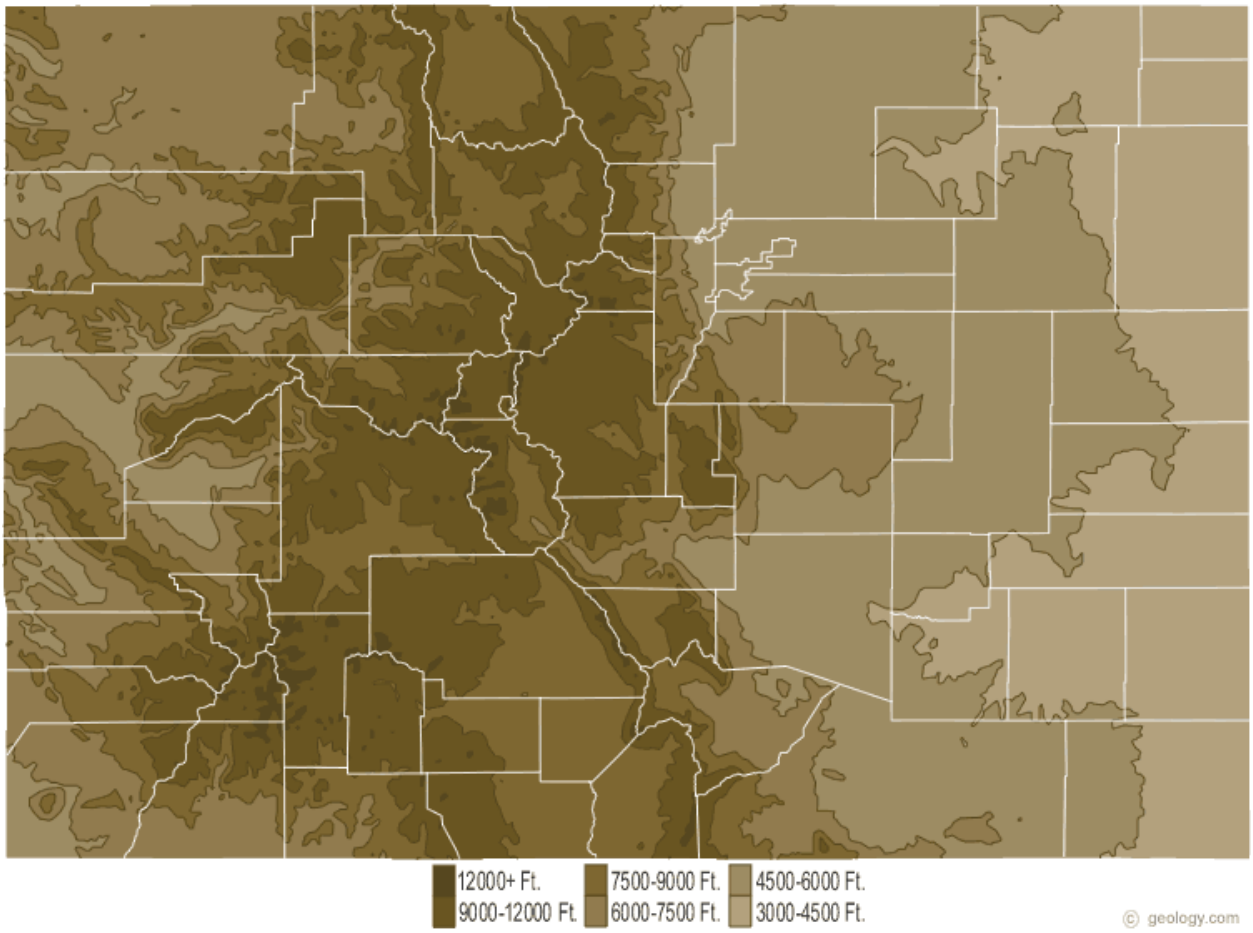
Management Challenges for Air Quality

Monitoring data available from the sites in the planning area and data collected at monitors in nearby areas reflect good to excellent air quality and visibility. The estimated ozone design concentration at Palisade is 67 ppb, which is below the current level of the standard (75 ppb). However, the EPA is currently evaluating the level of the standard and may reduce the standard to between 60 and 70 ppb. If the 8-hour ozone NAAQS is reduced within this range, nonattainment designation could be possible in the future. Continued maintenance of the applicable federal and state air quality standards for $PM_{2.5}$ is also an issue, considering historical monitoring data from 2009 and 2010. As additional resource development scenarios are considered for the planning area, it would be important to evaluate the impacts that emissions from development sources will have on criteria pollutants such as ozone and $PM_{2.5}$, as well as impacts on visibility and atmospheric deposition. The BLM expects to work cooperatively with CDPHE-APCD, the EPA, and other local, state, federal, and tribal agencies to address these issues. Developing effective management actions and strategies aimed to maintain compliance with ambient standards and other air quality goals will enable air quality improvement in the planning area.

3.2.2 Climate

The topography in Colorado is very complex with mountain ranges over 9,000 feet running mostly in the north-south direction in the middle of the state with peaks exceeding 14,000 feet. The planning area is west of the Continental Divide, with the Uncompahgre Plateau running in a northwest to southeast direction to the south and numerous mesas to the northeast. Both have elevations exceeding 9,000 feet. In between are the Colorado River drainage area and the Grand Valley, which includes the cities of Grand Junction, Fruita, and Palisade, where the elevation of these cities is around 4,500 to 5,000 feet. A topography map for the state of Colorado is shown in **Diagram 3-7**, Topographic Map of the State of Colorado. The Grand Valley that lies in the center of the planning area is adjacent to Utah, with a north-northwest to south-southeast orientation at the north-south mid-point of the state.

Diagram 3-7
Topographic Map of the State of Colorado



Due to the shape of the valley floor, the dominant wind direction at Grand Junction is channeled by the topography; during most months of the year, the dominant wind direction is easterly or east-southeasterly with speeds averaging 5 miles per hour in the winter and 10 miles per hour in the summer (WRCC 2012). **Diagram 3-8,** Grand Junction, Colorado - Meteorological Data Wind Rose**,** displays a wind rose of surface wind speed and direction at Grand Junction for the five year period, 1991-1995. The Grand Junction wind rose illustrates the channeling of the winds along the east-southeast to north-northwest orientation of the Grand Valley. Outside of the Grand Valley, wind distributions within the RMPPA may be slightly different given the complex terrain in the region. This is illustrated in annual wind roses for Nucla and Pine Ridge that are sites within the southern portion of the RMPPA in Montrose County shown in **Diagram 3-9**, Pine Ridge, Colorado - Meteorological Data Wind Rose, and **Diagram 3-10**, Nucla, Colorado - Meteorological Data Wind Rose. Over the higher elevations, the prevailing wind direction is from the west.

Diagram 3-8
Grand Junction, Colorado - Meteorological Data Wind Rose

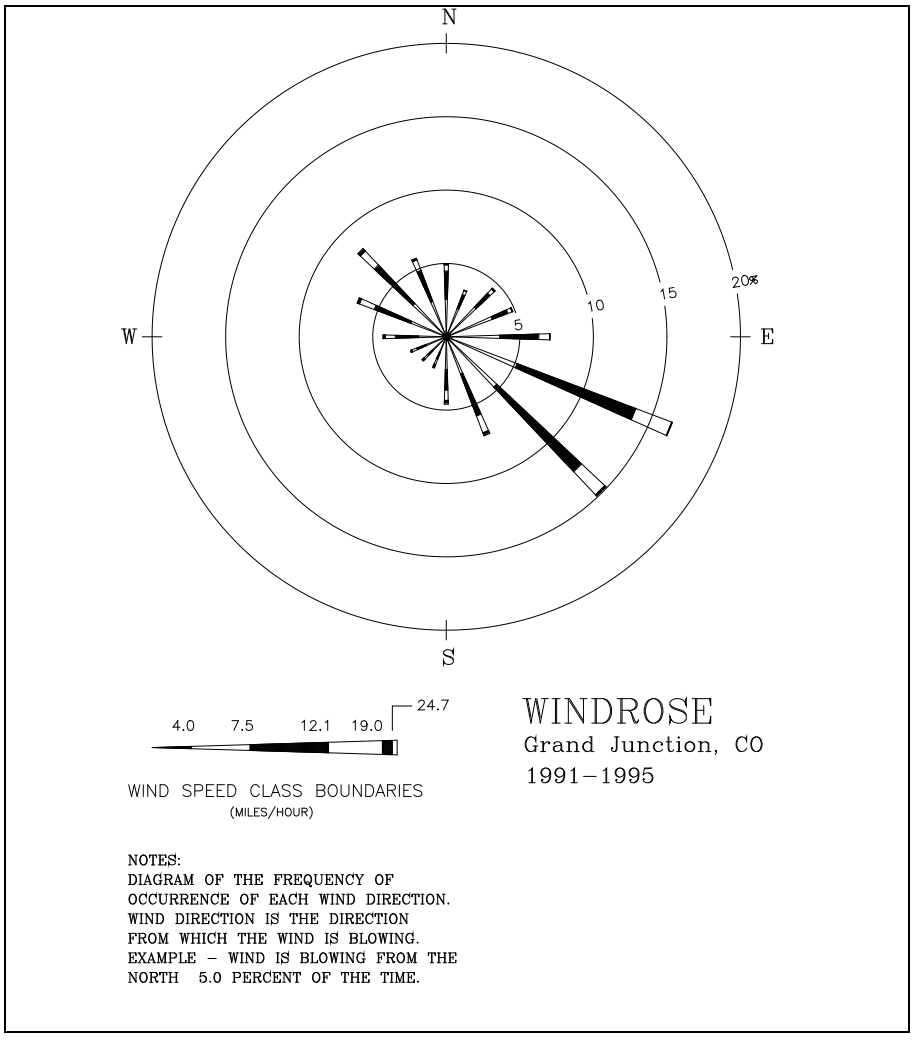


Diagram 3-9
Pine Ridge, Colorado - Meteorological Data Wind Rose

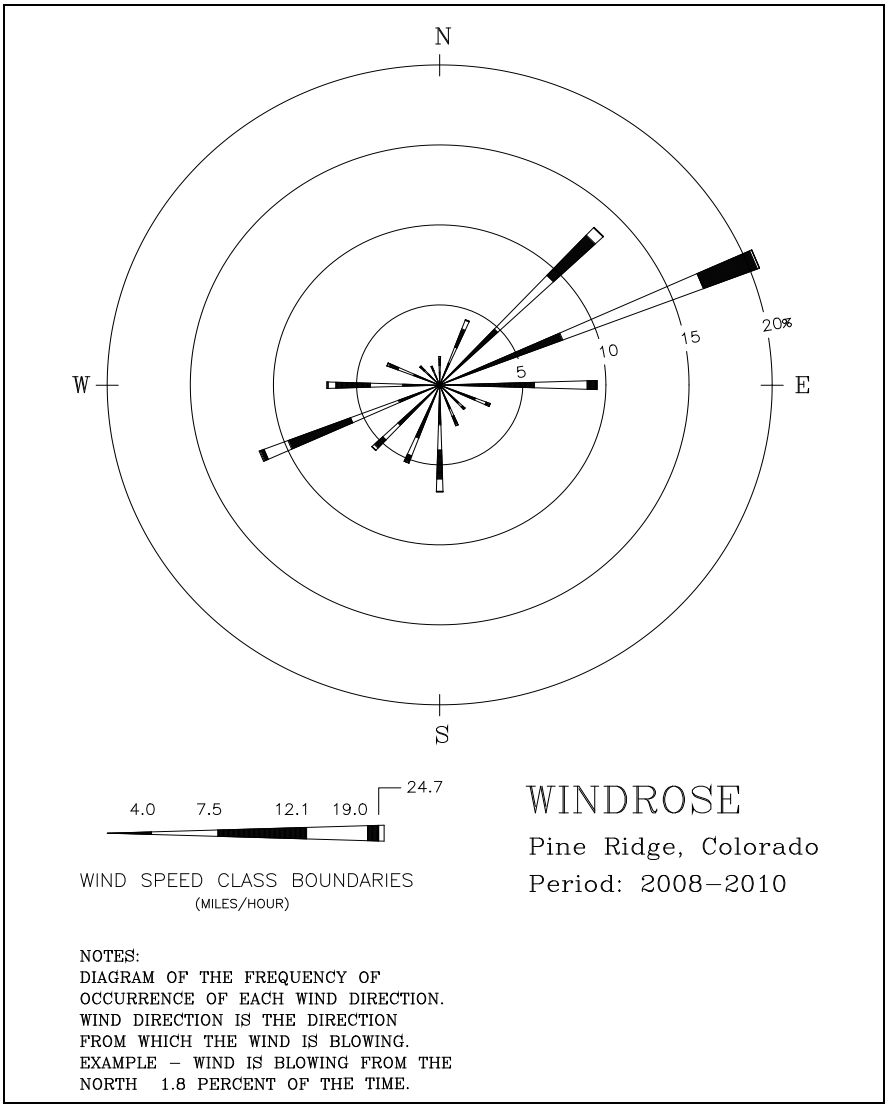
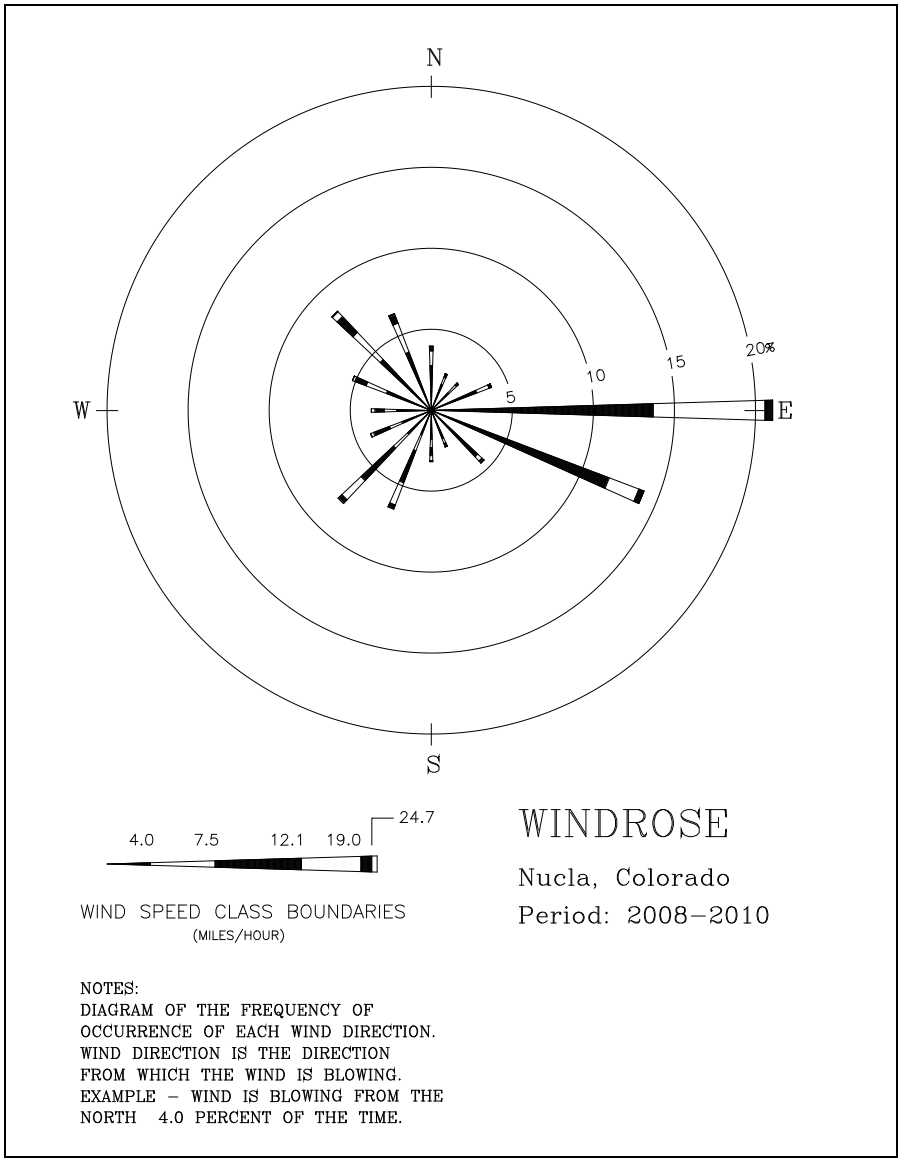


Diagram 3-10
Nucla, Colorado - Meteorological Data Wind Rose

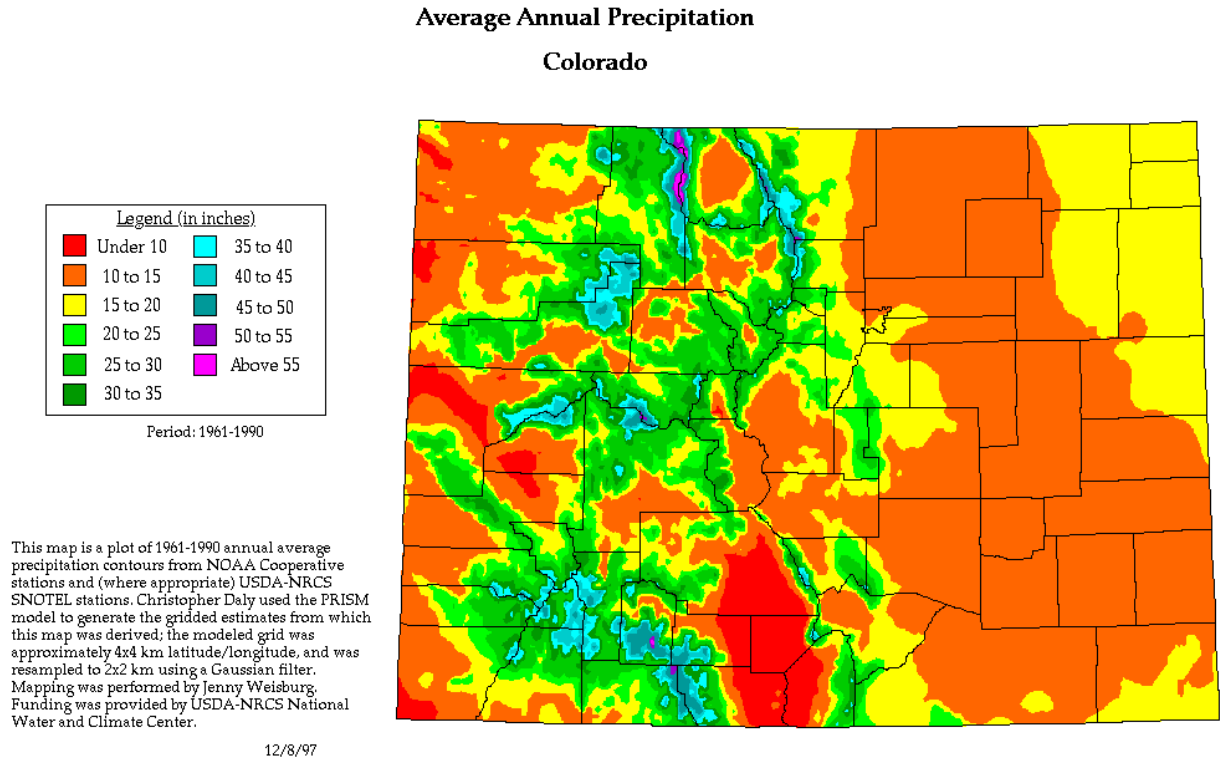


Average daytime high temperatures in the summer can vary from the lower 90s (°F) near the valley floor to the 60s at the higher elevations; in the winter, the average high temperatures near the valley floor are in the mid-30s to lower 40s, with temperatures in the 20s at higher elevations. Nighttime temperatures in the Grand Valley are typically in the 50s to lower 60s in the summer and in the teens in the winter, with cooler temperatures at the higher elevations. Monthly average temperatures drop below freezing in most valley floor locations from November to March. Grand Junction averages 8 days of fog per year.

Storms from the Pacific Ocean generally lose most of their moisture by the time they reach Colorado, resulting in very little precipitation in the valley. Grand

Junction, Fruita, and Palisade each receive on average 9 to 10 inches of precipitation per year. Monthly precipitation totals are fairly uniform in this area, but June tends to have the fewest number of days of precipitation and the lowest totals at most meteorological monitoring sites. More precipitation falls at the higher elevations, as shown in the 30-year climatological average annual precipitation map in **Diagram 3-11**, Average Annual Precipitation Map of Colorado, obtained from the Western Regional Climate Center (WRCC 2012).

Diagram 3-11
Average Annual Precipitation Map of Colorado



3.2.3 Geology

The geologic history of the GJFO planning area involves tectonics, sedimentation, igneous activity, and erosion extending from the Precambrian Era to the present, with the current landscape resulting from uplift and erosion during the past 5 million years. This text is derived from the *Mineral Potential Report for the Grand Junction Resource Area* (BLM 2010d). The reader is directed to this document for a fully referenced discussion of the geology of the GJFO.

Current Conditions

Stratigraphy

Rocks in the GJFO planning area range in age from Precambrian to Quaternary, with some significant gaps (see **Figure 2-65**, Alternatives A, B, C, and D: Surface Geology). Precambrian rocks form the basement to the planning area,

appearing in canyon bottoms in several places. Pennsylvanian-age Hermosa Group rocks are the oldest in the southwest part of the GJFO planning area, having formed in the Paradox Basin (which includes Paradox and Sinbad Valleys) prior to the uplift of the ancestral Rocky Mountains. The restricted circulation in the basin saw deposition of evaporites that have moved upward as diapiric structures with deposits of salt and potash.

The uplift in the Pennsylvanian and Permian Periods shed sediments to the west into the Paradox basin, depositing the Cutler Formation, consisting of coarse clastic sediments. To the north and east, the strata overlying exposed Precambrian rocks are Triassic, representing a hiatus of some 400 million years, indicating a period of either erosion or non-deposition in those geographical areas. Intrusive activity emplaced veins and dikes through the Precambrian strata that host small deposits of copper, gold, and silver, along with other minerals.

From the time the Chinle Formation was deposited in the Triassic Period, the GJFO planning area experienced a period of fluvial deposition, with river systems forming broad flood plains and deltas. The climate was arid for long periods of time, with deposition of eolian sands in a very dry environment occurring across the area. The development of a large inland sea (the Cretaceous Inland Seaway) introduced a period of deposition from floodplain to deep water, as sea level fluctuated back and forth across the area. Numerous volcanic eruptions to the west of the area deposited felsic tuffs, especially during the Jurassic. These tuffs are believed to be the source of uranium that was subsequently mobilized and redeposited in the sandstone stream channels of the underlying fluvial sediments in the Morrison Formation. The Cretaceous environment saw development of significant coal deposits in the fluvial, deltaic, and estuarine environments bordering the Cretaceous Interior Seaway.

Toward the end of the Mesozoic Era, Laramide deformation raised uplifts and downwarped basins, leading to the maturation of the natural gas deposits found in the Piceance Basin of the GJFO planning area. The seaway disappeared by the Tertiary Period, replaced by large lake systems. These lakes received clastic sediments from the surrounding uplands and were also the site for the quiet-water, varve-like deposition of the oil shale of the Green River Formation. Since that time, the lakes disappeared and the arid climate has taken over, with movement and deposition of sediments shed off the higher features dominating the landscape.

Precambrian

Precambrian rocks occur in the southwest portion of the GJFO planning area where they have been exposed by erosion beneath Paleozoic strata. No specific studies have been conducted on the geology of the Precambrian rocks within the GJFO planning area. Descriptions of the rocks and additional information are available from the Gunnison River area just to the east.

Precambrian crystalline rocks have been observed in the northeast corner of the Gateway quadrangle (BLM 2010d). Most of the exposed rock is a gray, medium-grained granite containing masses of partially-assimilated schist and gneiss. The gray granite is intruded by pink, coarse-grained granite, dikes of pegmatite and aplite, and dark hornblende-rich dikes.

Mapping of the Black Canyon area has divided the Precambrian rocks into metamorphic and igneous suites. Metamorphic rocks included quartz-mica gneiss, mica schists, sillimanite schist, amphibolites, and migmatites. The igneous rocks are the Pitts Meadow Granodiorite, the Vernal Mesa and Curecanti Quartz Monzonites, and smaller volumes of rocks intruded into those older plutonic bodies, including aplites, pegmatites, lamprophyres, and diabases (BLM 2010d).

Radiometric dating of the rocks of the Black Canyon indicates that the Pitts Meadow Granodiorite is the oldest of the intrusive rocks at 1,730 million years before present (Ma) +/- 190 Ma. The quartz monzonites date at 1,480 Ma (Vernal Mesa) and 1,420 Ma (Curecanti), and the lamprophyres also at 1,420 Ma. The youngest rocks are the diabases that intrude the other units, dated at 510 Ma, which is Paleozoic rather than Proterozoic (BLM 2010d).

Supracrustal rocks (metavolcanics and metasediments) have been assigned an age of 1.8 to 1.7 billion years before preset. The appearance of these rocks coincides with plutonic events elsewhere in Colorado. The Pitts Meadow Granodiorite is the same age as the Routt Plutonic suite, and the Curecanti event in the Black Canyon area is roughly the same age as the Berthoud Plutonic Suite (BLM 2010d).

The Precambrian crystalline rocks of the GJFO planning area in the Dominguez Canyon Wilderness Study Area comprise four separate units interpreted to be supracrustal in origin (BLM 2010d):

- Pink and grey gneissic biotite schists;
- Gray and pink medium-grained mica schist with felsic xenoliths;
- Pink, yellow, gray medium-grained gneiss with a well-defined schistosity; and
- Black to dark blue and gray to black medium-grained amphibolites.

Intrusive units include the following:

- Pink and white foliated granular granite;
- Pink and gray medium-grained biotite-hornblende granite;
- White to gray coarse-grained biotite granodiorite;

- Green coarse-grained biotite hornblendite (completely chloritized); and
- Pegmatites.

All the units are cut by metamorphosed diabase dikes of hornblende-biotite-garnet, striking northwest with low dips. Pegmatites crosscut the diabases in Big Dominguez Creek area vertically, with a northeast-southwest strike.

Cambrian, Ordovician, Silurian, Devonian, Mississippian

No strata of early Paleozoic age occur within the GJFO planning area and Mississippian rocks, while present in the subsurface, are not represented at the surface and thus do not appear on geologic maps.

Pennsylvanian

Hermosa Group: Hermosa Group rocks appear in the Sinbad Valley in the far southwest corner of the GJFO planning area. Salt and gypsum beds of the Paradox Formation of the Hermosa Group have pierced the overlying strata and appear as contorted beds of salt diapirs associated with a limestone unit, possibly the Honaker Trail Formation, the unit which overlies the Paradox stratigraphically (BLM 2010d). The thickness of the Hermosa Formation has yet to be determined, but a well drilled in the Paradox Valley, immediately south of the GJFO planning area, penetrated 2,300 feet of limestone believed to be the Honaker Trail Formation before encountering anhydrite beds of the Paradox Formation (BLM 2010d).

The Paradox Formation is a cyclical sequence of evaporites and shales, bounded on the top and bottom by black shales (BLM 2010d). No conclusion has been reached as to whether the cause of the cyclicity is eustatic or tectonic. The adjacent Uncompahgre highlands were uplifted from Pennsylvanian through Permian time and could well have influenced the sedimentation in the Paradox depositional basin.

The Paradox Valley, adjacent to the Sinbad Valley in the GJFO planning area, contains well-known potash deposits, including a Known Potash Leasing Area (KPLA) (BLM 2010d). The same potash-bearing geology occurs in the Sinbad Valley and is classified by the US Geological Survey as a resource area for potash (BLM 2010d).

Permian

Rico Formation: The Rico Formation is composed of conglomeratic sandstone and arkose with some interbedded shale and limestone. The BLM *Mineral Potential Report for the Grand Junction Resource Area* recognizes the Rico as a transitional facies between marine strata of the Hermosa below and the continental sequence represented by the Cutler Group above (BLM 2010d).

Within the GJFO planning area, the Rico Formation has been mapped only in a small area of the Juanita Arch quadrangle, but may appear in other locations in the Sinbad Valley.

Cutler Group: The Cutler Formation of Permian age consists of maroon, purple, red and mottled light-red, arkosic conglomerate and some sandy mudstone. In the Davis Mesa quadrangle just to the south of the GJFO planning area, the Cutler Formation consists of a basal limestone, alternating with the arkosic sandstones upward in the section (BLM 2010d). The conglomeratic units contain clasts of granite, gneiss, schist, and quartzite, in addition to mineral grains.

The Cutler Formation is exposed along the Dolores River below Gateway and along West Creek (BLM 2010d). Ranging up to 3,500 feet in thickness, the unit thins and pinches out against the rocks of the Uncompahgre Uplift (BLM 2010d). The Cutler Formation is considered the proximal section of alluvial fan sediments shed by the ancestral Rocky Mountains of the Uncompahgre Plateau (BLM 2010d). The sediments detail seven different facies of the formation, including debris-flow facies, water-laid deposits, laterally continuous streamflood facies, braided stream facies and sheetflood facies.

No mineral resources are known in the Permian rocks.

Triassic

Moenkopi Formation: The Moenkopi Formation is a sequence of mostly coarse-grained terrestrial sediments. Three members have been observed in the adjacent Roc Creek, Juanita Arch, and Davis Mesa quadrangles respectively: (1) a lower red sandy mudstone and silty sandstone with thin beds of gypsum; (2) a middle member of arkosic conglomerate and conglomeratic sandstone with interlayered thin shales; and (3) an upper micaceous brown sandstone and shale sequence (BLM 2010d). Numerous names have been proposed and adopted for the Moenkopi members across the Colorado Plateau, but these have not yet been applied to the sequence in the GJFO planning area.

The members have represent terrain that began with shallow standing-water deposition, moving to a fluvial regime in the middle member, and returning to the shallow standing-water environment in the upper member. The Moenkopi has generally been considered to represent a shoreline environment across the Plateau. The unit is approximately 500 feet thick in the southwest corner of the GJFO planning area.

Chinle Formation: The Chinle Formation, of Late Triassic age, also appears in the southwest corner of the GJFO planning area. The unit is a red siltstone with interbedded fine-grained siltstones. The siltstones are interbedded with conglomeratic units which are considered to be equivalent to the Shinarump Member that occurs in greater abundance to the south and west. Some cross-bedding and ripple marks can be found.

The Chinle Formation is interpreted as a braided stream facies. The lenses and channels of the Shinarump Member represent stream channels and other coarse debris that probably filled the lower valleys (BLM 2010d).

In the GJFO planning area, Chinle Formation outcrops are commonly obscured by talus from overlying sandstones. In many places, the Chinle Formation lies directly on Precambrian rocks, representing a profound unconformity, with no strata present between the Precambrian and the Triassic periods, a hiatus of at least 400 million years. The unit thickens south from 100 feet thick at Grand Junction to nearly 300 feet at Gateway (BLM 2010d).

Jurassic

The Glen Canyon Group is the collective term for three distinctive units of terrestrial sediments that provide the character of the Colorado Plateau's spectacular scenery. The Glen Canyon Group has been divided into three units – Wingate Sandstone, the Kayenta Formation, and Navajo Sandstone.

Wingate Sandstone: The Wingate Sandstone is a massive, fine-grained, red-gray to tan eolian sandstone that lies unconformably on the Chinle Formation. The unit displays cross-bedding characteristic of dune sands. Bedding ranges in thickness from several inches to several feet and weathers in a block- to slab-like fashion (BLM 2010d).

The unit consists of sands that were supplied by streams from the east, deposited by ephemeral streams and subsequently windblown across the terrain (BLM 2010d).

The Wingate Sandstone ranges in thickness from 275 to 400 feet where exposed in the GJFO planning area. The unit is a distinctive cliff-former, enhanced by prominent vertical jointing. Exposures are especially notable in the Colorado National Monument where it is the predominant rock type.

Kayenta Formation: Conformable with the Wingate Sandstone is the Kayenta Formation, a varicolored sandstone containing thin-bedded shale and red siltstone layers. Most of the sandstone is thin-bedded and flaggy. Conglomerate and mudstone occur in the upper half of the unit (BLM 2010d).

The Kayenta Formation was formed as braided alluvial streams prograded over the desert terrain during Wingate time.

As a result of the interbedded shales and lensoidal sandstones, the Kayenta Formation forms benches and ledges above the cliffs of Wingate Sandstone. The unit is harder and more tightly-cemented near the bottom, shielding the underlying Wingate Formation from erosion and preserving the cliff faces. Thickness typically varies from 90 to 220 feet; however, it may change abruptly over short distances (BLM 2010d).

Navajo Sandstone: The Navajo Sandstone is a fine-grained, gray to buff, cross-bedded sandstone of eolian origin. It represents a return to the desert environment that dominated before the deposition of the Kayenta Sandstone. The prominent cross-bedding is characteristic of this unit.

The unit thickens to the west and southwest, ranging from thin exposures in Maverick Canyon to a thickness of 260 feet in the far southwest corner of the GJFO planning area. The unit forms rounded hills caused by disintegration of the sandstone.

Entrada Sandstone/Carmel Formation: The Carmel, Entrada and Summerville Formations together comprise the San Rafael Group.

The Carmel Formation is composed of tan and red sandstones, siltstones, and mudstones grading upward from the underlying coarser-grained Navajo Sandstone. The Carmel Formation sediments have been interpreted as being deposited on an irregular Navajo Formation terrain, accounting for variations in the thickness. In many places, the Carmel Formation consists of reworked Navajo Sandstone, representing what was a complex suite of deposition along a fluctuating shoreline (BLM 2010d).

The Entrada Sandstone is a picturesque unit of orange, red, and white eolian sandstone overlying the Carmel Formation consisting of two parts. The prominent Slick Rock Member forms characteristic bulging, massive cliffs of sandstone with pits formed by differential weathering that occur up to a foot across. Above that is a section referred to as the "board beds," characterized by interbedded resistant sandstone and mudstone that form outcrops resembling a stack of boards (BLM 2010d). The Entrada Sandstone was formed as dunes once again encroached over the area. The "board beds" are interpreted as a flat interdune wet sand environment, also known as a sabkha environment (BLM 2010d). The total thickness of the Carmel-Entrada sequence ranges from 10 to more than 100 feet.

Summerville Formation/Wanakah Formation: The Summerville Formation has a type section in Utah and was originally mapped in the GJFO planning area of the Colorado Plateau (BLM 2010d). The sequence is described as silty shales, sand, and thin-bedded mudstones exhibiting even, thin horizontal bedding. A thin dark gray freshwater limestone has been observed in the upper part of the section (BLM 2010d). The interpreted gradational contact between the Summerville and the overlying Morrison Formation made distinguishing the two quite difficult. The Summerville Formation is comprised of debris-littered slopes beneath the more resistant sandstones of the Morrison Formation (BLM 2010d).

Recently, geologists working to the north and east of the Uravan Mining District have stopped using the term Summerville Formation and have referred to the top of the San Rafael Group in Colorado as the Wanakah Formation. The Summerville Formation and the Wanakah Formation have been dated as roughly

time-equivalent in Utah and Colorado respectively (BLM 2010d). The Summerville and Wanakah Formations are both truncated by a regional unconformity which is, in turn, overlain by the basal Morrison Formation, the Summerville to the west, and the Wanakah to the east. The Summerville Formation is younger than the Wanakah Formation, and shows no correlation to the Wanakah Formation or any of the other western San Rafael Group units, although the Wanakah terminology was used in the 1987 study of the Dominguez Canyon Wilderness Study Area (BLM 2010d).

The Wanakah in the Colorado National Monument consists of interstratified mudstone with 5 to 15 percent sandstone and silty sandstone, and up to 5 percent impure limestone. Traces of volcanic ash and gypsum also occur. The unit throughout the GJFO planning area is thin, probably not exceeding 100 feet in thickness (BLM 2010d).

It is not known if the unit mapped as Summerville in the Uravan Mining District is equivalent to the Wanakah Formation.

Morrison Formation: The Morrison Formation is a varied assemblage of siltstones, sandstones, and mudstones, ranging in thickness from 800 to 900 feet in the southwest to 500 to 600 feet near the city of Grand Junction. The braided streams, lakes, and deltas of the Morrison Formation create a depositional environment that is rich in paleontological resources (BLM 2010d). Four member units are recognized in the Colorado Plateau region, but only three occur within the GJFO planning area – the Tidwell, the Salt Wash, and the Brushy Basin Members.

Tidwell Member: Mudstone characterizes the Tidwell Member, with minor beds of sandstone and limestone. The mudstone is grayish-red to graying-yellow-green, with sandy siltstone, silty claystone, and siltstone, generally quite thin. Sandstone is light gray to greenish gray, rather fine-grained and well-sorted, with local bioturbation. Limestone beds present in the upper section represent the only limestone in the Colorado National Monument area. The unit is 125 feet thick in the National Monument. The Tidwell Member probably represents deposition in freshwater to brackish environments (BLM 2010d).

Salt Wash Member: Much of the Salt Wash Member consists of alternating beds of siltstone or mudstone with lenticular sandstone. Near the base, persistent limestone beds are not uncommon (BLM 2010d). Sandstone predominates in the Uravan Mining District of the GJFO planning area. The sandstone facies have been described in the Gateway quadrangle as traceable as ledges in outcrop for long distances, but individual beds within a stratum are lenticular and discontinuous, wedging out laterally where others wedge in, forming interfingering lenses in a mudstone matrix. This configuration is indicative of the depositional environment of meandering and anastamosing stream channels. It is these channels that host the abundant uranium deposits of the area.

The Salt Wash Member decreases in thickness from 600 feet in Utah to 200-300 feet in the Grand Junction area. Approaching Grand Junction, the nature of the rocks changes from a sandstone-mudstone facies to claystone containing lenticular sandstones. To the east and north of Grand Junction, the Salt Wash Member ceases to be a recognizable unit. The Salt Wash units form cliffs and steep slopes above the less resistant units of the Summerville and Wanakah Formations beneath.

The environment of deposition was probably a series of flat floodplains and marshy areas, rich in vegetation. Rivers meandered across the terrain, contributing abundant organic material to the sedimentary pile and providing habitat for the fauna whose fossils remain.

Brushy Basin Member: The Brushy Basin Member is predominantly mudstone and siltstone, but it contains some beds of sandstone, limestone and bentonitic mudstone. The sequence is characteristically colored, with red, purple, and green units. In the Uravan Mining District, beds are distinguished by their turquoise blue-green color.

Deposition in a fluvial to lacustrine environment is indicated for the Brushy Basin Member. The Brushy Basin Member is thought to be the world's largest and oldest known playa lake complex (BLM 2010d). Notable in the southern portion of the area is the contribution of volcanic tuffs. Alteration of these tuffs to bentonite and other secondary minerals have created the colors characteristic of Brushy Basin units. Furthermore, it is believed that these silicic tuffs are the source for uranium and vanadium that has been deposited in the sandstone channels of the underlying Salt Wash Member. The unit varies in thickness from around 95 feet in the Colorado National Monument area to over 400 feet to the south in the Roc Creek quadrangle.

Cretaceous

Burro Canyon Formation: In the GJFO planning area, the Burro Canyon Formation comprises a sequence of sandstones, siltstones, and green and red shales with a basal conglomerate, very much like the Salt Wash Member of the Morrison Formation. The sequence represents a change from the predominantly silty beds of the Brushy Basin Member to the conglomerate and then more sandy units up through the stratigraphic section.

The Burro Canyon Formation caps gently sloping mesas in the area around the city of Grand Junction at about 100 feet in thickness. The unit also occurs on mesa tops in the Gateway quadrangle, as the youngest unit present in that area. The environment of deposition was similar to that of the Salt Wash Member – an area of broad floodplains and slow, meandering rivers.

Dakota Sandstone: The Dakota Sandstone is a widespread unit that appears in the GJFO planning area mainly as a pale orange to gray, fine-grained sandstone. A basal conglomerate rests unconformably on the Burro Canyon Formation in

the Grand Junction area, but to the south, the contact between the two units becomes gradational (BLM 2010d). It grades laterally from fluvial sandstone to conglomerate, carbonaceous mudstones and shale with thin coals, to marine sandstone. The carbonaceous units contain numerous plant fossils while the sandstones show cross-bedding, bioturbation and channel fills. The Dakota Sandstone contains coal beds that are mined to the south in the Nucla area.

The Dakota Sandstone has been described as forming prominent ledges and ridges with steep slopes on the interbedded mudstones. The Dakota Sandstone is about 200 feet thick through much of the area, thinning somewhat to the south (BLM 2010d).

The Dakota Sandstone was formed as the Cretaceous Interior Seaway encroached from the east, leading to the formation of delta, bar, swamp, and shoreline facies. The Dakota represents a stack of strata comprising four separate sequences, reflecting tectonic and eustatic sea level fluctuations along the western edge of the interior sea (BLM 2010d).

Mancos Shale: The Mancos Shale is a sequence dominated by rocks formed offshore of the Cretaceous Interior Seaway. The total unit is 3,450 to 4,150 feet thick in the Piceance Basin and grades upward and intertongues with the overlying Mesaverde Group (BLM 2010d). The Mancos Shale is generally a gray to brown fissile shale with interbedded calcareous and silty zones and limestones.

Topographically, the Mancos Shale forms gentle slopes containing occasional white bentonite layers, broken by calcareous sandstones. The complex unit is interpreted as deposition in changing offshore environments, from distal turbidites to near-shore muds, silts and sandstones (BLM 2010d).

Mesaverde Group: The Mesaverde Group overlies the Mancos Shale throughout the GJFO planning area, comprising a thick sequence of rocks deposited shoreward of the Mancos Shale as the seaway regressed across the area toward the east. Because of the direction of the shoreward migration, the underlying Mancos Shale persists later in time to the east; rocks of the Mesaverde Group enter the section later in Colorado than in Utah. The stratigraphy has been studied carefully because of the presence of the economic coal deposits formed in the near-shore swamp and lagoonal environments (BLM 2010d).

The lowermost unit of the Mesaverde Group is the Castlegate Sandstone. Not a major unit in Colorado, the Castlegate Sandstone does occur in the GJFO planning area, pinching to a thin tongue in the Piceance Basin (BLM 2010d).

The Sego Sandstone is defined in the Sego Canyon of Utah. It is separated from the Castlegate Sandstone by the Buck Tongue of the Mancos Shale and is divided higher up the section into two parts by another tongue of the Mancos Shale – the Anchor Mine Tongue. The Sego Sandstone is a fine- to medium-

grained sandstone interpreted to be delta-front and delta plain sediments. The Anchor Mine Tongue is 100 feet thick at the Colorado-Utah state line, thickening and merging with the main body of Mancos Shale at East Salt Creek. The Sego Sandstone was being deposited in the western part of the area while the Mancos Shale was still being deposited in the offshore areas to the east (BLM 2010d).

Atop the Sego Sandstone in the Book Cliffs area is the *Mount Garfield Formation*, consisting of a sequence of brown to gray sandstone, siltstone, shale, and coal. The Mount Garfield is a shoreline and coastal plain facies characterized by three well-defined cliff-forming sandstones – the Corcoran Sandstone, the Cozzette Sandstone, and the Rollins Sandstone, all three considered members of the Mount Garfield Formation separated by tongues of Mancos Shale. These units are described below as they are also members of the Iles Formation to the east (BLM 2010d).

The Iles Formation is the next unit in the sequence in the east. In general, the Iles Formation is a fine to medium-grained sandstone, siltstone, mudstone, carbonaceous shale, and coal, formed along a coastal plan and lower alluvial plain under tidal influence. The Iles Formation is composed of three members – the Corcoran, the Cozzette, and the Rollins (BLM 2010d).

The Corcoran Member is very fine-grained sandstone, siltstone, shale, and coal, lying unconformably on the Sego Sandstone. The Corcoran forms 40 feet of delta plain deposits including carbonaceous shale, coal, and minor sandstone at Big Salt Creek. This represents the Palisade Coal Zone. The Corcoran Member is considered a tight gas sand and has been an exploration target (BLM 2010d).

The Cozzette Member is as thick as 230 feet with the same description as the Corcoran Member. It contains the Chesterfield and Carbonera coal zones, the former defined in and restricted to Utah, while the Carbonera zone has been traced into Colorado to East Salt Creek. The Cozzette Member is also a tight gas sand target.

At the top of the Iles Formation sequence is the Rollins Sandstone Member. Varying in thickness from 200 feet in the east to zero, it pinches out near Layton Wash north of Grand Junction. The Rollins Sandstone is a coarse-grained cliff-forming sandstone formed in a near-shore marine environment. Near the top of the Rollins is the Cameo coal zone, the uppermost coal zone of the Book Cliffs coal field.

The Williams Fork Formation includes all the Cretaceous strata above the Rollins Sandstone east of the Utah border. This is a thick sequence, grading from 1,200 feet thick at the Utah state line to nearly 5,155 feet thick at the Grand Hogback. Included in the Williams Fork Formation are coal zones in two of the members. The description of the Williams Fork Formation is much the

same as the Iles Formation – fluvial and coastal plain strata of sandstones, siltstones, carbonaceous shales and some major coals (BLM 2010d).

Included in the Williams Fork Formation are the Paonia and Bowie Shale Members and the Cameo-Fairfield, South Canyon and Coal Ridge coal zones. The Bowie Shale Member is nearly 1,000 feet thick, consisting of two coal-bearing coastal plain units overlain by marine shale and marginal sandstone. The Paonia Shale Member – up to 560 feet thick – also consists of coal-bearing coastal plain sediments but does not extend as far west as the GJFO planning area. An upper undifferentiated member is fluvial sandstone, conglomerate, siltstone, and shale. The top of the undifferentiated member consists of a kaolinitic sandstone that is correlated with the Ohio Creek Member of the Hunter Canyon Formation.

The Cameo-Wheeler coal zone occurs within the Williams Fork Member, intertonguing with the Rollins Sandstone and pinching out toward the south and west. The South Canyon and Coal Ridge coal zones both overlie and interfinger with the Bowie Shale but do not extend as far west as the GJFO planning area.

Tertiary

The Tertiary rocks in the GJFO planning area consist of Paleocene and Eocene formations described in the following sections.

Paleocene

Wasatch Formation: The main body of the Wasatch Formation varies from 1000 to nearly 6000 feet in thickness, consisting primarily of varicolored sandstones and mudstones representing floodplain, coastal plain and lacustrine facies. Detailed mapping at 1:24,000 scale in the GJFO planning area has identified three members of the Wasatch Formation – the Atwell Gulch of Late Paleocene age, the Molina of Paleocene-Eocene age, and the younger Shire Member. The Molina and Shire Members will be discussed in the Eocene section (BLM 2010d).

The Atwell Gulch Member is described as comprising three discernible portions. The lower section is 80 to 1,150 feet of black and gray claystone, mudstone with some coals. Sandstones are mapped toward the south in the Mesa quadrangle, while in DeBeque quadrangle, the Member is conglomeratic at the base and sits unconformably on the underlying Mesaverde Group. The unit disappears to the east, as it is not mapped in the Housetop Mountain or Hawxhurst quadrangles (BLM 2010d).

Eocene

Wasatch Formation (continued): Overlying the Atwell Gulch Member is the Molina Member of the Wasatch Formation. This unit is characterized by conspicuous gray to brown massive ledge-forming sandstones, up to 50 feet thick and persistent laterally, interlayered with grey to greenish to lavender non-laminated mudstones.

The top member of the Wasatch Formation is the Shire Member. It is comprised of mudstones and claystones with a few lenticular sandstones. The Shire Member thickens to the northeast, from as thin as 90 feet in the west to 1,700 feet in the Hawxhurst Mountain quadrangle in the northeast, where it is the only member of the Wasatch identified (BLM 2010d).

The Wasatch Formation was formed at a time when Piceance and Uinta Basins were beginning to take form as they appear today. In the GJFO planning area, an onlap of coastal plain sediments was followed by wetland and lacustrine environments. In the Eocene, the system of lakes was expanding in the basin with clastics sporadically introduced (the Molina Member).

Green River Formation (Garden Gulch, Douglas Creek, and Parachute Creek Members): The Green River Formation is found in the northeast corner of the GJFO planning area. The formation is divided into three members – the basal Anvil Points Member, the middle Garden Gulch Member, and the upper Parachute Creek Member. Earlier mapping in the Wagon Track Ridge quadrangle and in the Mesa quadrangle identified the Douglas Creek Member, but this appears to be at least equivalent to the Garden Gulch Member (BLM 2010d).

The Anvil Points Member is primarily a massive, cliff-forming sandstone that thickens to the northeast, toward the axis of the Tertiary basin where it reaches 1,200 feet in thickness in the Hawxhurst Mountain quadrangle.

Above the Anvil Points, the Garden Gulch Member is mainly a carbonate unit, composed of light gray marlstone, light-gray oolitic limestone with ostracodal and algal limestone, some paper-thin shale and thin sandstones. Thickness reaches 1,000 to 1,200 feet in the northeast of the GJFO planning area.

The youngest unit – the Parachute Creek Member – is composed of a gray-weathering marlstone that is a local cliff-former, containing minor beds of oil shale. The rich oil shale zone, the Mahogany Bed, occurs near the base of the Parachute Creek Member and reaches 120 feet of thickness within the GJFO planning area.

The Green River Formation reflects a large area with internal drainage. A large lake, with fluctuating shorelines, may have reached its maximum size at the time of the deposition of the oil-shale rich Mahogany Bed. By Late Eocene time, the lakes receded and, by Oligocene, were gone (BLM 2010d).

Uinta Formation: The Uinta Formation occurs in the far northeast corner of the GJFO planning area, capping the Tertiary strata with 900 feet of light-colored fine-grained sandstone with lesser marlstone and siltstone. The Uinta Formation is generally fossiliferous and represents clastic deposition along the margins of the retreating Eocene lake system.

Quaternary

Numerous unconsolidated Quaternary deposits occur within the GJFO planning area including glacial deposits (map unit Qd), older gravels (Qgo), colluvium (Qc) and alluvial and eolian deposits (Qae). Sand and gravel deposits occur in the larger river channels and their associated higher-level terrace deposits.

Structural Geology and Tectonics

The GJFO planning area covers a portion of the northeast corner of the Colorado Plateau geographic and structural province. Physiographic characteristics of this province reflect structural characteristics of the region that contrast with more complex terrain surrounding it. As a structural province, the Colorado Plateau acts as a high-standing block of relatively undeformed rocks framed by the deformed rocks of the Middle and Southern Rocky Mountains provinces, which wrap around from north to east, and the Basin and Range Province to the south and west. It is characterized by large regions of nearly flat lying Paleozoic and younger sedimentary formations occasionally broken up into broad uplifts bounded by monoclines and high-angle faults. This style typifies structural elements within the GJFO planning area wherein Mesozoic and younger sedimentary rocks are relatively undeformed with the exception of a few very prominent structural features related to the geologic evolution of the northwest trending Uncompahgre Plateau and the adjoining Piceance Basin.

Structural elements within the GJFO planning area can be best described by those primary periods of deformation during which they were active. For purposes of this discussion, the primary periods include early evolution of the North American craton during the Proterozoic followed by the late Paleozoic uplift of the Ancestral Rocky Mountains and the subsequent compressional Laramide Orogeny during the late Mesozoic and early Cenozoic. Finally, a recent period of extensional deformation began in the mid Cenozoic and continues today. A fifth category is described that covers deformation caused by flowage of buried evaporite deposits that began shortly after burial in the Late Paleozoic and has continued off and on since.

Proterozoic Structural Elements

The relatively undeformed nature of the Mesozoic and younger sedimentary formations at the surface within the GJFO planning area mask greater structural complexity at depth in the older rocks, particularly in the crystalline Proterozoic basement rocks. Exposure of Proterozoic rocks within the GJFO planning area is limited to a few narrow canyons on the Uncompahgre Plateau, such as Unaweep Canyon, and nearby canyons along the northeast edge of the Uncompahgre Plateau. Little direct information about the buried Proterozoic rocks can be obtained from within the GJFO planning area with such limited exposure; however, enough can be understood from regional exposures to have a basic understanding of the hidden terrain beneath the surface.

The Proterozoic rocks in this region formed at the margin of the North American Craton in an island arc and back arc basin setting as a series of sedimentary and volcanic rocks that underwent metamorphism between approximately 1.8 and 1.7 billion years ago followed by intrusive events up to approximately 1.4 billion years ago. The regional structural grain of these rocks trends northeast and the predominant deformational style is ductile associated with regional metamorphism. Subsequent brittle deformation is evidenced by the emplacement of mafic dikes and pegmatites with northeast trends in the Colorado National Monument area and northwest trends in the Dominguez canyon area (BLM 2010d).

For the next nearly 1 billion years the area underwent erosion with the next period of deposition starting approximately 520 Ma in the early Paleozoic. Development of the west to northwest trending Garmesa and Uncompahgre fault zones may have occurred during this period of non-deposition in late Precambrian time. These fault zones were later reactivated as primary structures during development of the ancestral Uncompahgre highland as described below. Early to middle Paleozoic time was marked by repeated transgression and regression of shallow continental seas across the entire region. Tectonic activity was apparently limited; however, uplift along high angle faults resulted in erosion in central Colorado during the Early Ordovician epoch. There is very little preserved of this period of time in the GJFO planning area due to tectonic uplift and erosion during the late Paleozoic (BLM 2010d).

Late Paleozoic Structural Elements

During the Pennsylvanian and Permian Periods of the Late Paleozoic, around 300 to 250 Ma, the region underwent tectonism that resulted in the uplift and erosion of the Ancestral Rocky Mountains (BLM 2010d). Fault-bound uplifted highlands trending generally northwest to southeast rose providing abundant sediments to adjacent basins. In Colorado these ancient mountain ranges included the Front Range and Apishapa highlands in the central part of the state and the Uncompahgre highland in southwest part of the state. Basins adjacent to these highlands included the Central Colorado Trough, also known as the Eagle Basin in the northwest part of the state, and the Paradox Basin that extended southwest of the Uncompahgre highland across much of the Four Corners region.

The ancestral Uncompahgre highland extended across most of the area now encompassed by the GJFO planning area and includes the modern day Uncompahgre Plateau. This uplift was bounded on the southwest by the Uncompahgre fault zone where there may have been as much as 20,000 feet of vertical displacement. This fault zone includes the Gateway Fault. The edge of the uplift has been placed along the Garmesa Fault Zone where there may have been up to at least 2,000 feet of vertical separation (BLM 2010d). This edge of the ancestral highland is now concealed beneath Late Cretaceous and Tertiary sediments of the Piceance Basin.

Development of the highlands and basins continued into the Permian Period; however, tectonic activity was apparently most robust during the Pennsylvanian. By Middle Triassic, uplift of the highlands had pretty much ceased with the Chinle Formation being the first formation to completely blanket the region (BLM 2010d).

Late Mesozoic and Early Cenozoic Structural Elements

Following a period of relative tectonic quiescence from the Middle Triassic through Early Cretaceous, around 240 Ma to 100 Ma, the region underwent a period of compressional tectonic deformation that developed many of the major structural and topographic features present today. This period of deformation began with regional subsidence along a north south trending foreland basin east of the Sevier orogenic belt of west-central Utah (BLM 2010d). This broad foreland basin was flooded by the Cretaceous Interior Seaway. Eastward progression of the Sevier thrust front pushed the axis of deposition in the seaway to the east and eventually the seaway retreated. Tectonic deformation subsequently advanced into the Rocky Mountain region during Late Cretaceous and into the Eocene, from around 70 to 50 Ma, as manifested by the Laramide Orogeny. During this phase of deformation, Precambrian basement-cored uplifts were accompanied by subsidence of intervening basins. In many places this event reactivated faults developed during the earlier Proterozoic period and Late Paleozoic events.

Although the main Laramide mountain building activity occurred in the Central and Southern Rocky Mountains north and east of the Colorado Plateau, the area encompassed by the GJFO planning area was affected by this tectonic event. Laramide deformation within the relatively stable Colorado Plateau occurred primarily as broad uplifts bounded by monoclines and high-angle faults (BLM 2010d). Northwest-trending monoclines cored by high-angle reverse faults bound the modern Uncompahgre Plateau, a prominent topographic high extending across the southwestern portion of the GJFO planning area. Most notable of these structural features is the Redlands fault and monocline that form the dramatic southwest edge of the Grand Valley and pass through the Colorado National Monument. This feature offsets Mesozoic strata downward to the northeast approximately 1,800 feet. On the southwest side of the Uncompahgre Plateau Laramide deformation resulted in as much as 1,300 feet of vertical displacement along the Uncompahgre fault zone (BLM 2010d).

The GJFO planning area also spans the southwest flank of the Piceance Basin, an asymmetric Laramide structural basin with its northwest-trending axis situated just west of the Grand Hogback. On this flank strata dip gently to the northeast toward the axis. Subtle Laramide folds trending generally northwest sub-parallel to the basin axis deform the flank in a number of locations (BLM 2010d).

The Douglas Creek Arch is a broad north-south trending anticline that forms the west edge of the Piceance Basin in the northwest part of the GJFO planning

area. This structural feature developed during the Laramide Orogeny contemporaneously with subsidence of the Piceance Basin and the Uinta Basin to the west and exerted a strong influence on deposition patterns of the Green River Formation. Late Cretaceous strata deposited in the foreland basin at the edge of the Cretaceous Interior Seaway are partially truncated by the arch while the Paleocene and Eocene Wasatch and lower Green River formations thin dramatically over the arch. Upper members of the Green River Formation, including the oil shale bearing Parachute Creek Member display less thinning over the arch than the older members. These relationships combined with distribution of clastic facies within the Green River Formation suggest that at times the feature formed a sub-areal lowland separating the greater Eocene Lake Uinta into two lakes, one within the Piceance Basin and the second in Uinta Basin. By the time the Parachute Creek Member was deposited the lakes had transgressed over the arch forming one large lake (BLM 2010d).

Cenozoic Structural Elements

By the end of the Eocene, Laramide style deformation in the region had waned. To the east in the Southern Rocky Mountain region this was followed by a period of voluminous volcanic activity, but little direct evidence of tectonic activity was preserved within the GJFO planning area. The next period of major tectonic activity affecting the region has been extensional deformation that began approximately 25 Ma in late Oligocene and has continued through the Quaternary. While the most notable structural features developed during this phase are associated with the Rio Grande Rift to the east, there is evidence of deformation within the GJFO planning area. Regional uplift has led to broad erosion and deep incision of modern stream systems. Other evidence includes Pliocene arching of the Uncompahgre Plateau and northeast-trending normal faults developed on the Douglas Creek Arch that are likely post-Laramide in age. Possible Quaternary movement has been identified for several faults within the Uncompahgre Plateau (BLM 2010d).

Evaporite Flow Structures

The southwest corner of the GJFO planning area extends into the Paradox Basin and enters a structural region known as the Paradox fold and fault belt where unique structures have developed in response to flowage of Pennsylvanian evaporite deposits. Within the GJFO planning area, the Sinbad Valley is one of these unique structures (BLM 2010d).

During basin subsidence in the Pennsylvanian and Permian periods, up to 20,000 feet of clastic sediments and evaporite deposits accumulated in the Paradox Basin; evaporite deposits, primarily salt, may have reached a thickness of up to 8,000 feet of this wedge of sediments. These evaporite deposits began to flow and form elongate salt anticlines as they were buried beneath rapidly accumulating clastic sediments. Pre-existing northwest-trending basement faults that may have originated in Late Precambrian along with the main boundary faults of the ancestral Uncompahgre highland probably controlled alignment of

the salt anticlines. Stratigraphic evidence suggests that upward salt flowage was rapid from Pennsylvanian through early Permian and continued into the Jurassic (BLM 2010d). Flowage generally ceased as the source salt beds were depleted until uplift and erosion began to expose the salt anticlines to meteoric groundwater flow. Modern groundwater flow and surface dissolution have led to collapse of the anticline crests to form grabens within the anticlines.

Characterization

Geologic resources are closely related to soils, water, minerals, and paleontological resources. Each of these resources is discussed in detail in other sections. Specific unique geologic features are discussed as part of visual resources.

Trends

The current trend for geologic resources is to manage any geologic resources or features as part of the management of soils, water, minerals, or paleontological resources.

3.2.4 Soil Resources

Many resources and resources uses, including livestock grazing, wildlife habitat, riparian habitat, special status species, fisheries, recreation, water quality, and forestry, depend on suitable soils. Therefore, soil attributes and conditions are important to RMP management decisions (BLM 2009d).

Current Conditions

Many different soil types occur in the GJFO planning area because of the varying climatic, vegetative, topographic, and geologic conditions. In the planning area, impacts on soil resources have resulted from energy development, grazing, recreation, natural processes, and other activities (BLM 2009d). Soil resources support range and forest plant communities that stabilize the soil surface and protect watershed function and condition. The potential for maintaining or restoring these communities and conserving the soil resource depends on the specific soil types and how the resource is managed.

Soil Types

The soil types in the project area occur from 4,400 feet above mean sea level on the valley floor to 8,600 feet above mean sea level in the higher elevations. The average annual precipitation and temperature in the project area vary greatly by elevation and aspect (Western Region Climate Center 2009). Many of the soils have developed from alluvium that was deposited over time as the Colorado, Dolores, and Gunnison Rivers and their tributaries eroded through the surrounding mountain ranges. Soils also vary with vegetative cover, including range and forest plant communities.

When making land management decisions based on soil-related hazards or limitations, the GJFO evaluates soil surveys available from the NRCS. Soils are mapped according to the boundaries of major land resource areas, which are

geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (NRCS 2009a). Each soil survey describes the specific properties of soils in the area surveyed and shows the location of each kind of soil on detailed maps. BLM evaluates soil map units to make management decisions that would likely affect soils. Each soil survey applicable to the GJFO describes soil map units by the individual soil or soils that make up the unit. These descriptions indicate the limitations and hazards inherent in each unit. Descriptions include soil depth, range of elevation, origin, climate, physical properties, runoff capabilities, erosion hazard, associated native vegetation, wildlife habitat use, and capability for community development and other uses.

Third-order soil surveys, provided by the NRCS, cover most of the GJFO. The NRCS maps over 250 soil map units in the GJFO, making summarization complex. Lands within the planning area are primarily within the Mesa County Area survey (908,649 acres in Mesa County) and Douglas-Plateau Area survey (858,188 acres in parts of Garfield and Mesa Counties), Uncompahgre National Forest Area (119,890 acres), Grand Mesa Area (253,141 acres), San Miguel Area (18,087 acres), and smaller acreages in the Paonia, Grand Mesa, Rio Blanco County, and Rifle Areas (NRCS 2009b).

Generally, soils in the planning area are loams, clays, and rock outcrop complexes. The depth of all soils range from 0 to 60 inches, depending on slope and aspect. Some soils have a very high runoff potential and erosion hazard rating. Prime farmlands are located on private land between Grand Junction and Mack and east to Palisade, as well as on private lands near Collbran and DeBeque and in Montrose County. No public lands are believed to have prime farmlands. Complete descriptions of the affected soil units are available from the NRCS (NRCS 2009b).

Biological Crusts

Biological (or cryptobiotic) soil crusts are composed of highly specialized communities of cyanobacteria, mosses, and lichens. These biological crusts cover open spaces between vascular plants on relatively barren soils. Biological crusts generally occur where vascular plant cover is sparse. Crust cover is generally greatest at lower elevation sites in semiarid areas (Belnap et al. 2001). The vertical and horizontal vascular plant structure of many semi-arid vegetation communities optimizes growth of biological soil crusts. Vascular plants create windbreaks and shade, influencing how much moisture and light reach the soil surface. They also trap leaf litter, keeping the interspaces free of substantial or persistent litter cover. Biological crusts in many regions are best developed in interspaces between shrubs. Invasive exotic plants generally decrease the biological crust cover in most ecosystems (Belnap et al. 2001). Stable or embedded rocks at or near the soil surface can increase soil crust cover by perching water and armoring the surface from physical disturbances.

Biological soil crusts have not been mapped in the planning area. In general, more stable, fine-textured soils (such as silty loams) support greater crustal cover than less stable, coarse-textured soils (Belnap et al. 2001). North and east slopes generally favor crustal development.

Soil Erosion

Erosion is a continuing natural process that can be accelerated by human disturbances. Factors that influence soil erosion include soil texture, structure, length and percent of slope, vegetative cover, and rainfall or wind intensity. Soils most susceptible to erosion by wind or water are typified by bare or sparse vegetative cover, non-cohesive soil particles with low infiltration rates, and moderate to steep slopes. Wind erosion processes are less affected by slope angles but are highly influenced by wind intensity.

The potential for soil erosion increases with increasing slope. Approximately 347,800 acres exceed 40-percent slope within the planning area. Steep slopes are concentrated adjacent to stream courses, particularly in the northern portion of the planning area and around the edge of the Grand Mesa in the southern portion of the planning area (**Figure 3-1**, Steep Slopes).

NRCS soil map unit descriptions rate soils in the planning area according to their susceptibility to water and wind erosion. Wind erosion is particularly a hazard when surface litter and vegetation are removed by fire or other disturbances. Soils in the planning area were screened based on several relevant characteristics that indicate potentially fragile soils or high erosion hazards (Dieterich 2009). These characteristics include:

- Soils rated as highly or severely erodible by wind or water, as described in NRCS soil survey reports;
- Landslide Areas, as identified in NRCS soil survey reports; and
- Soils on slopes greater than 35 percent, particularly with the following attributes:
  - Surface texture of sand, loamy sand, very fine sandy loam, fine sandy loam, silty clay, or clay;
  - Depth to bedrock less than 20 inches;
  - Erosion hazard rating of high or very high; and
  - K (soil erodibility potential) factor greater than 0.32.

Within the planning area, 481,600 acres were mapped as fragile and slumping soils (**Figure 3-2**, Fragile and Slumping Soils). These soils include 54,500 acres of slumping soils. Most fragile and slumping soils occur in the northern portion of the planning area, along the rise up to the Roan Plateau to the north. Slumping soils also occur in the Plateau Valley and Grand Mesa slopes areas.

One geologic formation in the planning area that experiences substantial instability is the Mancos Shale. The Mancos Shale is susceptible to hydration and flow. A thin, water-resistant lens of montmorillonite clay keeps water from moving to the bottom of this unit, restricting mass wasting to the upper Mancos Shale (Sinnock 1978). Approximately 171,900 acres of potentially unstable Mancos Shale areas were mapped throughout the planning area (**Figure 2-74**, Alternatives A, B, C, and D: Surface Geology). Outcrops of geologically unstable Mancos Shale occur predominately in the northern portion of the planning area.

Soil Salinity

Salinity is the presence of elevated levels of soluble salts (i.e., sodium chloride, magnesium and calcium sulfates, and bicarbonates) in soils or waters. As described in **Section 3.2.5**, Water Resources, salinity is one of the greatest water quality concerns within the Colorado River Basin. Plant species have a difficult time adapting in saline soils, and revegetation is challenging after soils are disturbed and lose vegetative cover (BLM 2009d).

As described in **Section 3.2.5**, Water Resources, many stream segments in lower elevation areas have elevated salinity, sediment, and/or selenium levels. The threshold for salinity is defined as 8 milliohms per centimeter. Salinity and selenium typically are associated with eroded sediment. Elevated pollutant levels commonly originate from eroding saline soils developed from the Mancos, Morrison, Wasatch, and Green River Formations (BLM 2009d). Approximately 308,000 acres of saline soils are mapped in the planning area, particularly in the Grand Valley north of the Colorado River, in lower portions of Roan Creek, east of the Gunnison River below the Grand Mesa, and in other localized areas (**Figure 3-3**, Saline Soils).

Studies conducted by the USGS and the National Irrigation Water Quality Program indicated primary source areas for selenium in the Colorado River near the Colorado/Utah State line to be the eastern side of the Uncompahgre Valley and the western one-half of the Grand Valley, where extensive irrigation is located on Mancos Shales (National Irrigation Water Quality Program 1993).

Soil Compaction

Soil compaction is the process by which soil pore air space is reduced in size because of physical pressure exerted on the soil surface. Compaction results in soil conditions that reduce infiltration, permeability, and gaseous and nutrient exchange rates of the soil. Physical resistance to root growth can occur with high soil bulk densities. Soil compaction changes the soil structure by reducing the porosity and increasing the bearing strength of the soil. As a result, the ability to receive water is reduced, leading to an overall reduction in the moisture-holding capacity of the soil. The degree of compaction depends on the moisture content at the time of compaction and on soil texture. Compaction decreases infiltration and increases runoff and the hazard of water erosion.

Fine-textured soils with poor internal drainage are the most susceptible to compaction. Sandy loam, loam, and sandy clay loam soils compact more easily than silt, silt loam, silty clay loam, silty clay, or clay soils (NRCS 1996).

Within the planning area, the combination of inherent soil characteristics and past grazing and surface-disturbing activities have resulting in soil compaction in some areas.

Characterization

Characterization of soil resources includes the trends or changes in soil conditions over time.

Trends

The BLM began a review process in 1991 to determine ways to improve rangeland management in response to public concern about livestock grazing management on western public lands. Since that time, the BLM has implemented the management tools, methods, strategies, and BMPs described in the Colorado Standards for Public Land Health to maintain or achieve healthy public lands. Based on GJFO Landscape Health Assessment Reports prepared from 2003 to 2006, all but a few localized areas within the four evaluated landscapes meet Standard 1. The reports identify localized areas of soil erosion and localized areas lacking vegetative cover. These conditions are attributed to past grazing and surface-disturbing activities and to inherently erodible soil types.

In addition, the GJFO has experienced increased requests to develop pipelines, well pads, roads, recreation trails, and other infrastructure on steep, unstable, or unsuitable soils (BLM 2009d). Implementation of NSO and other stipulations has limited the effects on soils from these activities.

3.2.5 Water Resources

Fresh water is scarce and therefore extremely valuable in semi-arid western Colorado. Surface water is the primary source of fresh water, with groundwater only accounting for approximately five percent of water uses in the planning area. Surface water and surface water quality are also intertwined with other natural resources and GJFO management actions and are the main focus of this section.

Surface water on public lands is regulated by the Clean Water Act, Colorado River Salinity Control Act, Public Land Health Standards, Colorado Water Quality Standards, and other laws, regulations, and policy guidance at the federal, state, and local levels. Oil and gas operators are subject to water allocation laws and protection measures at the state and federal level. These include COGCC regulations, including Rule 317B for public water system protections. The GJFO strives to manage for and sustain good water quality and adequate flows in area streams for the benefit of people and aquatic, riparian, and upland animals and plants on a watershed scale.

Current Conditions

Surface Water

The GJFO lies within the Upper Colorado River Basin in western Colorado, near its headwaters in the Rocky Mountains. As the river flows from its source to the Gulf of California, it provides livelihood to Colorado, six other states, and Mexico. Within the planning area, the Colorado River includes four major sub-basins. From east to west, these include Roan Creek, Plateau Creek, Gunnison River, and Dolores River. Of the 2.2 million acres within the GJFO planning area, the BLM manages nearly 1.1 million acres of public lands, or 60 percent of the land surface. Public land within the GJFO contributes 57 percent of the runoff from the total area. Peak flows on the major tributaries of the Colorado River typically occur in May and June, resulting from snowmelt. Base flows occur in late fall and winter from groundwater when surface runoff is minimal. Intense summer thunderstorms are often responsible for peak flows on the smaller tributaries that can cause severe flooding in localized areas.

While there are many perennial rivers and streams within the planning area, the majority of streams are intermittent or ephemeral, flowing seasonally or from storm events, respectively. According to the National Hydrography Dataset, 68 percent of all streams in Colorado are ephemeral or intermittent (Levick et al. 2008). Because west-central Colorado is an arid region within the state, and because the BLM manages primarily lower-elevation areas in contrast to the US Forest Service, the percentage of ephemeral and intermittent streams within the planning area is higher than the state average, at 90 percent of the total stream miles. Levick concludes that ephemeral and intermittent streams should be examined in a watershed context, which would highlight their importance in maintaining water quality, overall watershed function, or health, and in providing for the essential human and biological needs for clean water (Levick et al. 2008). Among other functions, healthy ephemeral and intermittent streams move water, nutrients, and sediment through the watershed, provide landscape hydrologic connections, dissipate stream energy during high flows to reduce erosion and improve water quality, provide groundwater recharge and discharge, maintain floodplains, and store and cycle nutrients. In addition, they provide wildlife habitat and migration corridors and support vegetation communities to help stabilize stream banks.

Surface Water Quality

The headwater stream segments within the GJFO generally have good water quality, meeting or exceeding water quality standards established by the State of Colorado for the beneficial uses on the streams. Many stream segments in lower-elevation areas have water quality concerns, with the primary pollutants being salinity, sediment, and selenium. Salinity and selenium are typically associated with sediment, as the ions tend to be bound to soil particles. Elevated pollutant levels commonly originate from eroding saline soils developed from the Mancos, Morrison, Wasatch, and Green River Formations. While erosion

rates are naturally high in many areas, erosion tends to be accelerated by land uses. These saline soils exist in the Grand Valley north of the Colorado River, in the lower portions of Roan Creek, in areas east of the Gunnison River below the Grand Mesa, and in other localized areas (**Figure 3-4**, Local Geologic Formations Affecting Water Quality).

Salinity is the presence of elevated levels of soluble salts in soils or waters. These salts are sodium chloride, magnesium and calcium sulfates, and bicarbonates. Salinity is one of the greatest water quality concerns within the Colorado River Basin and is subject to the Colorado River Basin Salinity Control Act (Public Law 98-569). Section 203(b)(3) of this act directs the Secretary of the Interior to "…develop a comprehensive program for minimizing salt contributions to the Colorado River from lands administered by the Bureau of Land Management…" High salinity levels threaten the multitude of uses, including municipal, agricultural, and industrial, supported by Colorado River water. The highest sediment loads occur during periods of high flow, spring snowmelt on the larger streams, and intense summer storms on the smaller tributaries. In general, high flows tend to dilute pollutant concentrations but increase pollutant loading within a stream. Low or base flows occur in late fall and winter, correlating with high dissolved salt concentrations.

Selenium is another pollutant of concern in the planning area. Studies conducted by the USGS and the National Irrigation Water Quality Program indicated primary source areas for selenium in the Colorado River near the Colorado/Utah state line to be the eastern side of the Uncompahgre Valley and the western one-half of the Grand Valley, where extensive irrigation is located on Mancos Shales (National Irrigation Water Quality Program 1993). Elevated selenium in surface waters is due in large part to above-average erosion rates and deep percolation from irrigated agriculture and irrigation return flow on soils derived from Mancos Shale or other formations with marine depositional origins.

Surface water quality varies greatly depending on natural and anthropogenic factors, including geology, precipitation, vegetation cover, and land use. The bedrock geology within a watershed is a key determinant of its surface water quality. In areas with sandstone, basalt, or granite bedrock, the surface water tends to be of good quality. Where the Morrison, Mancos, Wasatch, and Green River Formations are exposed within the GJFO, water quality tends to be poorer, with high total dissolved solids and/or selenium concentrations. Precipitation pattern also influences water quality. Average precipitation within the GJFO ranges from eight inches in the Grand Valley desert to eighteen inches or more in the higher elevation Book Cliffs and Uncompahgre Plateau. Most rainfall occurs in the form of isolated, short-duration, and intense summer thunderstorms, creating localized flood flows that have the power to erode, mobilize, and transport sediment downstream. This sediment is then

transported to streams and can increase salinity and selenium concentrations in surface water.

Precipitation also affects water quality by influencing vegetation. A diverse and abundant vegetation cover provides for a healthy watershed. A vegetation community with diverse spatial structure, both vertical and horizontal, is better able to stabilize the soil, minimizing soil erosion, sediment transport, and deposition in nearby streams. Vegetation reduces soil loss by minimizing raindrop impact, slowing runoff velocities, and allowing more percolation of rainwater, saturating the soil to further enhance vegetative growth in a positive feedback cycle.

Land use is another factor influencing water quality. Increased recreational demands placed on BLM-administered lands adjacent to urban expansion areas, conversion of currently nonirrigated public land to irrigated agriculture, energy development such as coal, oil, natural gas, and uranium, and surface-disturbing activities such as pipelines and roads can increase point and nonpoint source pollution in water bodies. Land use disturbances of marine-derived geologic formations enhance the introduction of dissolved materials into the river systems.

Coal mining can be associated with land subsidence which can change recharge rates, runoff and sediment production. Mining can also change groundwater flow gradients potentially leading to dewatering of surface water in perennial and intermittent streams and springs. Where coal or carbonaceous shales are present, increased infiltration may result in increased runoff of poor quality water and erosion from spoil piles; recharge of poor quality water to shallow groundwater aquifers; or poor quality water flow to nearby streams. This may contaminate both groundwater and nearby streams for long periods. Lakes formed in abandoned mining operations are more likely to be acidic if there is coal or carbonaceous shale present in spoil piles, especially if these materials are near the surface and contain pyrites.

Flood events can increase the risk to water resources from land use changes. Facilities associated with energy development such as roads, crushing and washing plants, storage piles, settling basins and surface water diversion structures can be damaged and release sediment and poor quality water many miles downstream from a mine site.

Recreational uses, particularly on user-created roads and trails, negatively impacts water quality through stream crossings, riparian and upland vegetation damage, and soil compaction. Flow paths and runoff timing, volume, and velocities can all be affected by unsustainable roads and trails, affecting a stream's hydrology.

All surface waters within Colorado are organized by basin and labeled by stream segment. For each stream segment, the state has set water quality standards for

physical, chemical, and biological parameters based on the existing or potential beneficial uses for water supply, aquatic life, recreation, and agriculture. Colorado's List of Water-Quality-Limited Segments Requiring Total Maximum Daily Loads (TMDL) fulfills Section 303(d) of the Clean Water Act, which requires that states submit to the US EPA a list of those waters for which technology-based effluent limitations and other required controls are not stringent enough to implement water quality standards. For these impaired water bodies, TMDL calculations would have to be completed to determine the loadings from anthropogenic and natural sources and to determine the loading allocations for the different polluting sources (Title 5 Colorado Code of Regulations [CCR] 1002-93). Colorado's Monitoring and Evaluation List identifies water bodies where there is reason to suspect water quality problems, but where there is also uncertainty regarding one or more factors such as the representative nature of the data. Water bodies that are impaired, but it is unclear whether the cause of impairment is attributable to pollutants as opposed to pollution, are also placed on the Monitoring and Evaluation List (Title 5 CCR 1002-93). Sediment and selenium are the primary water quality impairments within the GJFO planning area (**Table 3-8**, Water Bodies on Colorado's 2012 Section 303(d) List of Water-Quality-limited Segments Requiring Total Maximum Daily Loads or the Monitoring and Evaluation List within the Planning Area).

Colorado's water quality standards and regulations are codified in Regulation No. 31 of Title 5 CCR 1002-31 (Basic Standards and Methodologies for Surface Water). Colorado's regulations set forth provisions regarding the adoption of water quality-based designations for certain surface waters and establish an antidegradation review process applicable to certain activities impacting the quality of surface waters. Regulation No. 37 of Title 5 CCR 1002-37 for the Lower Colorado River Basin and Regulation No. 35 of Title 5 CCR 1002-35 for the Gunnison and Lower Dolores River Basins define the state-identified water quality standards for the planning area. Colorado does not have streamflow criterion to protect streamflow necessary to support existing uses. The state also does not have biological criteria or guidance.

One of two water quality-based designations may be adopted. An "outstanding waters" designation may be applied to certain high-quality waters that constitute an outstanding natural resource. No degradation of outstanding waters by regulated activities is allowed. A "use-protected waters" designation may be applied to waters with existing quality that is not better than necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water. The quality of these waters may be altered so long as applicable use-based water quality classification and standards are met. Colorado's designated uses for the planning area waters requiring TMDLs or monitoring and evaluation are included in Table 3-8.

Table 3-8
Water Bodies on Colorado's 2012 Section 303(d) List of Water-Quality-limited Segments Requiring Total Maximum Daily Loads or the Monitoring and Evaluation List within the Planning Area

Water Body ID	Watershed	Segment Description	State Designated Uses[1]	Portion	Impairment	Priority for TMDL Development	List[2]
COLCLC02a	Colorado	Colorado River, Rifle Creek to Rapid Creek	Aquatic Life Warm Water Class 1, Recreation E, Water Supply, Agriculture	All	sediment	NA	M&E
COLCLC02b	Colorado	Colorado River, Rapid Creek to Gunnison River	Aquatic Life Warm Water Class 1, Recreation E, Water Supply, Agriculture	Humphrey Backwater Area	selenium	medium	303(d)
				All	sediment	NA	M&E
COLCLC13b	Colorado	Tributaries to Colorado River from Government Highline Canal Diversion to Salt Creek	Aquatic Life Warm Water Class 2, Recreation E, Agriculture	Salt Creek	sediment	Low	303(d)
				All	selenium	Medium	303(d)
COLCLC13b	Colorado	Tributaries to Colorado River from Government Highline Canal Diversion to Salt Creek except specific segments	Aquatic Life Warm Water Class 2, Recreation E, Agriculture	All	selenium	medium	303(d)
				Adobe	e. coli iron	high	303(d)
				Leach Creek	e. coli iron	High	303(d)
				Indian Wash	iron	NA	M&E
COLCLC13c	Colorado	Walker Wildlife Area Ponds	Aquatic Life Warm Water Class 1, Recreation E, Agriculture	All	selenium	medium	303(d)

Table 3-8
Water Bodies on Colorado's 2012 Section 303(d) List of Water-Quality-limited Segments Requiring Total Maximum Daily Loads or the Monitoring and Evaluation List within the Planning Area

Water Body ID	Watershed	Segment Description	State Designated Uses[1]	Portion	Impairment	Priority for TMDL Development	List[2]
COLCLC14b	Colorado	Clear Creek from Tom Creek to Roan Creek including tributaries from Clear Creek to Kimball Creek	Aquatic Life Cold Water Class 1, Recreation P, Water Supply, Agriculture	All	e. coli iron	NA	M&E
COLCLC14c	Colorado	Roan Creek including all tributaries from Kimball Creek to the Colorado River	Aquatic Life Warm Water Class 1, Recreation P, Water Supply, Agriculture	Dry Fork (Roan Creek)	selenium	low	303(d)
COLCLC15	Colorado	Plateau Creek, including tributaries from source to Hwy 330 Bridge	Aquatic Life Cold Water Class 1, Recreation E, Water Supply, Agriculture	All	iron selenium	NA	M&E
COLCLC19	Colorado	Lakes and reservoirs tributary to the Colorado River, Parachute Creek to the Colorado/Utah border	Aquatic Life Warm Water Class 1, Recreation E, Agriculture	West Pond Orchard Mesa Wildlife Area	selenium	high	303(d)

Table 3-8
Water Bodies on Colorado's 2012 Section 303(d) List of Water-Quality-limited Segments Requiring Total Maximum Daily Loads or the Monitoring and Evaluation List within the Planning Area

Water Body ID	Watershed	Segment Description	State Designated Uses[1]	Portion	Impairment	Priority for TMDL Development	List[2]
COGULG02	Gunnison	Gunnison River, Uncompahgre River to Colorado River	Aquatic Life Cold Water Class 1, Recreation E, Water Supply, Agriculture	All	e. coli	high	303(d)
					sediment	NA	M&E
COGULG04a	Gunnison	Tributaries to Gunnison River, Crystal Reservoir to Colorado River	Aquatic Life Warm Water Class 2, Recreation N, Water Supply, Agriculture	Whitewater Creek from below Brandon Ditch to confluence with Gunnison River	sulfate	low	303(d)
					manganese	low	303 (d)
COGULD02	Dolores	Dolores River from the Little Gypsum Valley Bridge at the San Miguel/ Montrose County line, to the Colorado/Utah border	Aquatic Life Warm Water Class 1, Recreation E, Agriculture	All	Iron	high	303(d)
					e. coli	NA	M&E

Source: Title 5 CCR 1002-35 (CDPHE 2012a), Title 5 CCR 1002-37 (CDPHE 2012b), Title 5 CCR 1002-93 (CDPHE 2010a), CDPHE 2010b and CDPHE 2012c

[1]For a detailed discussion of state-designated uses, refer to Title 5 CCR 1002-35 (CDPHE 2012a) and Title 5 CCR 1002-37 (CDPHE 2012b)

[2]M&E: Monitoring and Evaluation

As part of the Colorado Public Land Health Standards passed in 1997 (BLM 1997a), water quality is one of the five standards for land health that must be assessed:

> Standard 5: The water quality of all water bodies, including groundwater where applicable, located on or influenced by BLM lands will achieve or exceed the water quality standards established by the State of Colorado. Water quality standards for surface and groundwater include the designated beneficial uses, numeric criteria, narrative criteria, and anti-degradation requirements set forth under state law (5 CCR 1002-8), as required by Section 303(c) of the Clean Water Act.
>
> **Indicators:**
> - Appropriate populations of macroinvertebrates, vertebrates, and algae are present.
> - Surface and groundwater only contain substances (e.g., sediment, scum, floating debris, odor, heavy metal precipitates on channel substrate) attributable to humans within the amounts, concentrations, or combinations as directed by the Water Quality Standards established by the State of Colorado (5 CCR 1002-8).

In several situations where stream segments on BLM-administered lands are not meeting water quality standards, it is due to land uses on private land beyond the management control of the BLM. As one example, the main stem of the Gunnison River from the Uncompahgre River to the Colorado River is currently listed for selenium on the 303(d) list of impaired water bodies (this segment now has a TMDL). However, the primary cause of the elevated selenium through the segment is deep percolation of irrigation water through croplands on Mancos Shale in the Uncompahgre Valley. Likewise, many tributaries on the north side of the Colorado River within the Grand Valley are listed for selenium on the 303(d) list. While the lower Book Cliffs and north desert on public lands may contribute selenium to streams from natural erosion and surface-disturbing activities, the scale of the pollution contribution is much less than that of irrigated agriculture in the Grand Valley.

Water quality in the planning area is generally meeting Standard 5, but there are localized areas that are functioning at risk (FAR) or not functioning (NF) for riparian areas, which if not improved could lead to water quality degradation.

Proper Functioning Condition (PFC) assessments have been conducted as part of Land Health Assessments on various landscapes within the GJFO (See **Section 3.2.6**, Vegetation). PFC is one tool used to help diagnose potential water quality problems. Other indicators relevant to water quality include assessments of Land Health Standard 1 for soils and Standard 3 for vegetation, as well as macroinvertebrate sampling and commitment to long term water

quality monitoring at established sites. A complete list of water quality data for these sites is available upon request at the GJFO.

Activities that occur in and in areas adjacent to rivers, streams, or waterbodies may also affect water quality. Riparian areas have been defined for the purpose of this management plan to aid in the classification of localized areas and to protect water quality. Typical riparian areas are lands along, adjacent to, or contiguous with perennially and intermittently flowing rivers, streams, glacial potholes, and shores of lakes and reservoirs with stable water levels. These areas exhibit vegetation or physical characteristics reflective of permanent surface or subsurface water influence. Riparian areas can be defined for lotic ecosystems with standing water such as lakes and ponds and lentic ecosystems with flowing water such as rivers and streams. Assessment of riparian areas is further discussed in **Section 3.2.6**, Vegetation.

In addition, activities adjacent to definable streambeds can impact water quality. For the purpose of this plan, definable streams include those with evidence of scour or deposition (Johnson and Buffler 2008).

Morphology and channel stability can be specifically monitored along streams that could be impacted by major land use actions or to assess concerns identified through land health assessments or inventories to determine appropriate management action. For the purposes of this plan, dysfunctional streams will be defined as those streams with a Pfankuch channel stability rating of "Poor" based on Rosgen channel type (Rosgen 1996) and/or streams in which riparian habitat is rated non-functional through BLM interdisciplinary team PFC evaluations.

Groundwater and Groundwater Quality

The GJFO lies within the larger Colorado Plateau and Wyoming Basin Groundwater Region. This region covers an area of 160,000 square miles throughout Colorado, Utah, Wyoming, Arizona, and New Mexico. A broad plateau averaging 4,000 to 7,000 feet dominates this region and is underlain primarily by horizontal to gently dipping layers of consolidated sedimentary rocks predominantly composed of Paleozoic to Cenozoic sandstone, shale, and limestone. Mountain ranges border this area on the north, west, and east (Heath 1984).

Surface water is the principal water resource in the GJFO with groundwater used for less than five percent of the water needs. The primary sources of groundwater in the planning area are the alluvial aquifer systems associated with the Colorado, Gunnison, and Dolores Rivers. Bedrock aquifers of the Piceance Basin account for a very small proportion of water use (Topper et al. 2003).

Alluvial groundwater occurs in unconsolidated deposits formed along drainage courses. The alluvial aquifer is capable of yielding sufficient water for domestic and stock water uses, and as irrigation water in some locations. Groundwater in

the alluvial drainages occurs primarily under unconfined conditions. Localized confined conditions may occur where clay layers are laterally extensive. The direction of groundwater flow in the alluvium is generally parallel or sub-parallel with the axis of the drainage.

The Plateau Valley consists of quaternary alluvial deposits as well as glacial till deposits. These sediments serve as an important source of domestic and municipal water in the Plateau Valley. The Mesa and Powderhorn Source Water Protection Areas contain a significant amount of these types of deposits and also have a high density of water wells.

Alluvial groundwater is recharged by stream flow in the upper reaches of the drainages where there is more likely to be a separation between the channel bottom and the underlying alluvial water table. Recharge of the groundwater is greatest during precipitation events or snow melt runoff when the stage of the creeks increases and more water is able to infiltrate. A lesser amount of recharge may occur from bedrock formations and from irrigation return flows.

The valley fill deposits or alluvium in the Colorado River basin consists generally of unconsolidated boulders, cobbles, gravel, sand, silt, and clay. The thickness of the alluvium can be extremely variable depending on location. Alluvium in the upper reaches of the basin tends to be thin due to increased slopes and higher flow velocities. Thicker deposits tend to accumulate in the lower reaches. Alluvium is very limited or nonexistent in the canyon sections of the Colorado River where bedrock is exposed. Alluvial groundwater resources are used for public water supply and agricultural irrigation, and represent an important resource in rural areas for domestic supplies. The principal agricultural area is the Grand Valley from Palisade to Fruita; other agricultural areas include Plateau Creek in the Collbran area (Topper et al. 2003).

The Gunnison River flows northwest through portions of the GJFO at Whitewater and joins the Colorado River at Grand Junction. Groundwater is used for irrigation, public and domestic water supply, and livestock. The alluvium of the Gunnison River basin consists of clay, silt, sand, gravel, and cobbles. Alluvial deposits are very thin or nonexistent in the canyon areas of the main stem of the Gunnison River and tributaries (Topper et al. 2003).

The Dolores River Basin passes through the southern part of the GJFO. Alluvium within the Dolores River basin is comprised of typical Quaternary alluvial valley fill. These deposits consist of gravel, sand, silts, clay, and various mixtures. The alluvial extent is limited to areas near the rivers and their tributaries and disappears entirely in areas where active canyon downcutting occurs. Mapped alluvial deposits are localized around the town of Gateway and in West Creek in Unaweep Canyon. Although restricted in extent, the alluvium is an important aquifer to those people who utilize it for domestic, livestock, and minor irrigation use (Topper et al. 2003).

Much of the northern part of the GJFO is in the Piceance Basin, an elongated structural depression trending northwest to southeast. The basin is more than 100 miles long and has an average width of over 60 miles. The principal bedrock aquifers in the northern portion of the Piceance Basin are the saturated, porous members of the Uinta Formation and Parachute Creek Member of the Green River Formation (both of Tertiary age). Bedrock aquifers in the Piceance Basin are typically under confined conditions, except along outcrops at the basin edge. The potentiometric surface indicates that the pressure head is at or very near the surface within the drainage valleys. This suggests that groundwater is moving from the aquifers to the creek alluvium (Topper et al. 2003).

The thickness of Tertiary-age rocks in the Piceance Basin varies from 2,000 to approximately 12,000 feet. South of the Colorado River, the upper Tertiary-age aquifers have largely been eroded off, exposing a thick basal confining unit of the lower Green River and Wasatch Formations (Topper et al. 2003).

In the planning area, the Entrada sandstone provides most of the artesian fresh water, and the Wingate sandstone is the source of the deepest artesian fresh water supply. The sandstone layers of the Salt Wash member of the Morrison Formation also provide artesian fresh water, but at lesser amounts. The Burro Canyon and Dakota sandstones often provide artesian water too, but typically the water is saline (Lohman 1965). In many areas, groundwater wells must be drilled to depths of roughly 1,000 feet or more depending on the location within the basin to tap the fresh waters of the most permeable sandstones and limestones. The shales and siltstones usually contain salty waters, or water containing more than 1,000 milligrams per liter of dissolved solids (Heath 1984). As such, most water supply wells in the southern portion of the Piceance Basin are completed in the alluvial aquifers associated with the Colorado and Gunnison River tributaries (Topper et al. 2003).

Colorado's water quality criteria are set by the CDPHE, Water Quality Control Division. Basic Standards for Ground Water are contained in CDPHE Regulation 41. For groundwater, specified areas are designated to delineate a special activity or use. Site-specific uses and standards are then promulgated for the specified area. Where there is no specified area, and therefore no site-specific standards, a general standard applies.

There is one small underground coal mine in the Book Cliffs north of Loma that uses groundwater inflows for mining processes, and one small underground uranium mine on the Uncompahgre Plateau that is idle and no longer pumping, treating and discharging groundwater inflows to the surface. Another larger underground coal mine (11,000 acres) has been proposed in the Book Cliffs north of Loma and is being analyzed in a separate EIS, and a new mine on existing leases was proposed to the Division of Reclamation Mining and Safety but later withdrawn. Industry is also utilizing tributary groundwater for dust suppression, drilling operations, and domestic purposes.

Water Use

The GJFO manages lands that support municipal, residential, agricultural, livestock watering, and industrial mining uses. Municipal watersheds and source water protection areas have been identified in the planning area (**Figure 3-5**, Municipal Watersheds and Source Water Protection Areas). Source water protection areas providing drinking water to local towns and communities were delineated by the State of Colorado as required by the Safe Drinking Water Act Amendments of 1996. To date, source water assessments have been completed for Grand Junction, Palisade, Collbran, DeBeque, and Clifton. Assessments have also been completed for smaller municipalities, resorts, homeowner associations, and ski areas. Notable municipal water supply areas and storage reservoirs that have been mapped in the planning area include the following:

- Grand Junction municipal watershed;
- Palisade municipal watershed;
- Jerry Gulch watershed;
- Collbran source water protection area;
- Mesa/Powderhorn source water protection area;
- Cabin Reservoir; and
- Jerry Creek Reservoir.

Smaller systems and private potable water sources are tapped throughout the planning area (CDPHE 2000, 2009). Irrigated agriculture remains an important water use, although much farmland has been converted to residential developments, especially in the Grand Valley. Fruit crops, wine, and corn production are strong agricultural products dependent on irrigation in the planning area. Livestock watering is an important use on public lands. If water for livestock is not otherwise available, it is developed by various means on grazing ranges. The mining industry is also a major user. Recreation and fish and wildlife uses are also important but do not consume appreciable quantities of water and are generally incidental to other uses.

Oil and gas well development uses both fresh and produced water during the drilling process. Well completion operations may use fresh, produced, or recycled completion water. Freshwater is used for dust abatement of associated oil and gas development. The freshwater sources can be located near the drilling activity and may affect local freshwater supplies.

The State of Colorado has authority for allocating limited water supplies to various uses. However, the BLM implements multiple responsibilities and authorities that are complementary to the state's authority for water allocation. First, any water diversion facility on BLM lands requires explicit land use authorization from BLM. In these land use authorizations, BLM's role is to fulfill mandates expressed in federal laws for resource maintenance and protection.

This responsibility is fulfilled by imposing terms and conditions on the land use authorization or by denial of land use applications if terms, conditions, and mitigation aren't sufficient to address resource management requirements. Second, the BLM applies to the state of Colorado for water rights that support BLM land management objectives in areas such as wildlife management, livestock management, recreation, and fire suppression. Third, BLM makes recommendations to the Colorado Water Conservation Board for protection of instream flows in streams that support fishery, riparian, wetland, and wildlife values.

Trends

The key trends that impact water supply and quality within the planning area are energy development, recreation, grazing, and urban development and sprawl. Energy development, primarily in the form of natural gas, uranium, and coal, has and will continue to impact surface and groundwater quality and quantity. The rate or extent of extraction or mining tends to be cyclical, with boom and bust periods. The Roan Creek and Plateau Creek watersheds have experienced rapidly expanding natural gas development in the past few years, creating a short- and long-term infrastructure of roads, pipelines, well pads, compression stations, and supporting industrial facilities.

Increased natural gas development may impact water quality by increasing erosion and sediment production from surface disturbance and from spills of fuel and chemicals used in drilling and production activities. Additional impacts could be anticipated from produced water disposal and the introduction of noxious and invasive plant species ineffective at stabilizing soils, causing accelerated erosion and resultant water quality impacts. Stream crossings, in particular low-water crossings, are numerous and are large sediment contributors to streams.

Natural gas and oil development requires the use of freshwater during the drilling process and the completion process. Freshwater is also used for dust abatement at the gas and oil site development sites and on associated roads. The sources of freshwater for use in these activities can be in close proximity to the activity, thereby affecting local freshwater supplies.

Uranium mining has a large legacy footprint throughout the Gateway area, which is part of the Lower Dolores River basin. Emergent activity over the past couple of years was flourishing but is now responding to depressed uranium prices and market conditions. One active mine, Whirlwind Mine, has recently gone idle. However, a new uranium mill is in the permitting stage on private land outside of Naturita and may cause an increase in uranium production if construction is completed.

An existing coal mine in the Book Cliffs north of Fruita is currently idle, though mining is anticipated to resume in the future. A proposal for a coal lease of approximately 11,000 acres is currently undergoing analysis in an EIS. As

described previously, coal mining can be associated with land subsidence, changes in recharge rates, runoff of poor quality water, sediment production, changes in groundwater flow gradients, potential dewatering of surface water and springs and contamination of surface water and groundwater sources.

The GJFO is experiencing growth in recreation on public lands due to local population growth, as well as the area's reputation as a national and international recreation destination. All forms of recreational activities can increase potential for erosion, sedimentation, gully creation, biologic soil crust damage, and riparian and upland vegetation damage. Recreation activities may also directly and indirectly impact water quality due to erosion and sediment production potential. However, the significance of such impacts varies with the nature and degree of disturbance, as well as site-specific environmental conditions. Typically larger disturbances in sensitive areas represent greater potential to damage soils and vegetation, degrade water quality, and impair overall watershed function and condition than smaller disturbances in less sensitive areas.

Colorado's Grand Valley is recognized as the largest non-point source of salinity in the Upper Colorado River Basin. Much of the lands currently open to all modes of travel are situated in areas mapped to be highly erodible (fragile) or saline. The cumulative erosion in these areas resulting from a dispersed, expanding, unmaintained, and in many cases poorly designed route system would be considered a nonpoint source of pollution.

Livestock grazing activities have affected the water quality of surface water sources in the planning area. In some areas, grazing activities have caused vegetation loss, soil compaction, reduced runoff retention, riparian function loss, direct soil disturbance, and runoff concentrated into animal trails, with consequent enhanced erosion. Grazing animals create waste that can introduce nutrients and pathogens to streams directly or in runoff. Excessive nutrient loading can lead to algal growth, depleted dissolved oxygen needed to support aquatic fauna, reduced water clarity, increased water temperature, and other effects that reduce riparian function.

Increasing populations and increasing participation in recreational activities can increase impacts to source water protection areas that provide drinking water to local towns and communities. There is increasing interest in multiple uses in municipal watersheds and source water protection areas, while there is increased need to protect those areas to ensure water quality.

Grand Junction is expanding, and the Grand Valley is increasing in population; both will add increasing development and recreation pressure. The urban development in these areas is pushing against BLM lands in the desert. Sprawled development is anticipated to have long-term negative impacts on surface water quality and flow. Rain in urban developed areas picks up and transports pollutants like sediment, oil and grease, nutrients (lawn fertilizers), and metals

into streams. This polluted runoff is called stormwater and is regulated by the US EPA and by the state. Increased development also adds impermeable surfaces from roads, parking lots, and rooftops and would permanently alter the natural hydrograph of local streams, creating flashier systems. Rain on impermeable surfaces is conveyed more rapidly to local drainages without soil infiltration, causing rapidly swelling streams with greater power to flood and erode stream banks, potentially impacting human and environmental resources.

Population growth outside of the GJFO may also be a key component to water resource issues in the future. For example, development along the Dolores River near Gateway will utilize groundwater wells drawing water from the Dolores River alluvium. Since the Dolores River is regulated by an upstream dam, recharge to alluvium is also regulated. Groundwater development in this area may result in capture of surface water, reducing downstream water availability needed to sustain already limited riparian communities. Future development, especially in river corridors, may have similar effects on water supplies and quality.

Predicted climate change impacts on Colorado may include earlier melting of snowpack, lower river flows in summer months, water shortages for irrigated agriculture, slower recharge of groundwater aquifers, effects on water availability for recreation and wildlife use, and migration of plant and animal species to higher elevations.

3.2.6 Vegetation

Vegetation serves multiple purposes in the landscape and provides many ecosystem services. Vegetation stabilizes soils, prevents erosion, uses carbon dioxide, releases oxygen, increases species diversity, and provides habitat and food for animals and products for human use. Many of the BLM's land management policies are directed toward maintenance of healthy vegetation communities. Vegetation can be characterized generally by ecological provinces and more specifically by plant communities. The ecological provinces and plant communities discussed below are those that provide the most important land cover across the GJFO planning area.

Ecological Provinces

Bailey's (1995) description of North American ecoregions places the GJFO planning area in three different ecological provinces, including the Nevada-Utah Mountains Semi-Desert-Coniferous Forest-Alpine Meadow Province (M341), Intermountain Semi-Desert Province (341), and Southern Rocky Mountain Steppe-Open Woodland-Coniferous Forest-Alpine Meadow Province (M331). Each ecological province covers approximately one-third of the GJFO planning area, including all land jurisdictions. The Nevada-Utah Mountains Semi-Desert-Coniferous Forest-Alpine Meadow Province is located in the northern portion of the planning area extending from the Utah State line to DeBeque. The Intermountain Semi-Desert Province extends through the central portion of the

planning area and includes the Dolores River drainage. The Southern Rocky Mountain Steppe-Open Woodland-Coniferous Forest-Alpine Meadow Province covers the upper elevation lands in the southern and eastern sections of the planning area (Uncompahgre Plateau and Grand Mesa). These ecoregions are depicted on **Figure 3-6**, Ecoregions.

Within a specific area, the type and amount of vegetation are largely determined by precipitation, elevation, topography, aspect, soil types, and human actions. The Nevada-Utah Mountain Semi-Desert-Coniferous Forbs-Alpine Meadow Province (M341) consists of hills, mesas, and lower mountains and occupies the highest elevations of the Colorado Plateau and the Great Basin of Colorado, Utah, and eastern Nevada. The lower elevations are dominated by shrubs and bunchgrasses. Where soils are saline, salt-tolerant species such as greasewood *(Sarcobatus vermiculatus)* dominate. Woodland areas consist of pinyon pine *(Pinus edulis)* and juniper *(Juniperus* spp.*)*, which give way to aspen *(Populus tremuloides)*, willow *(Salix* spp.*)*, and cottonwood in wetter areas (Bailey 1995; Cronquist et al. 1972). The valleys and basins are generally higher than 5,000 feet, and the upper peaks can be as high as 12,000 feet. Precipitation ranges from 5 to 8 inches per year in the lowest and driest basins to over 25 inches per year in the mountainous areas. Climate change may result in modified hydrographs which could result in earlier than normal peak flow conditions. Likewise climate change could result in water depletions associated with longer growing seasons (increased transpiration). These areas provide ideal year-round habitat for many species of wildlife.

The Intermountain Semi-Desert and Desert Province (341) is contained within the intermountain basins of Colorado and Utah. The chief vegetation type, sagebrush steppe, is made up of sagebrush, saltbush, and a mixture of grasses and forbs. The Intermountain Semi-Desert Province is sometimes considered a cold desert, as the summers are hot and the winters can be extremely cold. The growing season is short, and the annual precipitation is between 5 and 12 inches. Winter snow accumulation and runoff provide available moisture for spring plant growth. Snow distribution patterns caused by wind, topography, and existing vegetation develop pockets of highly productive sites within the drier, less productive surrounding areas. This area lies at elevations below 8,000 feet.

The Southern Rocky Mountain Steppe-Open Woodland-Coniferous Forest Province (M331) is a transition from grass- and shrub-dominated areas to shrub- and tree-dominated areas. Juniper, shrub, and grass communities dominate at elevations between 8,000 and 9,000 feet, with pine and spruce forest occurring between 8,500 and 12,000 feet. Riparian vegetation varies according to elevation as well; however, willows and water-tolerant grasses, sedges, and rushes often dominate from the foothills to the alpine (Bailey 1995). The climate of these areas is variable and dynamic due to factors such as elevation, aspect, slope, and topographical change. Eastern and southern slopes are generally drier and

warmer than western and northern slopes. As the elevation rises, the mean temperature decreases and the growing season shortens.

Current Conditions

Plant Communities

There are three main physiognomic groups in the GJFO planning area: rangelands, forests and woodlands, and riparian areas and wetlands. Barren land, also a physiognomic group, comprises less than one percent of the planning area. Physiognomic groups can be further divided into plant communities. There are 14 general vegetation plant communities in the GJFO planning area. A plant community is a group of plant populations that coexist in space and time and affect each other's population dynamics directly or indirectly. Distinct plant communities within the GJFO planning area are influenced by characteristics such as soil depth, texture, and salinity; climate variables, particularly temperature, total and seasonal distribution of precipitation, and wind; and topographic features, most importantly elevation, aspect, and slope. The following discussion of plant communities that occur within the GJFO planning area shows the diverse and complex nature of vegetation resources in the area. **Table 3-9**, Mapped Vegetation in the GJFO Planning Area, lists the plant communities and provides acreages for BLM-administered lands. **Figure 3-7**, Major Vegetation Groups, shows the location of plant communities in the planning area.

Barren/talus/rock outcrops

This community, representing less than one percent of the planning area, includes areas of barren soil, cliffs and talus slopes that support little or no vegetation, and rock outcrops. Barren areas, talus slopes, and rock outcrops are too steep and too sparsely vegetated to be beneficial to livestock or big game animals for forage. Barren areas are usually caused by soil conditions that preclude the growth of vegetation. Although vegetation in these areas is quite sparse, microbiotic crusts are abundant and diverse and are key to holding these soils intact. Other barren areas are found as small inclusions on Wasatch soils that are too steep or lack the proper soil characteristics to support vegetative growth.

Talus slopes form below cliffs of the Green River Formation as the cliffs begin to weather and crumble. These talus slopes consist of shale shards of various sizes and often have very little soil development or are too steep and unstable to support most forms of vegetation. However, many endemic rare plant species in the GJFO planning area occur on these talus slopes. Most of these species have biological characteristics that enable them to grow in extreme conditions.

Rock outcrops are usually areas of sandstone that are resistant to weathering. These areas are exposed rock ledges and benches, with soil deposition occurring only in cracks and low spots where soil accumulates.

Table 3-9
Mapped Vegetation in the GJFO Planning Area

Mapped Vegetation	Specific Plant Community	BLM Acreage	Percent of GJFO
Aspen	Quaking aspen-dominated stands	7,800	less than 1
Barren land	Barren talus slopes, badlands, rock outcrops, soil	100	less than 1
Blackbrush	Blackbrush, with lesser amounts of needle-and-thread grass, sand dropseed, Indian ricegrass, and winterfat	7,000	less than 1
Douglas-fir and mixed conifer	Douglas-fir, subalpine fir	33,800	3
Greasewood	Greasewood, halogeton, seepweed, cheatgrass	25,500	2
Mountain shrub	Gamble oak, serviceberry, snowberry, squaw apple, antelope bitter brush	160,700	15
Pinyon-juniper	Pinyon pine, Utah juniper, Rocky Mountain juniper, common juniper, shrubs, bare ground	539,900	53
Ponderosa pine	Ponderosa pine interspersed with Gambel oak	6,700	less than 1
Riparian	Cottonwood, willow, tamarisk, sedge, and rush	9,800	less than 1
Sagebrush	Wyoming big sagebrush, mountain big sagebrush, and black sagebrush; limited amounts of silver sagebrush, basin big sagebrush, and bud sage	83,900	8
Salt desert shrub	Shadscale, Gardner's saltbush, mat saltbush, spiny hopsage, greasewood, winterfat, broom snakeweed, and bud sage; limited native grasses and forbs	174,700	16

Source: BLM 2010a

Rangelands

Rangelands can be subdivided into grasslands and shrub communities. These vegetation types and the roles they play in the GJFO planning area are described below.

Grasslands

No true grasslands (where grass is dominant over shrubs) occur within the GJFO planning area; however, grass plays an important ecological role. In the lower elevations with sandier soils, needle-and-thread *(Hesperostipa comata)*, sand dropseed *(Sporobolus cryptandrus)*, galleta *(Hillaria jamesii)*, Indian ricegrass *(Achnatherum hymenoides)*, and blue gramma *(Bouteloua gracilis)* are common. In the more mesic settings, grass communities shift to junegrass *(Koeleria macrantha)*, wheat grasses *(Agropyron* spp.*)*, and bluegrasses *(Poa* spp.*)*. In general, the only pure stands of grass within the GJFO planning area occur as a result of some type of disturbance. Chainings and seedings in the 1960s have resulted in crested wheat grasslands on the Uncompahgre Plateau and Glade Park (crested wheat is an introduced but naturalized grass) (Weber 2001). In the lower desert (valley floor) and in areas of DeBeque, cheatgrass (*Bromus tectorum*) dominates the more degraded areas. Degradation into cheatgrass-dominated areas is most commonly associated with historic overgrazing, drought, and/or fire.

Cheatgrass-degraded sites tend to also contain other weedy species, including annual wheatgrass *(Eremopyrum triticeum)*, filaree *(Erodium cicutarium)*, halogeton *(Halogeton glomeratus)*, Russian thistle *(Salsola iberica)*, annual mustards, and in some areas, jointed goat grass *(Aegilops cylindrica)*. Increasing stands of non-native bulbous bluegrass *(Poa bulbosa)* have also been noticed across the GJFO planning area at all elevations.

Shrub Communities

Approximately 41 percent of the BLM-administered lands in the GJFO planning area are considered shrublands (salt desert shrub, mountain shrub, sagebrush, greasewood, and blackbrush *[Coleogyne ramosissima]*) (BLM 2010a). These communities are very diverse in plant composition, size, location, habitats, and forage they provide to wildlife and livestock. Therefore, this section discusses several shrub community types: salt desert shrub, mountain shrub, sagebrush (three dominant sagebrush species discussed within this type), greasewood, and blackbrush.

Salt Desert Shrub. Salt desert shrublands are characterized by drought-tolerant shrubs, with few grasses and forbs in the understory (BLM 2009d). The soils of these areas are shallow saline clays and loams. Typical shrubs in this vegetation type are shadscale *(Atriplex confertifolia)*, Gardner's saltbush *(A. gardneri)*, mat saltbush *(A. corrugata)*, four-wing saltbush *(A. canescens)*, spiny hopsage *(Grayia spinosa)*, greasewood, winterfat *(Krascheninnikovia lanata)*, broom snakeweed *(Gutierrezia sarothrae)*, and bud sagebrush *(Picrothamnus desertorum)*. Big sagebrush *(Artemisia tridentata)* and rabbitbrush *(Chrysothamnus* spp.*)* occur in looser and rockier soils and are much less abundant than in the other desert shrub types. Juniper *(Juniperus osteosperma)* is occasionally found on the lee side of rocky hills and ridges. Understory vegetation includes globemallow *(Sphaeralcea* spp.*)*, wild parsley *(Lomatium* spp. and *Cymopterus* spp.*),* prickly pear cactus *(Opuntia* spp.*)*, galleta *(Hilaria jamesii)*, needle-and-thread, and Indian ricegrass. These areas are often important winter ranges for wildlife and livestock, as they provide forage that is not buried in snow, and the shrubs and rough topography provide cover from wind and predators. The forage of these areas is excellent in the winter, as these shrubs maintain relatively high levels of protein and carbohydrates. In addition to winter forage, this shrub community is an important soil stabilizer in areas too salty or xeric for other plants to survive in. The salt desert shrub community occurs on 16 percent of the lands managed by BLM and is located in the lower elevations, from 5,000 to 7,000 feet (BLM 2009d).

In a degraded condition, these communities are dominated by invasive annuals; degradation often results from fire, historic grazing, or recreational activities. This vegetative community does not respond well to disturbance and is typified by extremely slow recovery. Examples of the fragility of this community are areas north of the Grand Junction Regional Airport where heavy recreational use has led to desertification, and in the north desert where salinity-control contouring was done in the 1960s (where native shrubs have yet to recover and

cheatgrass dominates), and areas north of Interstate 70 along the Utah border where fire has removed all woody species and invasive annual grasses are the primary species.

Mountain Shrub. Mountain shrub communities include Gamble oak *(Quercus gambelii)*, service berry *(Amelanchier* spp.*)*, snowberry *(Symphoricarpos rotundifolius)*, squaw apple *(Peraphyllum ramosissimum)*, antelope bitterbrush *(Purshia tridentata)*, and various other shrubs (BLM 2009d). These shrubs may reach 10 to 15 feet in height, occurring in dense stands or in scattered patches, often adjacent to aspen or willow. These areas are important wildlife summer and transition ranges, as well as spring, fall, and summer livestock ranges. This community provides hiding and thermal cover for deer, elk, and other wildlife species. The mountain shrub community comprises 15 percent of the land managed by BLM and generally occurs in all mid- to upper-elevation ranges (6,500 to 9,500 feet) across the GJFO planning area (occurring between the lower pinyon-juniper woodlands and upper-elevation aspen and conifer stands). Since this community typically occurs in areas of relatively abundant moisture, understory species are abundant, and density of the understory is determined by canopy cover. Common understory species are Letterman's and Columbia needlegrass *(Achnatherum lettermanii* and *A. nelsonii*, respectively*)*, junegrass, penstemon *(Penstemon* spp.*)*, Indian paintbrush *(Castilleja* spp.*)*, and aster (family Asteraceae). The mountain shrub community tends to respond favorably to fire due to its resprouting capabilities (BLM 2009d).

Sagebrush. Sagebrush communities in the GJFO planning area are dominated by Wyoming big sagebrush *(Artemisia tridentata* ssp. *wyomingensis)*, mountain big sagebrush *(A. t.* ssp. *vaseyana)* and black sagebrush *(A. nova)* (BLM 2009d). Less frequent species are silver sagebrush *(A. cana* ssp. *bolanderi)*, basin big sagebrush *(A. tridentata* ssp. *tridentata)*, bud sage *(A. spinescens)*, and an unidentifiable hybrid on the Uncompahgre Plateau. Collectively, sagebrush communities make up eight percent of the GJFO public lands. Sagebrush communities are especially rich in wildlife species that live only or predominately in this vegetation type, or as with mule deer *(Odocoileus hemionus)*, species that would be far less numerous if sagebrush were absent. Fire is an important component of all sagebrush-dominated plant communities. Degraded Wyoming big sagebrush and mountain big sagebrush communities are susceptible to cheatgrass invasion, and at extremes may have understories devoid of all perennials, populated solely by cheatgrass. The three dominant species are described below.

Wyoming Big Sagebrush. The Wyoming big sagebrush is the most tolerant big sagebrush species in arid locations, existing in areas with precipitation of 7 to 11 inches. Wyoming big sagebrush tends to grow at mid elevations in well-drained soils but can exist at elevations reaching 8,000 feet (Winward 2004). This species is important winter forage for big game species and sage-grouse. This species is the most diminutive of the big sagebrush group, with typical heights of 24 to 36 inches. Some mature plants may surpass four feet. Canopy cover is not

as extensive as for either basin or mountain big sagebrush, usually topping out between 30 and 40 percent. Wyoming big sagebrush often appears as the dominant plant in mosaic communities intermixed with other shrubs and open grasslands. In shallow, rocky to gravelly soils, Wyoming big sagebrush may be co-dominant with black sagebrush, viscid rabbitbrush *(Chrysothamnus viscidiflorus)*, and sometimes winterfat. Grass and forb species vary depending on soil texture, aspect, and slope. Common grass species include Sandberg bluegrass *(Poa secunda)*, Indian ricegrass, needle-and thread, western wheatgrass *(Pascopyrum smithii)*, and bottlebrush squirreltail *(Elymus elymoides)*. Common forbs include phlox *(Phlox* spp.*)*, buckwheat *(Eriogonum* spp.*)*, penstemon, Indian paintbrush, globemallow, and prickly pear cactus. It is also one of the dominant species found on antelope and mule deer crucial winter ranges.

Mountain Big Sagebrush/Grassland. Common to pinyon-juniper woodlands, Mountain big sagebrush grows in moderately deep, well-drained soils at elevations ranging from 6,500 to 8,500 feet. Most sites supporting this sagebrush are very productive and diverse. The fire return interval in mesic Mountain big sagebrush sites with abundant grass and forb cover is more frequent than other sagebrush sites, roughly 25 to 30 years. Mountain big sagebrush can increase in canopy cover without periodic fire, disease, or other disturbance. Canopy cover on areas that have not had disturbance for several decades can reach between 40 and 50 percent (Winward 2004). This sagebrush type is an important component of sage-grouse brood-rearing habitat, so any sagebrush reduction projects must be designed to consider sage-grouse habitat requirements (Winward 2004).

Black Sagebrush. Of the three dominant sagebrush species in the GJFO planning area, black sagebrush is the smallest (4 to 12 inches). Black sagebrush is found in shallow argillic or clay pan soils, with an elevation range of 4,000 to 8,500 feet. In order to survive, it must endure saturated soils in the spring and extremely dry soils in the summer (Winward 2004). In low-elevation winter ranges (during snow-free periods), black sagebrush is extremely important to pronghorn *(Antilocapra americana)* and mule deer. This species is particularly nutrient-rich winter forage and is highly palatable to domestic sheep.

Greasewood. Greasewood communities make up approximately two percent of the GJFO planning area, occurring in uplands and washes (lower desert) (BLM 2009d, 2010a). Areas populated by greasewood tend to have extremely saline soils, with limited plant associations. Plants most likely occurring within greasewood communities are greasewood, seep weed *(Suaeda* spp.*)*, cheatgrass, and halogeton, and, in less saline sites, sagebrush and shadscale. In general, greasewood-dominated communities are the most resistant vegetative community to treat and to revegetate as a more desirable community. While domestic livestock will graze greasewood, animals not adapted to it can suffer from oxalate poisoning, causing kidney failure. Greasewood provides important cover for upland game birds, big game animals, and other wildlife species.

Blackbrush. Blackbrush *(Coleogyne ramosissima)* is found in less than one percent of the GJFO planning area. Blackbrush is a drought-tolerant, low- to mid-level shrub (11 to 48 inches), with an elevation range of 2,500 to 6,000 feet. Blackbrush can be found on the north side of the Dolores River near the town of Gateway, and on a lower bench overlooking Unaweep Canyon near Casto Draw. Monitoring studies are established in both locations. While deer may utilize blackbrush in the winter, monitoring has determined that this species receives very little use. The blackbrush community near Gateway contains very little understory and is characterized by large bare-ground interspaces, while the Casto Draw location has a slightly more robust understory consisting of needle-and-thread grass, sand dropseed, Indian ricegrass, and winterfat.

Forests and Woodlands

Forest and woodland vegetation is primarily composed of pinyon-juniper woodlands, Douglas-fir, aspen, and ponderosa pine and collectively account for 55 percent of the GJFO planning area (BLM 2009d, 2010a). Pinyon-juniper woodlands make up the majority of this vegetation community. The forested areas within the GJFO planning area are found mainly within the mountainous areas of the Uncompahgre Plateau, Grand Mesa, areas accessed by Douglas Pass, and the extreme northern areas of the Book Cliffs (north of DeBeque). Pinyon-juniper is much more widespread, accounting for nearly all mid-elevation areas. Forested lands and woodlands managed by the BLM within the GJFO planning area total 588,200 acres.

Pinyon-Juniper Woodlands. Consisting of approximately 539,900 acres and accounting for 53 percent of the GJFO planning area, pinyon-juniper woodlands are the most dominant vegetative community in the GJFO planning area (BLM 2009d, 2010a). At lower elevations, many of the woodlands exhibit a greater dominance of juniper than pinyon, with many communities entirely dominated by juniper. Due to a lower xylem pressure, juniper is more drought tolerant than pinyon (BLM 2010e). The denser woodlands are found mainly at the intermediate elevations (4,900 to 8,000 feet) where precipitation averages 12 to 14 inches per year. As pinyon-juniper stands age, understory is drastically reduced. At extremes, older stands can be devoid of perennial grasses, containing only sparse forbs. Moss mats are also commonly found around the trunks of juniper within the drip lines of trees. While it has been thought that the allelopathic properties[1] of the Utah juniper were to blame for the lack of understory, research has not supported this theory. In studies done by Horman and Anderson (1998), Utah Juniper leachate was applied to seeds, and germination rates were found to be positively linked to the application instead of suppressed as would be expected of allelopathic effects. Understory amounts are more likely influenced by canopy cover, with older woodlands having a greater canopy and a sparser understory.

[1] Allelopathy is a characteristic of some plants, algae, bacteria, coral, and fungi by which they produce certain biochemicals that influence the growth and development of other organisms.

Cheatgrass invasion following fire is an increasing problem in the pinyon-juniper woodlands. Across the west, pinyon stands have been decimated by the Pinyon ips beetle. Mild winters, plentiful stands of drought-stressed pinyon, and large numbers of ips beetle have teamed together to create the optimal conditions for beetle infestations. Ips beetle-related mortality can be found in Bangs Canyon and Glade Park. The GJFO planning area has not experienced the same level of mortality that southern Colorado and other areas of the Southwest have, where entire stands have been lost. No estimates are available for the number of acres affected by ips beetle within the GJFO planning area.

Old-growth pinyon-juniper woodland has been identified within the GJFO planning area. Old-growth forests and woodlands encompass the later stages of stand development that typically differ from earlier stages in a variety of characteristics, such as tree size, accumulations of large dead woody material, number of canopy layers, species composition, and ecosystem function. Old-growth pinyon-juniper woodlands are composed not only of pinyon pine and juniper species, but also may include bristlecone pine *(Pinus longaeva)* and limber pine *(P. flexilis)*. Typically, these woodlands are structurally more complex than younger woodlands, adding biological diversity at the community and landscape levels, and providing habitat for many species (US Forest Service 1999). Structural attributes used to identify old-growth pinyon-juniper stands are provided in **Table 3-10**, Minimum Structural Attributes to Identify Old-Growth Pinyon-Juniper Stands.

Table 3-10
Minimum Structural Attributes to Identify Old-Growth Pinyon-Juniper Stands

Attribute	Description
Live Trees	
Trees per acre	30
Diameter at root collar	12 inches, with variation in diameter
Age	200 years
Decadence present	Yes, dead, broken, or deformed tops and/or bole or root rot
Number of tree canopies	Single story
Other	Upper canopy trees are slow growing Variation in tree diameter Basal area of 23 square feet/acre
Dead Trees	
Standing	
Number per acre	1
Diameter at root collar	10 inches
Down	
Pieces	2 per acre (10-foot-long segments)
Diameter	10 inches
Canopy Closure	
Total canopy cover	35 percent

Source: US Forest Service 1999

Douglas-fir and Mixed Conifer. Douglas-fir *(Pseudotsuga menziesii)* stands are generally found on northern and eastern aspects of the Book Cliffs and the Roan Plateau. There are very few grasses or forbs in the understory. This forest type represents approximately three percent of the GJFO planning area.

Aspen. The aspen forest type accounts for 7,800 acres, equaling less than 1 percent of the GJFO planning area (BLM 2010a). Aspen is typically relegated to areas above 8,000 feet on northern and eastern slopes. Within the GJFO planning area, aspen can be found on Douglas Pass, Mud Springs, and the Uncompahgre Plateau. Understories are highly variable. Across Colorado, aspen stands have been in a state of decline. Recent research has indicated that aspen stands are drought stressed, making them more susceptible to disease and insect infestation.

Ponderosa Pine. Ponderosa pine *(Pinus ponderosa)* occurs on the higher mesas and mountains of the planning area at about 8,000 feet, including the Uncompahgre Plateau, Douglas Pass, and other scattered areas. Ponderosa pine represent less than one percent of the planning area (BLM 2010a). Ponderosa pine stands tend to be small, with a mountain shrub understory. While Ponderosa pine is a fire adapted species, records indicate infrequent fires in the northern portion of the Uncompahgre Plateau.

Riparian Areas and Wetlands

Riparian areas are ecosystems that occur along rivers, streams, or waterbodies (NRCS 2007). These areas exhibit vegetation or physical characteristics reflective of permanent surface or subsurface water influence. Typical riparian areas are lands along, adjacent to, or contiguous with perennially and intermittently flowing rivers, streams, glacial potholes, and shores of lakes and reservoirs with stable water levels. Excluded are such sites as ephemeral streams or washes that do not exhibit vegetation dependent on free water in the soil (BLM 2006a). Wetlands are areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support and which, under normal circumstances, do support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include marshes, shallows, swamps, lakeshores, bogs, muskegs, wet meadows, estuaries, and riparian areas (BLM 2006a). Even though riparian and wetlands areas occupy only a small percentage of GJFO planning area land (less than one percent), these areas provide a wide range of functions critical to many different wildlife species, improve water quality, provide scenery, and provide recreational opportunities. A variety of physiognomic groups (Carsey et al. 2003) of riparian zones and wetlands occur within the GJFO, including evergreen riparian forests and woodlands, mixed coniferous and deciduous forests and woodlands, deciduous-dominated forests and woodlands, tall willow shrublands, short willow shrublands, non-willow shrublands, and herbaceous vegetation. These groups can be further divided into a variety of plant community types; however,

insufficient data exist to provide a comprehensive listing of plant association types in the GJFO planning area.

Information on the condition of riparian areas and wetlands is available from PFC assessments that have been conducted from 1993 to the present. Many of these assessments have been conducted as part of Land Health Assessments on various landscapes within the GJFO. Based on hydrology, vegetation, and erosion/deposition (soils) attributes and processes (BLM 1998a), the PFC assessments place the riparian area in one of three ratings: PFC, FAR, and NF. A trend is also identified for the FAR ratings, which may be upward, not apparent, or downward. Since the approach of the PFC assessment is to evaluate most of the indicators for land health Standard 2, the resultant functional rating (PFC, FAR, NF) for each riparian area determines whether the standard is being achieved. A PFC rating means most or all of the indicators (within the system's potential) have been met, and therefore Standard 2 has been achieved. A FAR rating with an upward trend generally means that several indicators have not been met but that significant progress is being made toward achieving Standard 2. A FAR rating with a downward or no apparent trend means several indicators have not been met and generally Standard 2 will not have been achieved. Likewise, an NF rating means that critical indicators have not been met and Standard 2 has not been achieved.

For lotic systems (riparian-wetland areas adjacent to flowing water such as rivers, streams, and springs), a riparian-wetland area is considered to be in PFC when adequate vegetation or landform (or large woody debris in Pacific Northwest systems) is present to accomplish the following:

- Dissipate stream energy associated with high water flow, thereby reducing erosion and improving water quality;
- Filter sediment, capture bed load, and aid floodplain development;
- Improve floodwater retention and groundwater recharge;
- Develop root masses that stabilize streambanks against cutting action;
- Restrict water percolation;
- Develop diverse ponding and channel characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterfowl breeding, and other uses; and
- Support greater biodiversity (BLM 1998a).

For lentic systems (riparian-wetlands areas with standing water, such as lakes, ponds, seeps, bogs, and meadows), riparian-wetland areas are functioning properly when adequate vegetation, landform, or debris is present to accomplish the following:

- Dissipate energies associated with wind action, wave action, and overland flow from adjacent sites, thereby reducing erosion and improving water quality;
- Filter sediment and aid floodplain development;
- Improve floodwater retention and groundwater recharge;
- Develop root masses that stabilize islands and shoreline features against cutting action;
- Restrict water percolation;
- Develop diverse ponding characteristics to provide the habitat and the water depth, duration, and temperature necessary for fish production, waterbird breeding, and other uses; and
- Support greater biodiversity (BLM 1998a).

Each riparian-wetland area has to be judged against its capability and potential (BLM 1998a).

Table 3-11, GJFO Lotic Proper Functioning Condition Assessment (miles), shows the most current results of PFC assessments on lotic systems within the GJFO. The measurement used for riparian areas is in miles. Areas determined to be non-riparian systems are not shown on the table. As displayed in the table, 76 percent of the total miles inventoried are meeting PFC. The causal factors for FAR and NF are shown on **Table 3-12**, Causal Factors for Functioning at Risk and Not Functioning Ratings. The lotic tables show only those riparian-wetland areas that have had a PFC assessment. The lotic table represents most riparian areas that occur along streams and rivers within the GJFO. PFC has been assessed on a few riparian areas at springs and seeps, but these data are incomplete and therefore not included.

Table 3-11
GJFO Lotic Proper Functioning Condition Assessment (miles)

Riparian Area Name	Year Assessed	Total Miles Inventoried	PFC	FAR	NF
Bangs Canyon	2003	1.77	1.77		
Barrel Spring Creek	1993/2006	3.76	3.76		
Barrel Spring Creek Left Fork	1993/2006	2.76	2.76		
Barrel Spring Creek Right Fork	1993	3.15	3.15		
	2006	4.26	4.26		
Beiser Creek	1993	1.90	1.90		
Big Salt Wash	1993	16.42	6.45	9.97	
	2006	7.53	7.53		
Blue Branch	1993	0.89	0.89		
Blue Creek	1993	10.41	10.41		
	2010	10.25	9.29	0.85	0.11
Blue Creek Tributary	2010	0.63	0.63		

Table 3-11
GJFO Lotic Proper Functioning Condition Assessment (miles)

Riparian Area Name	Year Assessed	Total Miles Inventoried	PFC	FAR	NF
Brandon Ditch	1993	2.28	2.28		
Briar Creek	1993	1.83	1.83		
Brush Creek	1993	0.44		0.44	
	2004	0.44	0.44		
Bull Creek	1993/2005	0.26	0.26		
Burro Creek	2010	0.20	0.20		
Calamity Creek	1993	7.97	7.97		
Calf Canyon Creek	1993	3.41		3.41	
	2006	3.41	3.41		
Carr Creek	1993	4.37	0.70	3.67	
	2004	3.41	3.41		
Carr Creek Left Fork	2004	3.23	3.23		
Clear Creek	1993	0.23		0.23	
	2004	0.50	0.50		
Coal Gulch Creek	1993	9.49		9.49	
Coal Gulch Creek Branch	1993	4.18		4.18	
Collier Creek	1993/2005	0.95	0.95		
Colorado River	1993	9.54	9.54		
	2004	8.76	8.76		
Conn Creek	1993	0.72	0.48		0.24
	2004	0.68	0.68		
Corral Canyon Creek	1993	4.64	4.64		
	2006	2.79	2.79		
Cottonwood Creek	1993	4.58	4.58		
	2005	4.96	4.96		
Cottonwood Creek (Collbran)	1993	0.07	0.07		
Cougar Creek	2010	1.99	1.99		
Cougar Creek Tributary	2010	0.08	0.08		
Dark Canyon	1993	1.62	1.62		
	2010	1.80	1.80		
Deer Creek	1993	4.90	1.08	3.82	
	2010	4.74	0.11	0.10	4.53
Dolores River	1993	18.65	14.66	3.99	
	2010	9.46	8.35	1.11	
Dry Fork	1993	1.27		1.27	
	2004	1.26	0.93	0.33	
Dry Fork Creek - Middle Fork	1993	0.91	0.91		
Dry Fork Creek - North Fork	1993	2.99	0.73	2.00	0.26
	2004	0.49	0.49		
Dry Fork Creek - South Fork	1993	1.66		1.66	
East Creek	1993	8.69	8.69		
	2003	7.48	7.48		
East Creek - North Fork	1993	7.33	7.33		
East Hawxhurst Creek	1993	1.21	1.21		

Table 3-11
GJFO Lotic Proper Functioning Condition Assessment (miles)

Riparian Area Name	Year Assessed	Total Miles Inventoried	PFC	FAR	NF
East Salt Creek (Collbran)	2005	0.34	0.34		
East Salt Creek	1993	21.80	6.90	14.90	
	2006	11.40	10.41	0.99	
Edd Canyon Creek	1993/2006	1.29	1.29		
Fish Creek	2002	1.28	1.28		
Gill Creek	1993	0.29	0.29		
Granite Creek	1993	5.51	5.51		
	2010	5.70	5.70		
Gunnison River	1993	3.97	3.97		
Hawxhurst Creek East Branch	2005	1.23	1.23		
Hawxhurst Creek West Branch	2005	1.60	1.60		
Hay Canyon Creek	1993	2.61	0.10	2.51	
	2006	2.61	2.61		
Hells Hole Tributary	2006	0.58	0.58		
Hill Creek	1993	3.24	3.24		
John Brown	1993	6.32	6.32		
Kannah Creek	1993/2005	0.21	0.21		
Kannah Creek - North Fork	1993	1.49	1.49		
	2003	1.49	1.49		
Kimball Creek	1993	4.07		4.07	
Kimball Creek Tributary	2005	0.47	0.47		
King Gulch	1993/2005	1.41	1.41		
Kings Canyon Creek	1993	5.51	5.51		
Ladder Creek	1993	1.72	1.72		
Lane Gulch Creek	1993	3.04	3.04		
Leon Creek	1993/2005	0.27	0.27		
Little Dolores River	1993	6.49	3.78	2.71	
Little Salt Wash	1993	5.28	5.28		
Little Salt Wash - Middle Fork	1993	4.21	4.21		
Lobe Creek - North Fork	1993/2002	1.48	1.48		
Lost Horse	2010	0.62	0.62		
Main Canyon	1993	7.77	7.77		
Maverick Canyon	1993	11.23	11.23		
	2010	0.64	0.64		
Mesa Creek - North Fork	1993	1.81	1.81		
Mckenzie Canyon Creek	1993	2.51	2.51		
Mule Creek	2010	0.52	0.52		
Oak Creek	1993	0.39	0.39		
Payne Canyon	1993	0.88		0.88	
Pine Gulch Creek	1993	4.64	4.64		
Plateau Creek	1993	2.99	2.99		
	2005	4.43	4.43		
Prairie Canyon Creek	1993	13.63	13.63		
	2005	6.13	6.13		

Table 3-11
GJFO Lotic Proper Functioning Condition Assessment (miles)

Riparian Area Name	Year Assessed	Total Miles Inventoried	PFC	FAR	NF
Rapid Creek	1993/2005	2.60	2.60		
Rapid Creek Tributary	1993/2005	1.29	1.29		
Roan Creek	1993	8.22	5.72	2.17	0.33
	2004	7.09	5.48	1.06	0.55
Rough Canyon	1993	9.80	9.80		
	2003	9.71	9.71		
Salt Creek	1993	5.16		5.16	
Salt Creek - Middle Fork	1993	0.72	0.72		
Salt Creek - North Fork	1993	4.01		4.01	
Smalley Gulch	1993	0.80	0.80		
Snyder Creek	1993	1.55	1.55		
Spring Creek	1993/2005	1.63	1.63		
Trail Canyon Creek	1993	6.90		6.90	
	2006	7.29	7.29		
Turner Gulch Creek	1993	1.99	1.99		
Ute Creek	1993/2002	4.15	4.15		
West Creek	1993/2002	4.70	4.70		
West Creek East Branch	2002	2.25	2.25		
West Creek Branch	2002	0.85	0.85		
West Creek - North Fork	1993/2002	3.24	3.24		
West Hawxhurst	1993/2005	1.60	1.60		
West Salt Creek	1993	21.70		21.70	
	2006	7.33	5.77	1.56	
West Salt Creek - East Branch	2002	0.62	0.62		
West Salt Creek - West Branch	1993	2.36	0.15	2.21	
	2006	2.36	2.36		
Whitewater Creek	1993	3.20	3.20		
	2006	4.63	4.63		
Willow Creek - East Fork	2008	0.32			0.32
Total		*516.77*	*393.08*	*117.35*	*6.34*

Source: BLM 2010f

Table 3-12
Causal Factors for Functioning at Risk and Not Functioning Ratings

Riparian Area Name	Causal Factor
Dry Fork	Insufficient woody vegetation resulting from heavy livestock use.
East Creek	Insufficient bank vegetation and streambed disturbance related to recreational use along the banks and OHV use.
East Salt Creek	Insufficient stream bank vegetation resulting from livestock grazing over season-long use.
Gibbler Gulch Creek	Insufficient stream bank vegetation resulting from OHV and livestock use.
Roan Creek	Insufficient stream bank vegetation resulting from heavy livestock use. Road encroachment and crossings are keeping banks unstable. Current beaver ponds are unstable because of the lack of large-diameter materials.
West Branch of West Salt Creek	Insufficient stream bank vegetation resulting from diversions of flow, landslides into the stream, saline seeps inhibiting vegetation growth and establishment, and livestock use along the stream bank.
West Salt Creek	Insufficient stream bank vegetation resulting from grazing use along the stream and a pipeline and road crossing that are creating bank instability.

Stream reaches determined to be not functioning or functioning-at-risk are managed by BLM to meet or exceed Standard 2. If livestock are determined to be a causal factor for not meeting Standard 2, the BLM must implement management changes to improve the stream reach within one year. When other factors such as recreational use or wildlife are compromising PFC, more collaborative approaches must be used. Management of vegetation resources, including riparian and wetland areas, is designed to enhance and maintain sustainable ecological condition within plant communities.

Most management practices for riparian areas and wetlands have been focused on improving grazing management and mitigating impacts from industry development. Methods used include reducing grazing use to the carrying capacity of the area; completing new and modifying existing grazing management systems to provide rest or deferment of upland and riparian areas to improve forage composition and productivity; improving distribution by encouraging herding and development of off-riparian area water sources and upland salting; and improving springs and seeps by modifying current spring projects to enhance riparian function and water quality. Riparian exclosures and pastures have been used to control grazing in specific areas, but these treatments are expensive to construct and to maintain. Development by industry is mitigated through avoidance of riparian areas. Where avoidance is not practical, site-specific conditions of approval and best management practices are developed specifically to mitigate impacts to riparian impacts.

Significant Plant Communities

Significant plant communities are those that are globally rare, rare within the state, or ancient, exemplary, in that they have not been substantially altered by human activity. The first category includes vegetation communities in which the individual species may not be rare but the unique assemblage is rare or uncommon. The second category of significant plant communities involves plant community types that are significant not because of their rarity, but because they represent relatively pristine plant communities with few nonnative species.

Significant plant communities on BLM lands are important for many of the same reasons that special status plants are important. Urbanization, agriculture, and other human activities have greatly modified many of the natural plant communities on private lands. BLM lands are therefore critical to maintaining the diversity of natural plant communities and biological diversity (BLM 1992c). Significant plant communities constitute relict areas and may serve as comparison areas to assess public land health and analyze the impacts of human activities. These areas may also prove to be important to future studies and research.

In the GJFO planning area, 50 occurrences of 28 significant plant communities have been identified (see **Table 3-13**, Significant Plant Communities). The list is neither complete nor conclusive as changes are expected over the life time of the RMP, and new significant plant communities are expected to be located and recorded over time.

Table 3-13
Significant Plant Communities

Scientific Name	Common Name	Global Rank	State Rank	Location	Number of Sites
Achnetherum hymenoides Shale Barren Herbaceous Vegetation	Western Slope Grasslands	G2	S2	Northeast of 6&50 Reservoir, near old rail road grade	1
Aquilegia micrantha / *Mimulus eastwoodiae* Herbaceous Vegetation	Hanging Gardens	G2G3	S2S3	Hwy 141, base of Sewemup Mesa, near Montrose County line. Partially within the Sewemup Mesa WSA and the proposed Dolores River Riparian ACEC.	1
Arctostaphylos patula / *Ceanothus velutinus* / *Ceanothus prostratus* Shrubland	Montane Shrublands	G3	S2	Glade Park, North of Pinyon Mesa, Briar Canyon	1
Atriplex confertifolia / *Achnatherum hymenoides* Shrubland	Cold Desert Shrublands	G3	S2	Near 2 Rd, in desert bottom	1

Table 3-13
Significant Plant Communities

Scientific Name	Common Name	Global Rank	State Rank	Location	Number of Sites
Atriplex confertifolia / *Pleuraphis jamesii* Shrubland	Cold Desert Shrublands	G3G5	S2	Delta County line, east of Hwy 50	1
Atriplex corrugata Dwarf-shrubland	Alkali Mat Saltbush Shrublands	G5	S2?	South of Badger Wash along 4 Rd, east of Highline State Park	3
Atriplex gardneri / *Leymus salinus* Dwarf-shrubland	Gardner's Mat Saltbush Shrublands	G2?	S2?	Along Hwy 6&50, 2 Rd, Hwy 139, southern portion of Badger Wash ACEC (approximately ½ of the known location are within the Badger Wash ACEC)	8
Atriplex gardneri / *Pleuraphis jamesii* Dwarf-shrublands	Gardner's Mat Saltbush Shrublands	G3G5	S1?	East of Highline State Park, Hwy 6&50, 25 Rd	3
Betula occidentalis / *Cornus sericea* Shrubland	Lower Montane Riparian Shrublands	G3	S1S2	Glade Park: Ryan Park, McKenzie Canyon, Middle Canyon (of the 3 known locations, only 1 is fully on BLM, Ryan Park)	3
Betula occidentalis / *Maianthemum stellatum* Shrubland	Foothills Riparian Shrubland	G4?	S2	Briar Canyon, Calf Canyon (on private and BLM land)	2
Eleocharis rostellata Herbaceous Vegetation	Emergent Wetland	G3	S2	Unaweep Seep ACEC, Calf Canyon, and the proposed Dolores River Riparian ACEC	3
Forestiera pubescens Shrubland	Foothills Riparian Shrubland	G1G2	S1	Palisade ACEC & the proposed Dolores River Riparian ACEC (all known locations fall within the 2 ACECs)	5
Fraxinus anomala Woodland	West Slope Riparian Woodland	GUQ	S1	Hunter Canyon	1
Hesperostipa comata Great Basin Herbaceous Vegetation	Western Slope Grasslands	G2G4	S2	North of NCA boundary along old 6&50 Hwy	1
Juniperus scopulorum / *Cornus sericea* Woodland	Riparian Woodland	G4	S2	Glade Park, north of Payne Mesa, above the Little Dolores	1
Picea pungens / *Cornus sericea* Woodland	Montane Riparian Forest	G4	S2	McKenzie Canyon (North Pinyon Mesa)	1

Table 3-13
Significant Plant Communities

Scientific Name	Common Name	Global Rank	State Rank	Location	Number of Sites
Pinus edulis / Juniperus monosperma / Juniperus osteosperma / Hesperostipa comata Woodland	Xeric Western Slope Pinyon-Juniper Woodland	G2?	S2	Unaweep Canyon, within the Sewemup Mesa WSA	1
Pinus edulis / Juniperus osteoperma / Colegyne ramosissima Woodland	West Slope Pinyon Woodland	G3	S2	Rough Canyon ACEC, Gateway near Lumsden Canyon	2
Pleuraphis jamesii Herbaceous Vegetation	Western Slope Grasslands	G2G4	S1	Coon Hollow, within the proposed South Shale Ridge ACEC	1
Populus balsamifera Woodland	Montane Riparian Woodland	GU	S2	Corral Canyon, near Long Canyon	1
Populus deltoides (ssp. *wislizeni* and ssp. *monilifera*) / *Salix exigua* Woodland	Fremonts Cottonwood Riparian Forests	G3	S1S2	Little Dolores River, on private and BLM	1
Pseudotsuga menziesii/ Acer glabrum Forest	Lower Montane Forests	G4?	S1	West of Douglas Pass	2
Rhus trilobata Rocky Mountain Shrub Herbaceous Vegetation	Skunkbrush Riparian Shrubland	G2	S2	Coal Gulch	1
Sarcobatus vermiculatus / Distichlis spicata Shrubland	Saline Bottomland Shrublands	G4	S2	Whitewater, Radio Towers area along Hwy 50	1
Sarcobatus vermiculatus / Sueda moquinii Shrubland	Saline Bottomland Shrublands	GUQ	S2S3	Badger Wash ACEC	1
Schoenoplectus acutus/ Typha latifolia/ Schoenoplectus tabernaemontani Herbaceous Vegetation	Great Plains Marsh	G4	S2S3	Unaweep Seep ACEC	1
Schoenoplectus maritimus Herbaceous Vegetation	Emergent Wetland (Marsh)	G4	S2	Sewemup Mesa WSA	1

Table 3-13
Significant Plant Communities

Scientific Name	Common Name	Global Rank	State Rank	Location	Number of Sites
Sullivantia hapemanii / Aquilegia barnebyi Herbaceous Vegetation	Sullivantia Hanging Gardens	G2	S2	Henderson Ridge	1

Source: CNHP 2011

Invasive Species/Noxious Weeds

BLM policy requires the application of Integrated Pest Management (IPM) methods. The GJFO's treatment of noxious weeds is guided by the BLM's Final Programmatic Environmental Impact Statement on Vegetation Treatment and Fuels Reduction (BLM 2007), the Environmental Assessment for Integrated Weed Management for the Grand Junction Field Office (BLM 2004c), and the Colorado Noxious Weed Act (Colorado Weed Management Association 2009a).

In 2004, Colorado amended the Noxious Weed Act to list species in three categories: A, B, and C (Colorado Weed Management Association 2009b). List A weeds are rare to the state and are subject to eradication wherever detected statewide in order to protect neighboring lands and the state as a whole. List B weeds have discreet statewide distributions that are subject to eradication, containment, or suppression in portions of the state designated by the commissioner in order to stop the spread of these species. List C noxious weeds are already widespread and well established for which control is recommended, but not required, by the state, although local governing bodies may require management. The GJFO planning area has species from all categories. **Table 3-14**, Colorado Noxious Weed Species, and **Figure 3-8**, Noxious Weeds: All Species Surveyed Since 2000, describes the species of weeds within each category.

Table 3-14
Colorado Noxious Weed Species

List A species are species that are designated by the Commissioner[1] for eradication.	
African rue *(Peganum harmala)*	Medusahead *(Taeniatherum caput-medusae)*
Camelthorn *(Alhagi pseudalhagi)*	Myrtle spurge *(Euphorbia myrsinites)*
Common crupina *(Crupina vulgaris)*	Orange hawkweed *(Hieracium aurantiacum)*
Cypress spurge *(Euphorbia cyparissias)*	Purple loosestrife *(Lythrum salicaria)*
Dyer's woad (*Isatis tinctoria)*	Rush skeletonweed *(Chondrilla juncea)*
Giant salvinia *(Salvinia molesta)*	Sericea lespedeza *(Lespedeza cuneata)*
Hydrilla *(Hydrilla verticillata)*	Squarrose knapweed *(Centaurea virgata)*
Meadow knapweed *(Centaurea pratensis)*	Tansy ragwort *(Senecio jacobaea)*
Mediterranean sage *(Salvia aethiopis)*	Yellow starthistle *(Centaurea solstitialis)*

Table 3-14
Colorado Noxious Weed Species

List B weed species are species for which the Commissioner[1] (in consultation with the state noxious weed advisory committee, local governments, and other interested parties) develops and implements state noxious weed management plans designed to stop the continued spread of these species.	
Absinth wormwood *(Artemisia absinthium)*	Moth mullein *(Verbascum blattaria)*
Black henbane *(Hyoscyamus niger)*	Musk thistle *(Carduus nutans)*
Bouncingbet *(Saponaria officinalis)*	Oxeye daisy *(Chrysanthemum leucanthemum)*
Bull thistle *(Cirsium vulgare)*	Perennial pepperweed *(Lepidium latifolium)*
Canada thistle *(Cirsium arvense)*	Plumeless thistle *(Carduus acanthoides)*
Chinese clematis *(Clematis orientalis)*	Quackgrass *(Elytrigia repens)*
Common tansy *(Tanacetum vulgare)*	Redstem filaree *(Erodium cicutarium)*
Common teasel *(Dipsacus fullonum)*	Russian knapweed *(Acroptilon repens)*
Corn chamomile *(Anthemis arvensis)*	Russian-olive *(Elaeagnus angustifolia)*
Cutleaf teasel *(Dipsacus laciniatus)*	Scentless chamomile *(Matricaria perforata)*
Dalmatian toadflax, broad-leaved *(Linaria dalmatica)*	Scotch thistle *(Onopordum acanthium)*
Dalmatian toadflax, narrow-leaved *(Linaria genistifolia)*	Spotted knapweed *(Centaurea maculosa)*
Dame's rocket *(Hesperis matronalis)*	Spurred anoda *(Anoda cristata)*
Diffuse knapweed *(Centaurea diffusa)*	Sulfur cinquefoil *(Potentilla recta)*
Eurasian watermilfoil *(Myriophyllum spicatum)*	Venice mallow *(Hibiscus trionum)*
Hoary cress *(Cardaria draba)*	Wild caraway *(Carum carvi)*
Houndstongue *(Cynoglossum officinale)*	Yellow nutsedge *(Cyperus esculentus)*
Jointed goatgrass *(Aegilops cylindrical)*	Yellow toadflax *(Linaria vulgaris)*
Leafy spurge *(Euphorbia esula)*	Saltcedar *(Tamarix chinensis*, *T. parviflora*, and
Mayweed chamomile *(Anthemis cotula)*	*T. ramosissima)*
List C weed species are species for which the Commissioner[1] (in consultation with the state noxious weed advisory committee, local governments, and other interested parties) will develop and implement state noxious weed management plans designed to support the efforts of local governing bodies to facilitate more effective integrated weed management on private and public lands. The goal of such plans will not be to stop the continued spread of these species but to provide additional education, research, and biological control resources to jurisdictions that choose to require management of List C species.	
Chicory *(Cichorium intybus)*	Johnsongrass *(Sorghum halepensei)*
Common burdock *(Arctium minus)*	Perennial sowthistle *(Sonchus arvensis)*
Common mullein *(Verbascum thapsus)*	Poison hemlock *(Conium maculatum)*
Common St. Johnswort *(Hypericum perforatum)*	Puncturevine *(Tribulus terrestris)*
Downy brome *(Bromus tectorum)*	Velvetleaf *(Abutilon theophrasti)*
Field bindweed *(Convolvulus arvensis)*	Wild proso millet *(Panicum miliaceum)*
Halogeton *(Halogeton glomeratus)*	

Source: Colorado Weed Management Association 2009a
[1]Colorado Department of Agriculture Commissioner

The GJFO strictly adheres to state direction for the management of List A weeds; however, some of the state's List B weeds are actually GJFO List A weeds. For example, spotted knapweed *(Centaurea maculosa)* is rare in the GJFO, and the BLM considers this one of its highest priorities. Repeat surveys are a vital part of a weed program, and the GJFO is planning to continue that process.

Current Status of Key Species

In 2000, the GJFO began a comprehensive inventory for noxious weeds within its jurisdiction. At the end of the 2004 field season this process was nearly completed, with the exception of the Gunnison and Dolores River floodplains. BLM weed staff conducted the surveys with the help of a contract horseback survey of the eastern half of Black Ridge Wilderness. Crews prepared GIS field maps ahead of time on aerial photos and searched all known disturbed sites and most perennial riparian areas. The results of the survey revealed about 20 species of noxious weeds (see **Figure 3-8**) in approximately 8,000 locations scattered throughout the field office and the Dominguez-Escalante and McInnis Canyons NCAs. The survey did not include cheatgrass, annual wheatgrass, Russian thistle, or other nuisance annuals. With the exception of the river floodplains, the planning area contains numerous small infestations of many species. GJFO lands are ideal for the implementation of Early Detection Rapid Response (USDA 2009), a key strategy for successful weed management.

As of 2008, BLM crews and cooperators have treated nearly 15,000 sites with noxious weeds. This figure is higher than the original survey results (+/- 8,000) because crews always find more weeds when they begin to thoroughly treat an area. The program includes large-scale spot treatments or small-scale broadcast treatments. There is very little collateral damage to non-target vegetation, since the majority of treatments are with a hand gun.

Weed infestations can be considered a slow-moving biological wildfire, and the strategy and tactics for treating them are exactly the same as fire suppression. Work begins on the perimeter and moves toward the center. For widespread weeds such as hoary cress (whitetop) in the Book Cliffs, the center of the "fire" is Highway 139 and Trail Canyon. The BLM has spent years treating adjacent canyons as the perimeter, slowly moving toward Hwy 139. Rapid and Cottonwood Creeks above Palisade are treated as a "spot fire," and aggressive action is in place to completely contain that area. Houndstongue is abundant in the higher elevations of the Book Cliffs, but very rare on the Uncompahgre Plateau and Glade Park. Those areas are treated as "spot fires" with aggressive action. In the rest of the Book Cliffs, the BLM treats the southern edge and around certain improvements.

Russian knapweed is scattered throughout the field office, with the river corridors as the centers. The BLM plans to treat every infestation in the uplands, and move toward the rivers, where the infestation is worst.

Weeds that are rare in the GJFO planning area receive a majority of the BLM's treatment work. Rare species include spotted and diffuse knapweed, purple loosestrife, yellow starthistle, black henbane, dalmatian toadflax, and perennial pepperweed. Other species treated frequently include saltcedar (tamarisk), bull thistle, and houndstongue.

Trends

Trends in the percentage of desirable species present in the GJFO planning area rangeland communities are mixed, with many areas having a relatively constant amount of desirable species, some areas with increases in desirable species, and other areas with decreases in desirable species and increases in undesirable species. Within the GJFO planning area, especially in the last ten years, there has been an increase in noxious and invasive weeds, including cheatgrass, saltcedar (*tamarisk*), halogeton, Russian thistle, and Canada thistle. These problems are most evident in the desert grazing allotments, oil and gas production fields, and other locations where native vegetation has been disturbed.

Trends in rangeland health are managed by adjusting livestock numbers and wild horse use, by implementing vegetation treatments and weed control techniques, and by various other measures used to control public land use. These actions manipulate plant composition with the goal of maintaining desirable plant species and communities that, on average, represent mid to upper seral stages of development.

The condition or health of forest stands varies by location. In the forest types, predominately Douglas-fir, the stands are past mature and the incidence of mortality is increasing as a result of mistletoe and bark beetles. In pinyon-juniper woodlands, there have been several large-scale stand-replacing fires over the past twenty years. Conifers are encroaching on aspen stands, limiting aspen regeneration. The disease known as bleeding rust is currently killing the older mature aspen clones.

Riparian and wetland condition in many areas of the Grand Junction planning area has been improved through adjustment and implementation of grazing systems. Monitoring data such as utilization, photo-points, and general observations, along with Land Health Assessments, indicate that riparian and wetland conditions in many areas are improving, and progress is being made in meeting land health standards. However, in some riparian-wetland areas, some issues remain.

Because plant communities respond to other environmental influences such as wildlife and livestock foraging, drought, disease, wildfire, and prescribed burns, it is difficult to forecast their health. Where the BLM has primary authority to manage livestock grazing, and grazing is the primary activity potentially diminishing vegetation health, the BLM will continue to act to restore the health of plant communities by managing for desired plant communities and/or adjusting the number and seasonal distribution of AUMs. Where other agencies or private landowners share or have primary authority over factors causing the decline of vegetation health, collaborative efforts will be pursued; however, the situation does become more complex. At best, resolution of landscape health issues is likely to progress slowly over the planning period.

3.2.7 Fish and Wildlife

This section describes the existing conditions of fish and wildlife resources within the GJFO planning area, including aquatic and terrestrial animal species and their habitats. Although the CPW and USFWS are directly responsible for the management of fish and wildlife species, the BLM is responsible for land management. Therefore, on BLM-administered lands in the decision area, the BLM is directly responsible for the management of habitat for fish and wildlife species and indirectly responsible for the health of fish and wildlife populations that are supported by these habitats. In addition, BLM is mandated by the Endangered Species Act of 1973 (ESA) and the BLM Land Use Planning Handbook (BLM 2005a) to ensure that special status species are protected. This mandate is reinforced through a Memorandum of Agreement with USFWS, US Forest Service, and National Marine Fisheries Service (BLM et. al 2000).

The fish and wildlife habitats that occur in the decision area are primarily characterized in the soil, water, and vegetation existing conditions discussions in **Sections 3.2.4**, **3.2.5**, and **3.2.6**, respectively. The discussions of aquatic and terrestrial habitat in this section identify attributes of these resources that are particularly important to their role in providing fish and wildlife habitat. **Table 3-15** displays Fish and Wildlife Species of Primary Interest in BLM's Environmental Planning; special status species are described in **Section 3.2.8**, Special Status Species, and also listed in **Table 3-16**, BLM Sensitive Plant Species.

Current Conditions

Within the planning area, the GJFO directly manages nearly 1.1 million acres of fish and wildlife habitat. The presence and interspersion of many habitat types support a large number of wildlife species. The discussion of fish and wildlife populations and habitat addresses the entire GJFO planning area, not just the lands managed by BLM (decision area), because fish and wildlife are mobile and may readily cross these boundaries. Elk *(Cervus canadensis)*, mule deer, pronghorn antelope (*Antilocapra americana*), bighorn sheep *(Ovis canadensis canadensis, Ovis canadensis nelsoni, and Ovis canadensis mexicana)*, mountain lion *(Felis concolor)*, raptors, and many nongame species, including migratory birds, are among the species that use habitat in the GJFO planning area. The diversity and populations of fish and wildlife throughout the planning area provide considerable recreational opportunity and economic benefit. A minimum of 84 species of mammals, 215 species of birds, 30 species of amphibians and reptiles, and 30 species of fish occur in the planning area. Most of the discussion that follows is based on BLM GIS data, CPW GIS data, BLM Land Health Assessments, and relevant agency literature review. A more thorough discussion of these species, their habitats, and recommended management actions can be found in Colorado's Comprehensive Wildlife Conservation Strategy (CPW 2006).

A group of species that are of primary interest to the BLM for environmental planning within the planning area are presented in **Table 3-15**, Fish and Wildlife Species of Primary Interest in BLM's Environmental Planning. These species are of management concern to one or more agencies, such as BLM, CPW, and USFWS because they are game species, rare, or keystone species. Therefore, they require consideration in management activities and may affect land management decisions. A keystone species is one whose presence and role within an ecosystem has a disproportionate effect on other organisms within the system.

Table 3-15
Fish and Wildlife Species of Primary Interest in BLM's Environmental Planning

	Rationale for Inclusion in Primary Interest Species										
					Special Status Species						
Species	Recreational Value	Economic Value	High Public Interest[7]	CO Partners in Flight Priority	Species of Concern (State)	Threatened (State)	Endangered (State)	Sensitive (BLM)	Candidate (Federal)	Threatened (Federal)	Endangered (Federal)
Fish											
Bluehead sucker *(Catostomus discobolus)*								X			
Bonytail *(Gila elegans)*			X				X				X
Colorado pikeminnow *(Ptychocheilus lucius)*			X			X					X
Cutthroat trout *(Oncorhynchus clarkii)*	X	X	X		X	X		X		X	
Flannelmouth sucker *(Catostomus latipinnis)*								X			
Humpback chub *(Gila cypha)*			X			X					X
Razorback sucker *(Xyrauchen texanus)*			X				X				X
Roundtail chub *(Gila robusta)*					X			X			
Cold water gamefish (brook, brown, rainbow trout)	X	X	X								
Warm water gamefish (bass, sunfish, pike, catfish)	X	X	X								
Amphibians											
Boreal toad *(Bufo boreas boreas)*							X		X		
Canyon treefrog *(Hyla arenicolor)*								X			
Great Basin spadefoot *(Spea intermontana)*								X			
Northern leopard frog *(Rana pipiens)*					X			X			

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Fish and Wildlife Species of Primary Interest in BLM's Environmental Planning

Species	Rationale for Inclusion in Primary Interest Species										
					Special Status Species						
	Recreational Value	Economic Value	High Public Interest[7]	CO Partners in Flight Priority	Species of Concern (State)	Threatened (State)	Endangered (State)	Sensitive (BLM)	Candidate (Federal)	Threatened (Federal)	Endangered (Federal)
Reptiles											
Long-nosed leopard lizard *(Gambelia wislizenii)*					X			X			
Midget faded rattlesnake *(Crotalus oreganus concolor)*					X			X			
Milk snake *(Lampropeltis triangulum taylori)*								X			
Birds											
American peregrine falcon *(Falco peregrinus)*[3,5]			X	X	X			X			
American white pelican *(Pelecanus erythrorhynchos)* [1]								X			
Bald eagle *(Haliaeetus leucocephalus)*[2,3,5]			X			X		X			
Brewer's sparrow *(Spizella breweri)*								X			
Burrowing owl *(Athene cunicularia)*			X	X		X		X			
Cooper's hawk *(Accipiter cooperii)*[5]			X								
Ferruginous hawk *(Buteo regalis)*[5]					X			X			
Golden eagle[2,5] *(Aquila chrysaetos)*			X								
Gray vireo *(Vireo vicinior)*				X							
Greater Sage-Grouse *(Centrocercus urophasianus)*			X	X	X			X	X		
Greater sandhill crane[1] *(Grus canadensis)*			X		X						
Gunnison Sage-Grouse *(Centrocercus minimus)*			X	X	X			X		X	
Lewis' woodpecker *(Melanerpes lewis)*				X							
Long-billed curlew *(Numenius americanus)*					X			X			
Mexican spotted owl *(Strix occidentalis lucida)*[5]			X			X		X		X	
Migratory birds	X	X	X	X	X	X	X	X	X	X	X
Mountain plover *(Charadrius montanus)*					X			X			
Northern goshawk *(Accipiter gentilis)*[5]			X					X			
Raptors					X	X		X		X	

Table 3-15
Fish and Wildlife Species of Primary Interest in BLM's Environmental Planning

Species	Rationale for Inclusion in Primary Interest Species										
					Special Status Species						
	Recreational Value	Economic Value	High Public Interest[7]	CO Partners in Flight Priority	Species of Concern (State)	Threatened (State)	Endangered (State)	Sensitive (BLM)	Candidate (Federal)	Threatened (Federal)	Endangered (Federal)
Scott's Oriole *(Icterus parisorum)*	X		X	X							
Shorebirds					X			X			
Southwestern willow flycatcher *(Empidonax traillii extimus)*			X				X				X
Swainson's hawk *(Buteo swainsoni)*[5]			X								
Turkey *(Meleagris gallopavo)*	X	X	X								
Waterfowl	X	X	X								
Western snowy plover *(Charadrius alexandrinus nivosus)*					X			X			
Western yellow-billed cuckoo *(Coccyzus americanus occidentalis)*					X			X		X	
White-faced ibis *(Plegadis chihi)*								X			
Mammals											
Big free-tailed bat *(Nyctinomops macrotis)*								X			
Desert bighorn sheep *(Ovis canadensis nelsoni and Ovis Canadensis Mexicana)*	X	X	X					X			
Rocky Mountain bighorn sheep *(Ovis canadensis canadensis)*	X	X	X								
Black bear *(Ursus americanus)*	X	X	X								
Canada lynx *(Lynx canadensis)*[5]			X				X			X	
Elk *(Cervus canadensis)*	X	X	X								
Fringed myotis *(Myotis thysanodes)*								X			
Kit fox *(Vulpes macrotis)*							X	X			
Moose *(Alces alces)*	X	X	X								
Mountain lion *(Felis concolor)*[5]	X	X	X								
Mule deer *(Odocoileus hemionus)*	X	X	X								
Pronghorn *(Antilocapra americana)*	X	X	X								
River otter *(Lontra canadensis)*			X			X					
Spotted bat *(Euderma maculatum)*								X			
Townsend's big-eared bat *(Corynorhinus townsendii)*					X			X			

Table 3-15
Fish and Wildlife Species of Primary Interest in BLM's Environmental Planning

Species	Rationale for Inclusion in Primary Interest Species										
					Special Status Species						
	Recreational Value	Economic Value	High Public Interest[7]	CO Partners in Flight Priority	Species of Concern (State)	Threatened (State)	Endangered (State)	Sensitive (BLM)	Candidate (Federal)	Threatened (Federal)	Endangered (Federal)
White-tailed prairie dog *(Cynomys leucurus)*[6]	X		X					X			
Invertebrates											
Great Basin silverspot *(Speyeria nokomis nokomis)*								X			

Source: BLM 2009e; CPW 2007; Colorado Partners in Flight 2000; USFWS 2009a
Notes: [1]Uses concentrated nesting and foraging areas; [2]Bald and Golden Eagle Protection Act; [3]Delisted from federal threatened and endangered species list; [5]Top of food chain species; [6]Keystone species; [7]This category includes all federal threatened and endangered species, all game animals, and other species that are well known to the public; it is not a regulatory category.

Fish and Aquatic Wildlife

Aquatic habitats in the GJFO planning area include both lentic (riparian-wetlands areas with standing water, such as lakes, ponds, seeps, bogs, and meadows) and lotic (riparian wetland areas adjacent to flowing water such as rivers, streams, and springs) resources. While the CPW and USFWS are directly responsible for managing fish and amphibian species, the BLM is directly responsible for aquatic habitat management on the lands under its jurisdiction.

The diverse abundance of fish throughout the planning area provides considerable recreational opportunity and economic benefit.

Cold Water Sport and Native Fish (Salmonid and Non-Salmonid)

Higher-elevation waters located generally above 5,200 feet support cold water fishes, consisting largely of non-native sport fish including brook trout *(Salvelinus fontinalis)*, rainbow trout *(Oncorhynchus mykiss)*, and brown trout *(Salmo trutta)*, as well as the native cutthroat trout *(Oncorhynchus clarkii* spp.*)*. Higher elevation non-game species include mottled sculpin *(Cottus bairdii)* and speckled dace *(Rhinichthys osculus)*. Cutthroat trout *(Oncorhynchus clarki)* is a special status species and is discussed further in **Section 3.2.8**, Special Status Species.

Waters generally below 6,500 feet support primarily cool water and warm water fishes, including the native bluehead sucker *(Catostomus discobolus)*, roundtail chub *(Gila robusta)*, flannelmouth sucker *(Catostomus latipinnis)*, razorback sucker *(Xyrauchen texanus)*, Colorado pikeminnow *(Ptychocheilus lucius)*, bonytail *(Gila elegans),* and humpback chub *(Gila cypha)*. These fish are special status species and are discussed further in **Section 3.2.8**, Special Status Species.

Invasive/Nonnative/Competitive Fish

Fish species that occur but are not native to the GJFO planning area include, but are not limited to, several warm water sport fish, such as largemouth bass *(Micropterus salmoides)*, smallmouth bass *(Micropterus dolomieu)*, crappie *(Pomoxis* spp.*)*, bluegill *(Lepomis macrochirus)*, northern pike *(Esox lucius)*, and channel catfish *(Ictalurus punctatus)*. All of these species compete with native species. Several species of nonnative nongame species occur within the planning area, the most notable being common carp *(Cyprinus carpio)* and white sucker *(Catostomus commersonii)*.

Amphibians

Six species of frogs, three toads, and one salamander are known to occur in or near aquatic and riparian habitats within the planning area. CPW and BLM surveys have documented the presence of tiger salamander *(Ambystoma tigrinum)*, bullfrog *(Rana catesbeiana)*, northern leopard frog *(Rana pipiens)*, red spotted toad *(Bufo punctatus)*, and woodhouse toad *(Bufo woodhousii)* across portions of the planning area (BLM 2008g, 2009f). Boreal toad habitat is located in the highest elevation areas within the planning area, generally in areas above 8,500 feet that contain suitable aquatic habitat. Lower-elevation amphibians include the Great Basin spade-foot toad *(Spea intermontana)*. The Northern leopard frog and tiger salamander use various aquatic habitats and are found at varying elevations throughout the GJFO planning area. All of the amphibian species of primary interest (**Table 3-15**, Fish and Wildlife Species of Primary Interest in BLM's Environmental Planning) are special status species, which are discussed further in **Section 3.2.8**, Special Status Species.

Wildlife

A variety of terrestrial wildlife species use the vegetation types discussed in **Section 3.2.6**, Vegetation. The key terrestrial wildlife species within the GJFO planning area are primarily herpetiles (reptile and amphibians), birds, and mammals. However, many terrestrial invertebrate species also occur and adequate populations of terrestrial invertebrates are assumed when populations of the vertebrate groups that prey on invertebrates are healthy. Information regarding terrestrial wildlife distribution within the GJFO planning area is informed by both the Land Health Assessments and GIS data maintained by CPW. In addition, CPW maintains statistics on big game harvests, hunter use days, and population trends.

Reptiles

Species of reptiles that have been historically documented within the planning area include 9 lizards and 11 snakes. Population numbers are not known. The majority of reptiles occur in lower elevations and in dryer habitats such as sagebrush, greasewood, and pinyon-juniper.

The reptiles of primary concern are BLM sensitive species and are discussed in **Section 3.2.8**, Special Status Species. Other reptiles that occur in the GJFO planning area include collared lizard *(Crotaphytus collaris)*, sagebrush lizard *(Sceloporus graciosus)*, tree lizard *(Urosaurus ornatus)*, side blotched lizard *(Uta stansburiana)*, prairie/plateau lizard *(Sceloporus undulates)*, short-horned lizard *(Phrynosoma hernandesi)*, plateau striped whiptail *(Cnemidophorus velox)*, western whiptail *(Cnemidophorus tigri)*, desert striped whipsnake *(Masticophis taeniatus)*, smooth green snake *(Liochlorophis vernalis)*, bull/gopher snake *(Pituophis catenifer)*, western terrestrial garter snake *(Thamnophis elegans)*, western blackneck garter snake *(Thamnophis cyrtopsis)*, wandering garter snake *(Thamnophis elegans vagrans)*, western yellow-belly racer *(Coluber constrictor)*, corn snake *(Elaphe guttata)*, Mesa Verde night snake *(Hypsiglena torquata loreala)*, and Utah blackhead snake *(Tantilla planiceps)*.

Ants

The University of Houston is conducting a long-term study of the population biology of the western harvester ant (*Pogonomyrmex occidentalis Cresson*). Research has been ongoing in a portion of the field office adjacent to 16 Road since 1992, and is expected to continue in the future. Researchers have permanently marked and mapped 1,000 – 1,400 colonies of P. occidentalis which they monitor on an annual basis. Researchers collect data on survival/mortality, recruitment (new colonies), and the size of all living colonies. The long-standing date collection at this site allows researchers to relate changes in temperature and rainfall patterns to changes in population growth, population size, and population age/size structure. Harvester ants are important agents of seed dispersal for annual plants. For example, soil in the vicinity of ant mounds is better aerated, has a higher nitrogen content, and often a higher water content than surrounding areas. Thus, ant abundance is an indicator of landscape health (Cole 2012).

Waterfowl and Shorebirds

The key water bird species include great blue heron *(Ardea herodias)*, several species of ducks and geese, and sandhill cranes *(Grus canadensis)*. Great blue heron foraging and breeding areas are primarily along the Colorado and Gunnison Rivers, though individual herons visit small streams and ponds throughout the planning area.

Canada geese *(Branta canadensis)* and other waterfowl species winter along the Colorado and Gunnison Rivers. Important foraging areas occur on private lands in agricultural areas and within the river corridors. Important production areas

extend along much of the Colorado and Gunnison Rivers, with brood (group of young birds from the same mother) concentration areas reflecting the location of the important foraging areas. Sandhill cranes use areas within the GJFO planning area as a migratory stopover in the fall and spring. The majority of the areas used occur on private agricultural lands; however, ponds and reservoirs managed by BLM, such as 6 and 50 Reservoir, provide a migratory stopover for this species. Long-billed curlew *(Numenius americanus)* occasionally nest in the desert areas near the Utah border.

Upland Game Birds

The dusky grouse *(Dendragapus obscurus)*, wild turkey *(Meleagris gallopavo),* and the Gunnison Sage-Grouse *(Centrocercus minimus)* and Greater Sage-Grouse *(Centrocercus urophasianus)* (discussed in **Section 3.2.8**, Special Status Species) occur in the GJFO planning area. High-elevation forested zones in the upper elevations of the planning area provide habitat for nesting blue grouse. Turkeys occur throughout the planning area, primarily in higher elevations. Chukar *(Alectoris chukar)*, an introduced game bird, occur throughout the planning area, including lower Roan and Plateau Creeks, the Book Cliffs, and along the Gunnison and Colorado Rivers.

Raptors

Raptors include eagles, falcons, hawks, and owls. Because they are at the top of food chains and therefore occur in fewer numbers than their prey, they serve as important indicators of overall ecosystem health. The CPW maintains data on observations of most raptor species, and several species are tracked individually. The BLM has particular management interest in concentrations of raptors (particularly bald eagles *(Haliaeetus leucocephalus)* and peregrine falcons *(Falco peregrinus)* along the Colorado, Dolores, and Gunnison Rivers.

Cavity-Nesting Birds

Of the primary interest species, only the Lewis's woodpecker *(Melanerpes lewis)* is a cavity nester. This fly-catching woodpecker inhabits open habitats such as open pine forests, burn areas, cottonwoods in riparian areas, and pinyon-juniper forests (Johnsgard 1986).

Other Migratory Birds

Numerous species of migratory birds summer, winter, and/or migrate through the planning area. The habitat diversity provided by the broad expanses of pinyon-juniper, sagebrush, and saltbush vegetation zones support many species of birds. Common species include mourning doves *(Zenaida macroura)*, horned lark *(Eremophila alpestris)*, gray vireo *(Vireo vicinior)*, pinyon jay *(Gymnorhinus cyanocephalus)*, and sage sparrow *(Amphispiza belli)*.

Birds of Conservation Concern (USFWS 2008b) that occur in the GJFO include bald eagle, Brewer's sparrow *(Spizella breweri)*, burrowing owl *(Athene cunicularia),* Cassin's finch *(Carpodacus cassinii)*, ferruginous hawk *(Buteo regalis)*, flammulated owl *(Otus flammeolus)*, golden eagle *(Aquila chrysaetos)*, Grace's

warbler *(Dendroica graciae)*, gray vireo, Gunnison Sage-Grouse, juniper titmouse *(Baeolophus ridgwayi)*, Lewis's woodpecker, long billed curlew *(Numenius americanus)*, peregrine falcon, pinyon jay *(Gymnorhinus cyanocephalus),* and prairie falcon *(Falco mexicanus).*

Owls

Long-term owl research in the field office began in 2002 by the Rocky Mountain Bird Observatory with the intent to capture and mark migrating Northern Saw-whet Owls during fall migration. The owl banding station in the Sunnyside area was selected after experimenting with several other locations and determining that owl capture rates seemed to be highest at this location. Owls were captured and banded between sunset and 10pm every Tuesday evening from September until Thanksgiving. A total of 41 Northern Saw-whet Owls (*Aegolius acadicus*), 1 Long-eared Owl (*Asio otus*), and 1 Western Screech Owl (*Megascops kennicottii*) over were banded over 5 years. The same bird has never been captured twice, suggesting that these are indeed migrating owls and not just residents (Potter 2008). Through this research it appears Saw-whet Owl migration in this area begins in early October, peaks around Halloween, and usually ends by Thanksgiving.

Big Game Species

The overall range of elk occupies the majority of the GJFO planning area except for the lower semi-desert shrub valleys of the Colorado, Gunnison, and Dolores Rivers (**Figure 3-9,** Elk Range). Summer range is found at the top of the Book Cliffs, on the Grand Mesa, along the Uncompahgre Plateau, and in Glade Park. Production occurs in concentrated areas in summer in the upper Book Cliffs, in the Uncompahgre National Forest, on the Grand Mesa, and in the upper elevations of Glade Park. Winter range includes the majority of the Book Cliffs, the Roan Creek drainage, the Grand Mesa Slopes and Collbran areas, the lower-elevation slopes around the Uncompahgre Plateau, and Glade Park. Migration corridors have been identified by CPW in areas in the Roan Creek drainage and Unaweep Canyon and a small corridor on private lands in Glade Park.

Severe winter range is defined as that part of the winter range where 90 percent of the individuals are located when annual snowpack is at its maximum and/or temperatures are at a minimum in the two worst winters out of ten (BLM 2010a). Critical winter range is defined as the winter habitat which is used during the most extreme portion of the winter (BLM 2010a).

Mule deer *(Odocoileus hemionus)* range includes the entire GJFO planning area, except for areas of high human concentration like downtown Grand Junction (**Figure 3-10**, Mule Deer Range). Summer range is found at the top of the Book Cliffs, on the Grand Mesa, along the Uncompahgre Plateau, and in Glade Park. Production occurs in concentrated areas within the summer range of the upper Book Cliffs, and on the Uncompahgre Plateau, on the Grand Mesa, and on the upper elevations in Glade Park. Winter range includes the majority of the Book

Cliffs, the Roan Creek drainage, the Grand Mesa Slopes and Collbran areas, the lower-elevation slopes around the Uncompahgre Plateau, and the Dolores River drainage and the north end of Glade Park to the Colorado River. Two migration corridors have been identified by CPW near the town of Mesa and another in Glade Park. In addition to the migration corridors, many migration pattern areas have also been identified in the GJFO.

The GJFO planning area contains both desert bighorn sheep *(Ovis canadensis nelsoni and mexicana)* (south of the Colorado River and west of the Gunnison River) and Rocky Mountain bighorn sheep *(O. canadensis canadensis)* (east of the Gunnison River and north of the Colorado River). The desert bighorn is a BLM sensitive species and is discussed in **Section 3.2.8**, Special Status Species. The planning area also contains two Rocky Mountain bighorn sheep populations. The Battlement Mesa herd (S-24) is found northwest of the town of Mesa, Colorado and ranges across both BLM and US Forest Service lands. It is one of 34 native, indigenous herds in the state of Colorado and is one of the few low-elevation herds still persisting in native habitat. The Battlement Mesa population numbers approximately 50 individuals (Duckett 2012). The Main Canyon herd (S-75) was extirpated from its range in the DeBeque Canyon/Roan Creek areas in the mid-1900's (Duckett 2006). This herd was re-established through translocations in 2003 and 2004. The primary factor currently influencing, and that will continue to influence, the growth and establishment of this herd is the ongoing impacts of respiratory disease that has affected adult survival and long-term lamb recruitment. It is likely that the respiratory disease is a result of a highly virulent strain of Pasturella (a bacteria), that was brought in with the translocation in 2004 of bighorn sheep from Almont, Colorado as part of the reintroduction effort. There are currently approximately 40 individuals in the Main Canyon herd (Duckett 2012).

Pronghorn antelope occur across the GJFO planning area in the lower elevation desert areas in the Colorado and Gunnison River valleys.

Other Priority Mammal Species

White-tailed prairie dogs (*Cynomys leucurus*) and the many species that are associated with this keystone species are present in the lower elevations of the GJFO planning area. This sensitive species is described further in **Section 3.2.8**, Special Status Species.

Numerous bats use the abandoned mines and natural caves in the GJFO planning area. The Townsend's big-eared bat (*Corynorhinus townsendii)* is known to occur in the planning area. There are two known maternity roosts in the planning area, one of which, the Pup Tent mine site, was withdrawn in 2008 from settlement, sale, location, or entry under the general land laws, including the mining laws, subject to valid existing rights. The second location is within a leased coal area. Some netting of bats was conducted in 2006 to determine which bat species were using the areas around the Book Cliffs. The most

common species observed during the limited sampling of this study was the silver-haired bat (Lasionycteris noctivagans), followed by the big brown bat *(Eptesicus fuscus)*, hoary bat *(Lasiurus cinereus),* and long-legged bat *(Macrophyllum macrophyllum)* (Chung-MacCoubrey 2008).

The CPW has reintroduced moose on US Forest Service lands at the top of the Grand Mesa. Moose are likely to disperse to lower elevations on adjacent BLM lands at least seasonally as numbers increase.

Additional species of management concern are black bear and mountain lion, both of which occur throughout the GJFO planning area in appropriate habitat. The GJFO planning area provides habitat for a number of other mammals of management and conservation concern. Special status mammals are discussed in **Section 3.2.8**, Special Status Species.

Trends

For most fish and wildlife species, habitat loss and fragmentation have been and remain the primary cause for declines. Some of these species have also suffered from historic efforts to extirpate them, and some suffer competition or predation from species that have expanded their range or that have been introduced. Management efforts by the BLM, USFWS, CPW, and others have reversed the downward trend for a number of these populations, but few populations are near their historic levels.

The GJFO does not have monitoring data for most species. However, the CPW maintains monitoring data for some species and a few local and national trends have been documented by the BLM and others including:

- The CPW designates and surveys big game Data Analysis Units (DAU), which are intended to encompass one herd's range throughout the year. Several Data Analysis Units overlap the GJFO planning area. For elk populations the majority of the field office is within DAUs E-10, E-19 and E-14 which are above, at, and below population objectives respectively. For mule deer the majority of the field office is within DAUs D-11, D-12, D-18 and D-41; the first two of these are currently below population objectives and the last two are within population objectives (CPW 2014).
- Recent CPW surveys suggest pronghorn numbers are declining in the herd south of Whitewater, Colorado, and that the herd west of Grand Junction is stable to declining.
- Nationally, 76 percent of bird species that only breed in arid lands have declined since 1976 (North American Bird Conservation Initiative, US Committee 2009).

Although well below historic levels, wetland breeding birds have shown steady increases in numbers nationally since the late 1970s when policies shifted from

draining to protecting wetlands (North American Bird Conservation Initiative, US Committee 2009).

3.2.8 Special Status Species

Special status species and the ecosystems upon which they depend require special management consideration to promote their conservation on BLM-administered lands. Species may need to be designated as special status species for variety of reasons: because they are species that are naturally occurring rare species, or due to consequences of habitat loss or modification, competition, disease, predation, overharvest. Such species may or may not be legally protected by federal or state agencies. BLM land management practices are intended to sustain and promote species that are legally protected by the Endangered Species Act or similar state laws and prevent species that are not yet legally protected from needing such protection.

Current Conditions

Species discussed in this section have been listed by the USFWS (USFWS 2009a), listed by the CPW (CPW 2007), or placed on the Colorado BLM State Director's Sensitive Species List (BLM 2009e). **Table 3-15**, Fish and Wildlife Species of Primary Interest in BLM's Environmental Planning, in **Section 3.2.7**, Fish and Wildlife, lists fish and wildlife species of primary interest to the BLM in the GJFO planning area, including all special status species that could occur. Federal threatened and endangered species and designated critical habitat crucial to species viability are managed by the USFWS in cooperation with other federal agencies to support recovery. Species identified by the State of Colorado and Colorado BLM are treated similarly in terms of protection measures. BLM, USFWS, and the State of Colorado have developed formal and informal agreements to provide guidance on the management of species within the GJFO planning area. Consultation with USFWS is required on any action proposed by the BLM or by another federal agency that may affect a listed species or that could jeopardize the continued existence of a species or modify designated critical habitat under Section 7 of the ESA.

Species considered for designation on the Colorado BLM sensitive species list (BLM 2009e) were reviewed against the following criteria:

- Species occurs on BLM Colorado public lands;
- Native species;
- Species has a documented or predicted downward trend such that the species is at risk across all or a significant portion of its range;
- Species inhabits ecological refugia or unique/specialized habitats;
- Actions on BLM lands may influence habitats or species populations to a degree that the species is at risk across all or a significant portion of its range;

- BLM has the capability to significantly affect the conservation status of the species through management;
- Species occur in small or widely dispersed populations; and
- Species is under status review by USFWS or is being managed under a Species Conservation Management Plan.

There are seven federally listed species and four candidate species for federal listing that have been documented or have critical habitat in the GJFO planning area, including four species that are candidates for federal listing (UFSWS 2009a). Many of these federally listed species are also listed by the State of Colorado (CPW 2007). Other species that are only on the BLM sensitive species list (BLM 2009e) or that are listed by the State of Colorado (CPW 2007) are also discussed below. Information on the distribution of special status species in the GJFO planning area is derived from project-related biological surveys, Colorado Natural Heritage Program (CNHP) data, Land Health Assessment comments, CPW GIS data, and other sources. Inventories have been completed across portions of the field office for some of the listed and candidate plant, fish, and wildlife species. Specific management direction to influence habitat components, leading to species recovery, is integrated into BLM management plans. Designated critical habitat for four fish species exists within the GJFO planning area (USFWS 2009a).

Plants

The spineless hedgehog cactus *(Echinorcereus triglochidiatus* var. *inermis)* was included as a federally endangered species in the 1987 RMP (BLM 1987). This species has been delisted and is no longer included as a listed species in the planning area.

The spineless hedgehog cactus was listed as federally endangered on November 7, 1979 (USFWS 1979). The GJFO 1987 RMP designated 51,452 acres as sites protected from surface disturbance to protect the spineless hedgehog cactus. The spineless hedgehog cactus was delisted on September 22, 1993 (USFWS 1993) under the ESA species status code DO (delisted taxon, erroneous commercial data). The spineless hedgehog cactus was found to be a spineless variety of the red-flowered hedgehog cactus *(E t.* var. *melanacanthus)*, which is widespread in Utah, Colorado, and Mexico. The spineless hedgehog cactus is no longer a BLM sensitive species (BLM 2009e).

Federally Listed Species

The following three plants within the GJFO planning area are identified as federal listed species:

- Colorado hookless cactus *(Sclerocactus glaucus)*–Threatened;
- DeBeque phacelia *(Phacelia submutica)*–Threatened; and
- Parachute penstemon *(Penstemon debilis)*–Threatened.

Colorado Hookless Cactus. The Colorado hookless cactus (*Sclerocactus glaucus*, formerly Uinta Basin hookless cactus, see the following paragraph) occurs mainly in the DeBeque area (north and south of Interstate 70) and in the Whitewater area within the planning area. The GJFO 1987 RMP designated 131,503 acres as sites protected from surface disturbance to protect the Uinta Basin hookless cactus. The cactus typically occurs on gravelly or rocky surfaces on river terrace deposits and lower mesa slopes and in desert shrub communities (CNHP 1999) dominated by shadscale, galleta grass *(Pleuraphis jamesii)*, sagebrush, and Indian ricegrass *(Oryzopsis hymenoides)*. It occasionally occurs in pinyon-juniper or greasewood and cheatgrass communities. The Colorado hookless cactus flowers between April and May and may be visible only when flowering (CNHP 1999). The Colorado hookless cactus is found in the Pyramid Rock ACEC (Colorado Natural Areas Program [CNAP] 2009). The Colorado hookless cactus is being monitored by the BLM; however, existing data are insufficient to determine present population trends. Ongoing monitoring is expected to fill in data gaps during the life of the RMP.

The taxonomy of the Colorado hookless cactus (*Sclerocactus glaucus* complex) has changed since the 1987 RMP was prepared. The USFWS now recognizes the Uinta Basin cactus as three separate species: the Colorado hookless cactus *(S. glaucus)*, the Uinta Basin cactus *(S. wetlandicus)*, and the Pariette cactus *(S. brevispinus)*. The Uinta Basin and Pariette cacti only occur in Utah, which is outside of GJFO planning area.

DeBeque Phacelia. The DeBeque phacelia *(Phacelia submutica)* is a federally listed threatened species (USFWS 2011a). The DeBeque phacelia is endemic to exposures of chocolate to purplish brown and dark charcoal gray alkaline clay soils of the Atwell Gulch and Shire Members of the Wasatch Formation, including Pyramid Rock ACEC. The soils are characterized by large cracks due to the shrink-swell potential of the clays. Within the planning area, the DeBeque phacelia is primarily dependent on BLM-administered lands for survival (CNAP 2009).

A total of 24,987 acres of critical habitat has been designated for DeBeque phacelia within nine critical habitat units (CHUs): Sulphur Gulch, Pyramid Rock, Roan Creek, DeBeque, Mount Logan, Ashmead Draw, Baugh Reservoir, Horsethief Mountain, and Anderson Gulch. BLM-administered lands within the GJFO planning area cover 21,558 acres of these CHUs (USFWS 2011b).

Parachute Penstemon. The Parachute penstemon *(Penstemon debilis)* is a federally listed threatened species (USFWS 2011a). The species is endemic to oil shale outcrops on the southern escarpment of the Roan Plateau in Garfield County. Parachute penstemon grows on steep slopes of white shale talus at 8,000 to 9,000 feet elevation and occurs within the GJFO planning area and Colorado River Valley Field Office. The species is found only on the Parachute Creek Member of the Green River Formation. There are seven known occurrences of

the Parachute penstemon, two of which are wholly or partially on BLM-administered lands within the GJFO planning area.

Within the GJFO planning area, Parachute penstemon is found on Mount Logan, where there are estimated to be less than 550 plants. The Mount Logan Mine population extends along and is fragmented by an OXY mining road (OXY USA WTP LP, a subsidiary of Occidental Petroleum). OXY utilizes the mining road for ongoing mine reclamation activities as well as for plant monitoring activities. OXY cooperates in monitoring activities associated with the Logan Mine population. Also, OXY is proposing to designate the Logan Mine population (private lands) as a designated State Natural Area with the Colorado Natural Areas Program. As part of this effort, OXY will also be applying habitat and plant pollinator best management practices to its private lands not designated as part of the state natural area, but within the vicinity of the state natural areas.

Scattered plants were also found within the Colorado River Valley Field Office in Smith Gulch, an outwash far below the expected elevation for this species. This may mean that there are more populations in the GJFO planning area at lower elevations, however none are known at this time.

Four CHUs have been designated for Parachute penstemon: Brush Mountain, Cow Ridge, Mount Callahan, and Anvil Points. The Brush Mountain and Cow Ridge CHUs cover a total of 6,256 acres, all on BLM-administered lands. Eleven percent (868 acres) of the Mount Callahan CHU is on BLM-administered lands within the planning area. The Anvil Points CHU is not within the planning area (USFWS 2011b).The Parachute penstemon is also found on Mount Callahan, approximately three miles east of the planning area within the Colorado River Valley Field Office. The private land is owned by OXY. OXY entered into a voluntary conservation effort with CNAP. To conserve the Parachute penstemon, CNAP and OXY designated Mount Callahan State Natural Area (CNAP 1987) and recently designated Mount Callahan Saddle State Natural Area, an additional 360 acres (CNAP 2008). OXY also agreed to best management practices for drilling near the Parachute penstemon, including buffer zones, weed control, and addressing storm water impacts (Colorado Rare Plant Conservation Initiative 2009).

BLM Sensitive Species

Twenty-five plant species that are on the Colorado BLM State Director's Sensitive Species List are known to occur within the GJFO planning area (BLM 2009e). As shown on **Table 3-16**, BLM Special Status Plant Species, 11 of the 25 species have a CNHP rank of State 1, critically imperiled. The definitive distribution of these species within the GJFO planning area is not known. Species locations that occur outside the GJFO planning area (such as private land, Colorado National Monument, and Rabbit Valley) are shown in Table 3-16 because they may provide information about the potential locations of nearby unknown populations of special status plant species within the GJFO planning area.

Table 3-16
BLM Special Status Plant Species

Common Name	Species Name	Federal Listing	CNHP Global/ State Ranking (G_/S_)[1]	Ecological Description	Known Locations within the GJFO Planning Area
Narrow-stem gilia	*Aliciella stenothyrsa (Gilia stenothyrsa)*	Not listed	**G3/S1**	Clay hills	Coal Canyon
Jones' bluestar	*Amsonia jonesii*	Not listed	**G4/S1**	Powder-blue flowers bloom in May. Runoff-fed draws on sandstone, desert steppe	Rabbit Valley
DeBeque milkvetch	*Astragalus debequaeus*	Not listed	G2/S2	Purple flowers bloom from late April to May. Varicolored, fine textured, seleniferous, saline soils of the Wasatch Formation-Atwell Gulch Member. Barren outcrops of dark clay interspersed with lenses of sandstone. Elevation ranges from 5,100 to 6,400 feet. Endemic to Colorado, in the Colorado River Valley near DeBeque	Pyramid Rock, Atwell Gulch, DeBeque to Mesa
Horseshoe milkvetch	*Astragalus equisolenis*	Not listed	**G5T1/S1**	Flowers from early May to June. Typical habitat consists of sagebrush, shadscale, horsebrush, and other mixed desert shrub communities	Gateway
Grand Junction milkvetch	*Astragalus linifolius*	Not listed	G3Q/S3	Flowers from early May to June, has grass-like leaves. Grows on the Chinle and Morrison Formations, with pinyon-juniper and sagebrush on canyon sides. Elev. 4,800 to 6,200 feet. Endemic to Colorado	Rough Canyon
Ferron milkvetch	*Astragalus musiniensis*	Not listed	**G3/S1**	Flowers from late April to early June. Gullied bluffs, knolls, benches and open hillsides; in pinyon-juniper woodlands or desert shrub (sagebrush) communities, mostly on shale, sandstone, or alluvium derived from	Badger Wash

Table 3-16
BLM Special Status Plant Species

Common Name	Species Name	Federal Listing	CNHP Global/ State Ranking (G_/S_)[1]	Ecological Description	Known Locations within the GJFO Planning Area
				them. Elev. 4,700 to 7,000 feet. Endemic to Colorado (Mesa and Garfield Counties) and Utah	
Naturita milkvetch	*Astragalus naturitensis*	Not listed	G2G3/S2S3	Flowers from April to June. Sandstone mesas, ledges, crevices and slopes in pinyon-juniper woodlands. Elev. 5,000 to 7,000 feet. Found in Mesa, Montrose, and Montezuma Counties	Pyramid Rock, DeBeque
Fisher Tower's milkvetch (named for Fisher Towers, Utah)	*Astragalus piscator*	Not listed	**G1?/S1**	Pale lilac flowers bloom from late April to early June. Sandy, sometimes gypsiferous soils of valley benches and gullied foothills. Elev. 4,300 to 5,600 feet. Endemic to Colorado and Utah, Dolores River Valley	Dolores River
San Rafael milkvetch	*Astragalus rafaelensis*	Not listed	**G3Q/S1**	White or pale purple flowers bloom from late April to early June. Gullied hills, washes, and talus under cliffs; in seleniferous clayey, silty, or sandy soils. Elev. 4,400 to 6,500 feet. Endemic to Colorado and Utah, Dolores Canyon bottom	Gateway
Grand Junction suncup	*Camissonia eastwoodiae*	Not listed	G2/S1	Flowers in early spring. Adobe hills in the lower valleys.	North Desert
Gypsum Valley cateye	*Oreocarya revealii*	Not listed	G1G2/S1S2	Gypsum outcrops	Gateway
Osterhout cryptanth	*Cryptantha osterhoutii* (*Oreocarya osterhoutii*)	Not listed	**G3/S1S2**	Small sized plant. Flowers from April to early June. Dry, barren sites, in reddish-purple decomposed sandstone. Elev. 4,500 to 6,100 feet	Colorado National Monument, Rabbit Valley, Gateway

Table 3-16
BLM Special Status Plant Species

Common Name	Species Name	Federal Listing	CNHP Global/ State Ranking (G_/S_)[1]	Ecological Description	Known Locations within the GJFO Planning Area
Kachina daisy, Kachina fleabane (named for Kachina Natural Bridge, Utah)	*Erigeron kachinensis*	Not listed	**G2/S1**	Flowers from May to July. Saline soils in alcoves and seeps in sandstone canyon walls. Elev. 4,800 to 5,600 feet. Endemic to Colorado and Utah	Dolores River
Grand buckwheat	*Eriogonum contortum*	Not listed	G3/S2	Flowers from May to August. Mancos Shale badlands, with shadscale and other salt desert shrub communities. Elev. 4,500 to 5,100 feet. Endemic to Colorado and Utah, Colorado River Valley	Badger Wash, North Fruita Desert
Tufted green gentian	*Frasera paniculata*	Not listed	**G4/S1**	Endemic to Colorado, Mesa County	Gateway
Piceance bladderpod	*Lesquerella parviflora*	Not listed	G2/S2	Flowers from June to early July. Shale outcrops of the Green River Formation, on ledges and slopes of canyons in open areas. Elev. 6,200 to 8,600 feet. Endemic to Colorado, in Garfield, Mesa, and Rio Blanco Counties	Green River Formation, area north of DeBeque, Roan Cliffs
Canyonlands biscuitroot, Wideleaf biscuitroot	*Lomatium latilobum (Aletes latilobus)*	Not listed	**G1/S1**	Flowering from April/May to early June. Pinyon-juniper and desert shrub communities; sandstone ledges and canyons in sandy soils derived from the Entrada Formation or the contact point of the Wingate and Chinle Formations. Elev. 5,000 to 7,000 feet. Endemic to Colorado and Utah	Pyramid Rock, DeBeque
Dolores River skeleton plant	*Lygodesmia doloresensis*	Not listed	**G1G2/S1**	Endemic on the benches of the Dolores River Valley	Gateway, Rabbit Valley

Table 3-16
BLM Special Status Plant Species

Common Name	Species Name	Federal Listing	CNHP Global/ State Ranking (G_/S_)[1]	Ecological Description	Known Locations within the GJFO Planning Area
Roan cliffs blazingstar, Southwest stickleaf	*Mentzelia rhizomata (M. argillosa, Nutallia argillosa)*	Not listed	G2/S2	Flowers from late June to July/August. Steep eroding talus slopes of shale, Green River Formation. Elev. 5,800 to 9,000 feet. Endemic to Colorado and Utah, Parachute Creek drainage	Mount Callahan (private), area north of DeBeque, Roan Cliffs
Eastwood's monkeyflower	*Mimulus eastwoodiae*	Not listed	G3G4/S1	Flowers from late July to early September. Shallow caves and seeps on steep canyon walls. Elev. 4,700 to 5,800 feet	Dolores River
Aromatic Indian breadroot	*Pediomelum aromaticum*	Not listed	G3/S2	Mixed pinyon-juniper	Pyramid Rock, DeBeque
Sun-loving meadowrue	*Thalictrum heliophilum*	Not Listed	G2/S2	Flowers June-July/July-August. Found in open sunny sites on sparsely vegetated, steep shale slopes of the Green River Formation. Elev. 6,300 to 8,800 feet. Endemic to Colorado, Garfield, Mesa, and Rio Blanco Counties	area north of DeBeque, Roan Cliffs
Parachute Penstemon, Parachute beardtongue	*Penstemon debilis*	T	**G1/S1**	Flowers mid-June to mid-July. Sparsely vegetated, south facing, steep, white shale talus of the Parachute Creek Member of the Green River Formation. Soils are a mixture of thin shale fragments and clay. Typical elev. 8,000 to 9,000 feet, but can occur down slope. Endemic to Colorado, Garfield County	Mount Callahan (private), Logan Wash Mine

Table 3-16
BLM Special Status Plant Species

Common Name	Species Name	Federal Listing	CNHP Global/ State Ranking (G_/S_)[1]	Ecological Description	Known Locations within the GJFO Planning Area
DeBeque Phacelia	*Phacelia submutica*	T	G4T2/S2	An annual plant with small cream flowers that bloom late April-June/May-June. Late in the summer, submutica shrivels up and may be washed or blown away. Sparsely vegetated, steep slopes; chocolate-brown or gray clay; Atwell Gulch and Shire Members of the Wasatch Formation. Soils often have large cracks because of the high shrink-swell potential of the clays. Elev. 4,700 to 6,200 feet. Endemic to Colorado, Garfield and Mesa Counties	Pyramid Rock, DeBeque, Sunnyside Road
Colorado hookless cactus	*Sclerocactus glaucus*	T	Not assigned yet after taxonomy change	Flowers April to May. Plants are usually only visible when flowering. Rocky hills, mesa slopes, and alluvial benches; in desert shrub communities. Elev. 4,500 to 6,000 feet. Endemic to Colorado	Pyramid Rock, Atwell Gulch, South Shale Ridge, DeBeque, Whitewater

Source: CNHP 1999; Weber and Wittmann 2001

[1]CNHP ranking system is as follows:

1 = Critically Imperiled (Example: G1 = Globally Ranked Critically Imperiled; critically imperiled species are shown in bold font)
2 = Imperiled (Example: N2 = Nationally Ranked Imperiled)
3 = Vulnerable to Extirpation (Example: S3 = State Ranked Vulnerable to Extirpation)
4 = Apparently Secure
5 = Demonstrably Widespread, Abundant, and Secure
T = Gives the rank of a separate taxon (i.e., the rank of a subspecies or a variety)
? = Inexact or Uncertain rank. See CNHP's Rare Plant Field Guide for a full description of ranks (CNHP 2009)

Fish

Five federally listed fish species and four BLM sensitive species occur or have habitat within the GJFO planning area (USFWS 2009a, BLM 2009e). Several of these species also have state designations (CPW 2007) (see **Table 3-15**, Fish and Wildlife Species of Primary Interest in BLM's Environmental Planning, in **Section 3.2.7**, Fish and Wildlife). These species are discussed below.

Native Cutthroat Trout Species

The status of cutthroat trout in Colorado has been in a state of flux for some time. However, new research on cutthroat trout genetics and historic stocking practices (Metcalf et al. 2007, 2012), and new research on cutthroat trout meristics (Bestgen et al. 2013) across the state of Colorado has emerged. With the advent of new genetic testing procedures, and new analysis, the picture has become clearer. Ever since the greenback cutthroat trout (*Oncorhynchus clarki stomias*) was listed as endangered under the Endangered Species Act in 1974, there has been strong interest in developing methods to distinguish them from closely related subspecies with confidence. Prior to recent molecular testing, phenotypic traits associated with greenback cutthroat trout were larger spots, and higher scale counts above the lateral line and in the lateral series when compared to Colorado River cutthroat trout (*O. c. pleuriticus*; Behnke 1992). However, these two subspecies cannot be separated consistently on the basis of those characteristics (Behnke 1992). As a result, geographic range had become the default approach for establishing subspecies designation and occupation.

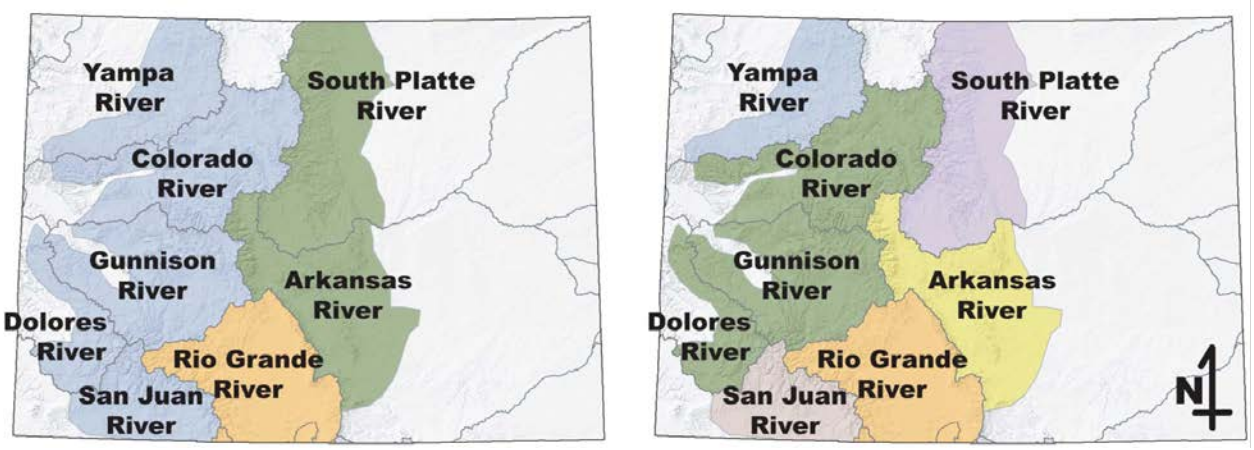
Based on geographic range, it was for years believed that Colorado contained four subspecies of cutthroat trout: the greenback cutthroat (*Oncorhynchus clarki stomias*) in the South Platte and Arkansas basins, the Rio Grande cutthroat (*Oncorhynchus clarki virginalis*)in the Rio Grande basin, the extinct yellowfin cutthroat (*Oncorhynchus clarki macdonaldi*) in the upper Arkansas River basin (Twin Lakes), and the Colorado River cutthroat trout(*Oncorhynchus clarki pleuriticus*) in all five major river basins west of the Continental Divide (Figure 1, left panel).

Early molecular work did not distinguish between the subspecies, but in 2007, Metcalf et al. used mitochondrial and nuclear molecular markers to suggest that indeed there was a genetic basis for separating greenback cutthroat trout from Colorado River cutthroat trout. The primary concern raised by that paper was five of the nine east slope greenback cutthroat trout populations they examined actually displayed genetic fingerprints more similar to Colorado River cutthroat trout of Trappers Lake (White River basin) origin than they did with many of the other greenback populations. This was particularly troubling since mechanisms were in place to deliver Colorado River cutthroat trout to the East Slope. From 1903 through 1938, at least 80 million pure Colorado River cutthroat trout were produced at Trappers Lake (Rogers 2012a). Millions more were produced on the south slope of Pikes Peak (Rogers and Kennedy 2008). Although the fate of many of those fish remains a mystery, it is clear that they were stocked in virtually every county east of the Continental Divide that would support trout (Metcalf et al. 2012).

A finding of Metcalf et al. (2007) that attracted less attention was the discovery of a "greenback" cutthroat trout population west of the Continental Divide near Gunnison in West Antelope Creek. Intensive survey and genetics testing work since that time indicated that in fact the West Antelope Creek population is not

unique, and that populations with similar genetic fingerprints are pervasive across Colorado's western slope (Rogers 2010). That finding lead the Greenback Cutthroat Trout Recovery Team to question whether the West Antelope Creek fish were really greenback cutthroat trout as suggested by Metcalf et al. (2007), or whether they simply represented diversity within Colorado River cutthroat trout (Rogers 2010). In an effort to avoid confusion, trout with this genetic fingerprint are hereafter referred to as Green Lineage cutthroat trout, while cutthroat trout displaying the genetic signature commonly associated with those from Trappers Lake (White and Yampa river basins) are referred to as Blue Lineage cutthroat trout.

In 2012, the native distribution of different lineages of cutthroat trout in Colorado was clarified greatly with work published by a University of Colorado led research team that examined DNA from 150 year old museum specimens collected prior to large-scale stocking activities (Metcalf et al. 2012). This work confirmed that indeed, Green Lineage cutthroat trout are at least native to the Colorado and Gunnison river basins. Additional work suggests they probably were found in the Dolores River basin as well (Rogers 2010), with every other remaining major basin represented by its own distinct lineage (Figure 1, right panel). Since the subspecies were described using phenotypic characters, and recent court cases have affirmed that visual characteristics should be central to the description of taxa (Kaeding 2003), the Recovery Team launched an additional research project with the Larval Fish Lab at Colorado State University to explore if distinct phenotypes can be predicted from these underlying genetic fingerprints. The results of this meristics study (Bestgen et al. 2013) largely support the genetic information that suggests six distinct lineages of cutthroat trout existed in Colorado.



Historically, native cutthroat trout could be found in streams within eight major drainage basins (colored areas) in Colorado. The traditional view (left panel in the above image) was that all five drainages west of the Continental Divide were home to Colorado River cutthroat trout, while greenback cutthroat trout occupied both the South Platte and Arkansas River basins, and the headwaters

of the Rio Grande contained its own namesake subspecies. Metcalf (2012) suggests that aside from the complex of the Colorado, Gunnison, and Dolores Rivers, complex, each major basin supported its own distinct lineage (right panel in the above image).

Of the six linages once found in Colorado, two are believed extinct, the Yellow Linage (Yellowfin cutthroat trout, and the as yet to be named San Juan River Lineage cutthroat trout. The four remaining linages of cutthroat trout in Colorado have seen dramatic reductions in their range, precipitated primarily by the introduction of nonnative salmonids. Rainbow trout hybridize with native cutthroat trout and brook and brown trout tend to outcompete them where they co-exist. In an effort to preserve the legacy of these fish, multi-agency conservation teams have been established. These teams have been working on conservation actions and measures to improve conditions and status of all lineages of cutthroat trout. All four linages look very similar and all are special status species (Greenback cutthroat are federally listed as threatened, Rio Grande cutthroat are candidates for listing under ESA, Blue lineage cutthroat trout are BLM sensitive species and have been petitioned for listing – found to be Not Warranted by USFWS on June 13, 2007, and Green lineage are currently considered as Threatened per USFWS Guidance (USFWS 2012).

Within the GJFO planning area, cutthroat trout have been documented in Brush Creek (tributary of Roan Creek), Bear Gulch, Brandon Ditch (Whitewater Creek), Cabin Reservoir, Payne Canyon, Brush Creek (of the Buzzard Creek drainage), Collier Creek, Little Dolores River, Left Fork Carr Creek, East Fork Big Creek, the upper reaches of Roan and the main stem of Carr Creeks and the Hawxhurst drainage. Cutthroat trout have also been documented in Bird Creek, the Little Dolores River, East and West Brush Creeks (tributaries of Buzzard Creek), and the Middle Fork of Big Creek; although these streams flow through private or US Forest Service surface land, they are located on federal mineral estate.

Green Lineage Cutthroat Trout

Based on recent genetic research (Metcalf et al. 2012), only one remaining population of true greenback cutthroat trout exists in Colorado. However, until such time as the genetic and physical characteristic research is interpreted and decisions are made, previously suspected greenback cutthroat trout (Green Lineage) populations in western Colorado will continue to be considered as greenbacks with regard to ESA compliance, per USFWS direction (USFWS 2012). Currently, seven conservation populations of Green Lineage cutthroat occur in the GJFO planning area and they are found in Brush Creek, East Fork Brush Creek, West Fork Brush Creek (Buzzard Creek drainage), Carr Creek, Roan Creek, East Fork Big Creek, and Middle Fork Big Creek.

The true greenback cutthroat trout is a salmonid native to the headwaters of the South Platte River drainage. Adult greenbacks are greenish brown to olive-

colored on the back with silvery to yellow sides and a white belly (red during spawning). They have a crimson slash under each side of the lower jaw and low numbers of large spots concentrated toward the tail fin. Greenback, like all cutthroat subspecies, inhabits cold-water streams and lakes with adequate spawning habitat present in the spring of the year. Spawning generally occurs when water temperatures reach 5 to 8 degrees Celsius. Greenback feed on a wide variety of organisms but their primary source of food is aquatic and terrestrial insects. Size and growth of greenbacks vary, based upon elevation and population size, typically 1 to 2 pounds maximum.

Blue Lineage Cutthroat Trout (Colorado River cutthroat trout)

Colorado River cutthroat trout (CRCT) were historically believed to be the native trout species of the western slope of Colorado. However, based on recent genetic research, blue lineage cutthroat trout appear to be native to the Yampa and Green river basins in Northwest Colorado. Based on review of historic fish stocking records, many CRCT were stocked into streams within the GJFO outside of their native range. Adult CRCT, like green lineage cutthroat trout, are greenish brown to olive-colored on the back with silvery to yellow sides and a white belly (red during spawning). They have a crimson slash under each side of the lower jaw and low numbers of large spots concentrated toward the caudal fin. They are very hard to distinguish visually from green lineage cutthroat trout.

CRCT, like all cutthroat subspecies, inhabit cold-water streams and lakes with adequate spawning habitat present in the spring of the year. Spawning generally occurs when water temperatures reach 5-to-8 degrees C. CRCT feed on a wide variety of organisms but their primary source of food is aquatic and terrestrial insects. Size and growth of greenbacks varies, based upon elevation and population size. This species typically does not reach a large size, generally 5 pounds maximum.

The CRCT is designated as a species of special concern by the CPW and is classified as a sensitive species by the BLM in Colorado. Declines in Colorado River cutthroat trout distribution have been documented in a number of reports (Behnke and Zarn 1976; Binns 1977; Martinez 1988; and Young 1995). Young (1995) determined most lotic populations reside in streams with average daily flows less than 0.85 cubic meters per second (30 cubic feet per second [cfs]). Stream gradients usually exceeded 4 percent, and all populations were found above 2,290 meters (7,500 feet). Colorado River cutthroat trout occupy 11 percent of their historical range (Hirsch et al. 2013). This species has been petitioned for federal listing under the ESA but was found "Not Warranted" by USFWS in 2007. In an effort to keep this species from becoming federally listed, a large range-wide inter-agency team consisting of BLM, USFS, USFWS, NPS, Ute Indian Tribe, and the States of Colorado, Utah, and Wyoming was formed. This group then completed the "Rangewide Conservation Agreement and

Strategy for Colorado River Cutthroat Trout in the States of Colorado, Utah, and Wyoming" (CRCT 2006).

Within the GJFO planning area, cutthroat trout have been documented in Brush Creek (tributary of Roan Creek), Bear Gulch, Brandon Ditch (Whitewater Creek), Cabin Reservoir, Whitewater Creek, Payne Canyon, Brush Creek (of the Buzzard Creek drainage), Brush Creek (of the Roan Creek drainage), Cabin Reservoir, Collier Creek, Little Dolores River, Left Fork Carr Creek, East Fork Big Creek, the upper reaches of Roan and the main stem of Carr Creeks and Hawxhurst and Coon Creek drainages. Cutthroat trout have also been documented in Bird Creek, the Little Dolores River, East and West Brush Creeks (tributaries of Buzzard Creek), and the Middle Fork of Big Creek; although these streams flow through private or US Forest Service surface land, they are located on federal mineral estate.

Threats to this species include introduction of non-native trout species, poor livestock grazing practices, energy development, water diversions, climate change, water quality changes, disease, and habitat alteration.

To help prevent the need to federally list cutthroat subspecies, the BLM works with cooperating agencies to sample suitable habitats and collect and analyze fin clip tissue samples to determine the genetic status of cutthroat subspecies and identify their distribution. BLM staff also conducts Land Health Assessments at a watershed scale to evaluate cutthroat trout habitat conditions, and thereby help direct habitat management for these fish.

Big River Fish Species

Seven big river fish species or their critical habitat are found in the GJFO planning area, including roundtail chub, bluehead sucker, flannelmouth sucker, Colorado pikeminnow, razorback sucker, bonytail, and humpback chub.

The Roundtail Chub, Bluehead Sucker, and Flannelmouth Sucker are collectively known as the "Three Species." All three have seen significant reductions in their occupied range and all three are BLM sensitive species. These fish are addressed in the document: "Range-Wide Conservation Agreement and Strategy for Roundtail Chub, Bluehead Sucker, and Flannelmouth Sucker (Colorado River Fish and Wildlife Council 2006)." BLM Colorado is one of several signatories to this agreement that include the states of Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming, the BLM in New Mexico, Utah, and Wyoming, and the Park Service's Intermountain Region, as well as the Jicarilla Apache Nation. As a signatory, BLM Colorado has made commitment to implement identified strategies to improve habitat conditions, minimize negative effects, and improve populations. These efforts are intended to preclude the need to list them as threatened or endangered under the ESA.

Roundtail Chub. This species inhabits pools and rapids of moderate to large rivers and large reservoirs and selects cobble-rubble, sand-cobble, or sand-gravel

substrate in association with undercut banks, fallen logs, or other overhead cover (Rees et al. 2005a). Within the GJFO planning area, roundtail chub have been observed in the Dolores, Gunnison, and Colorado Rivers and their major tributaries, including but not limited to Plateau Creek and East Salt Wash.

Bluehead Sucker. This species inhabits a variety of habitats from headwater streams to large rivers, in moderate to fast-flowing water above a rubble-rock substrate (Ptacek et al. 2005). Young fish prefer quiet, shallow areas near the shoreline. In the GJFO planning area, bluehead suckers have been observed in the Dolores, Gunnison, and Colorado Rivers and their major tributaries, including, but not limited to, Blue Creek, West Creek, Bieser Creek, East Salt Creek, Carr Creek, and Plateau Creek.

Flannelmouth Sucker. This species is found in a wide variety of habitats, ranging from riffles to backwater areas to large pools, in larger rivers and streams (Rees et al. 2005b). Within the GJFO planning area, these fish are found primarily in the Dolores, Colorado, and Gunnison Rivers and portions of the major tributaries to these rivers where no barriers preclude movement between the river and the streams. Some tributary streams may be used seasonally for spawning. Threats to flannelmouth sucker, bluehead sucker, and roundtail chub include impairment of water quality, disease, introductions of nonnative fish, predation, hybridization, reductions in flow, and physical changes and loss of important habitats. Plateau Creek provides habitat for all three species and is believed to be used year-round by these species.

BLM Colorado is a signatory to the Range-Wide Conservation Agreement and Strategy for Roundtail Chub, Bluehead Sucker, and Flannelmouth Sucker (Colorado River Fish and Wildlife Council 2006), which was developed to expedite implementation of conservation measures for these three species across their range as a collaborative and cooperative effort among resource agencies.

Colorado Pikeminnow, Razorback Sucker, Bonytail, and Humpback Chub. All four of these native fish are federally listed as endangered under the ESA. Ongoing efforts to recover these fish in Colorado are being led by the Upper Colorado River Endangered Fish Recovery Program, a partnership of local, state, and federal agencies, water and power interests, and environmental groups. Initiated in 1988, primary work includes restoring and managing stream flows and habitat, boosting wild populations with hatchery-raised endangered fish, and reducing negative interactions with certain nonnative fish species.

Within the GJFO planning area, the 100-year floodplain of the Colorado River from the eastern boundary of the GJFO to the Utah state line and beyond, as well as the 100-year floodplain of the Gunnison River from the southern GJFO boundary to the confluence with the Colorado River, is designated critical habitat for the Colorado pikeminnow (squawfish) and razorback sucker (USFWS 1994). Designated critical habitat for bonytail and humpback chub is

located along the Colorado River from Black Rocks in Colorado to Fish Ford River in Utah (USFWS 1994). All four species require a diversity of habitats at varying life stages. Colorado pikeminnow generally prefer swift-flowing turbid rivers with quiet, warm backwaters and adequate spawning substrates (USFWS 1994). The humpback chub prefers deep turbid pool habitats often found in canyon-bound portions of the Upper Colorado River system (USFWS 1994). This species is found in the Black Rocks area near the Colorado-Utah border and in Westwater Canyon west into Utah along the Colorado River (USFWS 1994). The razorback sucker is most often found in quiet, muddy backwaters along the Colorado River but uses main channel habitats as well (USFWS 1994). The bonytail is extremely rare in Colorado, and no self-sustaining populations exist throughout the Colorado River Basin (USFWS 1994). This species prefers swift turbid reaches of the Colorado River basin but is now found only in portions of the Green River and Lake Mohave (USFWS 1994). The alteration of habitats due to construction and operation of large dams that capture sediment, reduce water temperatures, change river morphology below the dams, and cut off migration corridors is one of the major factors that have contributed to the decline of these species (USFWS 1994). Other factors that have contributed to their decline include reductions in water flow caused by water diversions and other water-depleting activities, and introductions of nonnative predatory game fish species such as smallmouth bass, northern pike, and channel catfish. A recovery program managed by USFWS has been underway for several years. Threats to these fish include impairment of water quality, disease, introduction of nonnative fishes, hybridization, reductions in flow, and physical changes and loss of important habitats.

Amphibians

Four BLM sensitive amphibian species occur in the GJFO planning area (BLM 2009e) (see **Table 3-15**, Fish and Wildlife Species of Primary Interest in BLM's Environmental Planning, in **Section 3.2.7**, Fish and Wildlife). Two of these species also have state designations.

Federally Listed or Candidate Species

No amphibians listed as threatened or endangered under the ESA are known to exist in the GJFO planning area (USFWS 2009a).

BLM Sensitive Species

Four BLM sensitive species of amphibians are known to occur in the GJFO planning area (BLM 2009e) (see **Table 3-15**, Fish and Wildlife Species of Primary Interest in BLM's Environmental Planning, in **Section 3.2.7**, Fish and Wildlife).

Boreal Toad (Anaxyrus boreas boreas). This toad species inhabits a variety of wet habitats, including marshes, wet meadows, streams, beaver ponds, glacial kettle ponds, and lakes interspersed in subalpine forest at altitudes primarily between 8,000 and 12,000 feet (USFWS 2009c). There has been one observation of this

species within the GJFO, just south of Collbran in 1991. There are numerous observations of the species on the Grand Mesa on National Forest lands (Lampert 2006). BLM lands within the GJFO are generally lower that what the species typically inhabits. Additional information on the species and recovery efforts can be found in the 2001 Conservation plan and agreement for the management of the southern rocky mountain population of the boreal toad.

Canyon Treefrog (Hyla arenicolor). This frog is largely restricted to riparian areas in rocky canyons. It is typically found along streams among medium to large boulders from desert to desert grassland and into oak-pine forests (Stebbins 1985). Within the GJFO planning area, it is found in rocky canyons south of the Colorado River and west of the Gunnison River.

Great Basin Spadefoot (Spea intermontana). This toad occurs mainly in sagebrush flats, semi-desert shrublands, and pinyon-juniper woodland. This species digs its own burrow in loose soil or uses those of small mammals, and it breeds in temporary or permanent water, including rain pools, pools in intermittent streams, and flooded areas along streams (NatureServe 2009). Within the GJFO, it occurs from the Book Cliffs to Glade Park.

Northern Leopard Frog (Rana pipiens). This frog generally inhabits permanent water with rooted aquatic vegetation (NatureServe 2009). Northern leopard frog was observed in all corners of the GJFO during surveys conducted in 2008 (BLM 2008g).

Reptiles

Federally Listed or Candidate Species

No ESA-protected reptile species are known to occur in any of the counties in the GJFO planning area (USFWS 2009a).

BLM Sensitive Species

Three BLM sensitive species have been documented in the planning area (BLM 2009e).

Long-Nosed Leopard Lizard (Gambelia wislizenii). Habitat for this lizard includes desert and semidesert areas with scattered shrubs or other low plants such as creosotebush and sagebrush, especially areas with abundant rodent burrows (Stebbins 1985).

Midget Faded Rattlesnake (Crotalus oreganus concolor). Habitat for this snake is high, cold desert dominated by sagebrush with an abundance of rock outcrops and exposed canyon walls. Greasewood, juniper, and other woody plants may occur in some areas (Travsky and Beauvais 2004).

Milk Snake (Lampropeltis triangulum). Habitat for this BLM sensitive subspecies of milk snake is not well documented.

Birds

Eighteen special status bird species occur or have the potential to occur in the GJFO planning area (USFWS 2009a, CPW 2007, BLM 2009e) (see **Table 3-15**, Fish and Wildlife Species of Primary Interest in BLM's Environmental Planning, in **Section 3.2.7**, Fish and Wildlife).

Federally Listed or Candidate Species

The Mexican spotted owl *(Strix occidentalis lucida)* and southwestern willow flycatcher *(Empidonax traillii extimus)* are two species listed under the ESA that have never been documented on BLM-administered lands within the GJFO planning area but that have some potential to occur. The western yellow-billed cuckoo and the Gunnison Sage-Grouse are listed as threatened, and both occur in the planning area. The Greater Sage-Grouse is a candidate for listing under ESA.

Mexican Spotted Owl. The Mexican spotted owl can be found in the forested mountains and canyons of central and western Colorado and southern Utah south through Arizona and New Mexico into Central Mexico. The owl's distribution in this range is not contiguous but occurs in patches of suitable habitat. Mexican spotted owl uses mixed-conifer forests throughout most of their range (USFWS 1995). The Mexican spotted owl occurs in southwestern Colorado but has never been recorded on BLM-administered lands within the GJFO planning area. While potential habitat for the species does occur in the GFJO planning area, the closest designated critical habitat for the species occurs approximately 30 miles southwest of the field office boundary in San Juan County, Utah (USFWS 2004).

Southwestern Willow Flycatcher. This songbird requires extensive riparian habitat with dense patches of trees or shrubs with slow to still water available at or near nesting habitat (USFWS 2002). The GJFO planning area is on the edge of the range of the southwestern willow flycatcher. This subspecies has never been recorded in the GJFO, and the USFWS no longer lists the species as potentially occurring in Mesa County (USFWS 2009a).

Western Yellow-Billed Cuckoo (Coccyzus americanus). This subspecies' habitat includes old-growth riparian woodlands with dense understories (Carter 1998). Potential habitat for the cuckoo exists along the Colorado, Gunnison, and Dolores Rivers within the GJFO planning area. During surveys conducted in 1998, one presumed pair was located at Corn Lake State Park, along the Colorado River within the planning area. The species has also been detected in the Grand Junction State Wildlife Area, along the Gunnison River near the confluence of the Colorado River, and at the Bishop State Wildlife area (south of the Colorado River near Palisade) in 2013 and 2014, though breeding in these areas was not suspected (John Toolen, personal communication, September 4, 2014). On October 3, 2014, the USFWS announced that it had determined that the yellow-billed cuckoo requires the protection of the Endangered Species Act

as a threatened species. On August 15, 2014 and again on November 12, 2014 the USFWS announced a proposal to designate critical habitat for the western distinct population segment of the yellow-billed cuckoo under the Endangered Species Act of 1973. The comment period for the proposed critical habitat rule closed on January 12, 2015.

Gunnison Sage-Grouse. On November 12, 2014, the USFWS announced that it had determined that the Gunnison Sage-Grouse, a ground-dwelling bird found only in southwestern Colorado and southeastern Utah, requires the protection of the Endangered Species Act as a threatened species. The Piñon Mesa population of Gunnison Sage-Grouse occurs entirely within the GJFO planning area in the Glade Park area (**Figure 3-11**, Sage-Grouse Habitat). Historically, leks occurred on BLM-administered lands; however, currently the birds primarily use private land in the southwest corner of Glade Park. The CPW began augmenting this population in 2010; immediate results of increased males in lek counts were not observed as males at leks dropped to 11 in 2012 but jumped to 31 in 2013. The large jump is partly due to finding a new lek with 8 birds on it but also to increased overall numbers that may be attributable to the transplant efforts. A conservation plan for this population was completed in 2000 (Piñon Mesa Gunnison Sage-Grouse Partnership 2000), and a rangewide conservation plan for the species was completed in 2005 (Gunnison Sage-Grouse Rangewide Steering Committee 2005). The BLM has been actively managing public lands in the Glade Park area to improve Gunnison Sage-Grouse habitat through mechanical treatments and prescribed fire. Recent data on greater and Gunnison Sage-Grouse populations within the GJFO planning area are provided in **Table 3-17**, Estimated Sage-Grouse Populations.

On July 15, 2013, the BLM Colorado State Office issued IM 2013-033, Gunnison Sage-grouse Habitat Management Policy on Bureau of Land Management-Administered Lands in Colorado. This guidance provides updated direction regarding management and ongoing planning actions in Gunnison Sage-Grouse proposed critical habitat. It also reiterates BLM Colorado's existing policy to defer leasing of occupied Gunnison Sage-Grouse habitats until RMP Revisions, including the GJFO RMP revision, or Amendments have been completed.

On May 30, 2014, the BLM issued IM 2014-100, Gunnison Sage-Grouse Habitat Management Policy on Bureau of Land Management-Administered Lands in Colorado and Utah. This interim guidance requires the BLM to focus any type of development in non-habitat areas. Disturbance will be focused outside of a 4-mile buffer around leks. The BLM intends that little or no disturbance occur within the 4-mile buffer, except for valid existing rights, and except where benefits to the Gunnison Sage-Grouse are greater compared to other available alternatives.

Table 3-17
Estimated Sage-Grouse Populations

Year	High Count Males on Lek
Greater Sage-Grouse (PPR Population)[1]	
1975*	234
2005*	184
2006	226
2007	178
2008	103
2009	95
2010	77
2011	106
2012	170
2013	127
Gunnison Sage-Grouse (Piñon Mesa Population)[2]	
1995	16
1996	24
1997	23
1998	26
1999	29
2000	33
2001	31
2002	27
2003	25
2004	29
2005	34
2006	33
2007	26
2008	22
2009	16
2010	15
2011	13
2012	11
2013	31

[1]Source: Parachute-Piceance-Roan (PPR) Greater Sage-Grouse Work Group 2008
[2]Source: CPW 2011
*Data collected between 1975 and 2005 for Greater Sage-Grouse are considered unreliable because of varied effort and difficulty in collecting accurate lek counts in the area.

On July 18, 2014, the BLM issued a notice in the Federal Register announcing the agency's intention to incorporate conservation measures into BLM land use plans and prepare an associated EIS in order to protect Gunnison Sage-Grouse habitat across the species' range. The EIS is slated for completion by July 2016. The range-wide planning area will consist of more than 625,000 acres of BLM surface estate in Chaffee, Delta, Dolores, Gunnison, Hinsdale, Mesa, Montrose, Ouray, Saguache, and San Miguel counties in Colorado and Grand and San Juan counties in Utah. BLM Colorado will lead the effort to evaluate existing and

potential measures for protecting occupied and potential Gunnison Sage-Grouse critical habitat on behalf of BLM Colorado and BLM Utah. These conservation measures will be incorporated into applicable BLM land use plans, including the new GJFO RMP.

Greater Sage-Grouse. In March 2010, the USFWS announced a 12-month finding that listing the Greater Sage-Grouse (rangewide) is warranted, but precluded by higher priority listing actions (USFWS 2010a). The species was placed on the candidate list range-wide. In December of 2011 the BLM released IM 2012-044, BLM National Greater Sage-Grouse Land Use Planning Strategy. This IM included a report on national Greater Sage-Grouse conservation measures produced by the Sage-Grouse National Technical Team (NTT report). The IM and the NTT report outline conservation measures for preliminary general habitat (PGH) and preliminary priority habitat (PPH). The Parachute-Piceance-Roan (PPR) population of the Greater Sage-Grouse occurs on the northeastern side of the GJFO planning area (**Figure 3-11**, Sage-grouse Habitat), and Colorado has identified 5,600 acres of PPH and 8,900 acres of PGH. The Colorado Greater Sage-Grouse Conservation Plan (Colorado Greater Sage-Grouse Steering Committee 2008) shows a larger portion of the GJFO planning area as potential pre-settlement habitat based on historic sagebrush distribution, encompassing everything above the Book Cliffs and portions of the Grand Mesa slopes (though the plan identifies this as an area where the species of sage-grouse is uncertain). Sixteen active and inactive Greater Sage-Grouse leks occur within the GJFO planning area; three occur on BLM-administered lands, and thirteen occur on private lands. Of these sixteen leks, seven are considered active; two of the active leks occur on BLM-administered lands. In the winter of 2008, sage-grouse droppings were found within the GJFO just north of the town of Mesa, in an area between occupied Gunnison Sage-Grouse habitat and Greater Sage-Grouse habitat. A follow-up study was conducted in the winter of 2009 by the Rocky Mountain Bird Observatory where numerous droppings and cecal casts were discovered, suggesting the area is an important wintering area. Genetic information could not be collected from the droppings and cecal casts, therefore the species of sage-grouse (Gunnison or Greater) is still unknown (Beason 2009), but is believed to be Greater Sage-Grouse. More detailed information on this population can be found in the PPR Conservation Plan (PPR Greater Sage-Grouse Work Group 2008), the Colorado Greater Sage-Grouse Conservation Plan (Colorado Greater Sage-Grouse Steering Committee 2008), and the Western Association of Fish and Wildlife Agencies' Greater Sage-Grouse Comprehensive Conservation Strategy (Stiver et al. 2006).

On December 9, 2011 the BLM issued a notice in the Federal Register announcing the agency's intention to incorporate conservation measures into BLM land use plans and prepare an associated EIS in order to protect Greater Sage-Grouse habitat across the species' range.

BLM Sensitive Species

Fifteen BLM sensitive bird species have potential to occur in the GJFO planning area (BLM 2009e) (see **Table 3-15**, Fish and Wildlife Species of Primary Interest in BLM's Environmental Planning, in **Section 3.2.7**, Fish and Wildlife).

American Peregrine Falcon. Peregrine falcons use cliff and canyon habitats for breeding. Foraging areas include riparian zones and nearshore environments where waterfowl and riparian birds may be found. The species was removed from the Endangered Species List in 1999 (USFWS 1999). This falcon has been known to nest on within the GJFO since the late 1970's and there are at least 17 documented current or former nests on BLM-administered lands within the GJFO, and there are likely many more than that. Nesting sites are concentrated in DeBeque, Dolores, Ruby, and Unaweep canyons; Black Ridge; and the Book Cliffs in the eastern end of the Grand Valley.

American White Pelican (Pelecanus erythrorhynchos). This species generally breeds in colonies on islands in large bodies of water and forages up to 30 miles away in marshes, rivers, and lakes (Potter 1998). Pelicans were seen at Cheney Reservoir in 2011 and are known to forage there.

Bald and Golden Eagles. Bald eagles generally nest in large trees near rivers and lakes with abundant fish. In winter they are more transient and occur where food, including fish, waterfowl, and carrion, is available. The bald eagle was removed from the endangered species list in 2007 (USFWS 2007). Bald and golden eagles are both protected by the Bald and Golden Eagle Protection Act. Bald eagles nest on the Colorado River and winter along the Colorado, Gunnison, and Dolores Rivers and along Plateau Creek in the GJFO planning area. Golden eagles generally nest on cliffs throughout the planning area and forage on small- to medium-sized mammals, such as rodents and rabbits, in open habitats.

Brewer's Sparrow (Spizella breweri). This sparrow occurs primarily in sagebrush habitats, particularly big sagebrush, and arrives on breeding grounds in April (Lambeth 1998). Occurrence records are across the GJFO but species trends are unknown.

Burrowing Owl. This owl occurs in sparsely vegetated grasslands, shrublands, and deserts and nests primarily in rodent burrows. In western Colorado, they use burrows of prairie dogs and ground squirrels (Jones 1998), and are generally highly dependant on prairie dog burrows. Based on recent surveys conducted by the Rocky Mountain Bird Observatory, Burrowing owls seem to be increasing in numbers in the GJFO since an apparent drop off in numbers during the drought of 2002 (Beason 2008).

Ferruginous Hawk. This hawk inhabits ungrazed or lightly grazed grasslands and shrublands with varied topography. They tend to nest on hilltops in trees or other structure when available but also nest on the ground (Preston 1998). This

species is believed to be declining in the GJFO as active nests have not been documented since the late 1990s. Formal monitoring of this species has not occurred since the late 1990's, however informal surveys conducted in spring 2011 indicate that areas utilized for nesting 20 years ago still show signs of possible nesting activity.

Long-billed Curlew. This large shorebird occurs primarily in shortgrass prairie with nearby standing water for feeding and drinking (Nelson 1998a). In Colorado it primarily occurs on the eastern plains but is believed to exist in Mesa County (Nelson 1998a).

Mountain Plover (*Charadrius montanus*). Mountain plovers typically breed in sparsely vegetated upland areas. The species is primarily found in upland areas and is often associated with prairie dog colonies, as prairie dogs keep the vegetation cover sparse. It has not been documented on BLM-administered lands in the GJFO planning area (BLM 2009e).

*Northern Goshawk (Accipiter gentilis).*This raptor requires large blocks of forest for nesting and foraging and tends to be intolerant of human disturbance around nests. Most nests occur in coniferous forests. However, details of habitat types used vary considerably (Barrett 1998).

Western Snowy Plover (Charadrius alexandrinus nivosus). Inland populations of this shorebird occur on ephemeral alkali playas, reservoir shores, and man-made habitats such as evaporation ponds (Nelson 1998b).

White-faced Ibis (Plegadis chihi). This species nests primarily in marshes with tall emergent vegetation such as cattails and rushes. They feed in marshes, other shallow water bodies, and flooded agricultural lands (Ryder 1998).

Mammals

Twelve special status mammal species occur or have some potential to occur in the GJFO planning area (USFWS 2009a; CPW 2007; BLM 2009e) (see **Table 3-8**, Fish and Wildlife Species of Primary Interest in BLM's Environmental Planning, in **Section 3.2.7**, Fish and Wildlife).

Federally Listed or Candidate Species

The GJFO planning area contains suitable habitat for two federally listed mammal species, black-footed ferret and Canada lynx. In addition, there is some potential for future occurrence of gray wolf.

Black-footed Ferret (Mustela nigripes). The black-footed ferret does not currently occur within the GJFO planning area and is unlikely to become established without reintroduction effort. This species' habitat is shortgrass and midgrass prairie to semidesert shrublands and is associated with large prairie dog colonies (USFWS 1988). Populations have been established in the White River Field Office north of Grand Junction through introductions, but because of

topographic barriers these animals are unlikely to move into the GJFO planning area on their own.

Canada Lynx (Lynx canadensis). Lynx occurrence is highly correlated with the habitat of their primary prey, snowshoe hare. They occur in uneven-aged coniferous stands with relatively open canopies and well-developed understories (Armstrong et al. 2011). The CPW began reintroducing lynx to Colorado in 1999 (CPW 2009b). Canada Lynx has been recorded on US Forest Service-administered lands adjacent to the GJFO planning area. Several lynx analysis units have been designated in the vicinity of Collbran and provide habitat for the lynx. Primary habitat for the species occurs only in small pockets on high-elevation BLM lands. As the species' range in Colorado continues to expand, BLM lands are more likely to be used for dispersal and foraging.

Gray Wolf (Canis lupus). Historically, gray wolves were spread across North America, including Colorado and the GJFO planning area, in areas where prey density (primarily hoofed mammals) was sufficient, regardless of habitat type (Armstrong et al. 2011). Gray wolves reintroduced into Yellowstone National Park provide the closest source of dispersing individuals. Individuals from the Yellowstone population have been documented in Colorado in recent years. Therefore, there is some potential for wolves to occur in the GJFO planning area during the lifespan of this RMP.

BLM Sensitive Species and State-listed Species

Nine BLM sensitive species and state-designated mammals could occur in the GJFO planning area (CPW 2007, BLM 2009e).

Big Free-tailed Bat (Nyctinomops macrotis). This species is the largest bat in Colorado. They roost in crevices on cliff faces or in buildings. Its habitat requirements are not well known (Armstrong et al. 2011).

Desert Bighorn Sheep. Bighorn sheep prefer steep areas with good visibility, grass cover, and low shrubs (Armstrong et al. 2011). This subspecies of bighorn occurs south of the Colorado River and west of the Gunnison River. There are three populations of desert bighorn sheep in the GJFO planning area. These include the Black Ridge wilderness population, the Uncompahgre or Dominguez population, and the Middle Dolores River population. The Black Ridge wilderness population primarily inhabits the McInnis Canyons NCA. This herd was established by four translocations since 1979; the population is believed to be stable and estimated at 230 individuals (CPW 2010b). The Black Ridge and Uncompahgre populations use portions of the GJFO planning area; however, their core habitat areas are within the NCAs not included in this RMP revision. Only a very small portion of the Middle Dolores River population occurs within the GJFO planning area.

Kit Fox (Vulpes macrotis). This state endangered species occurs in semidesert shrubland and margins of pinyon-juniper woodlands, including mixed juniper-

sagebrush communities and rimrock, and lower elevation sagebrush such as the patches growing in the Grand Valley (Armstrong et al. 2011). Kit fox historically occurred in the GJFO planning area. The last known den site was just north of the Grand Junction Regional Airport, observed in the early 1990s. From 2008 to 2011 surveys were conducted for Kit Fox north and west of the town of Grand Junction. One probable kit fox track was found near Badger Wash, in addition CPW biologists reported seeing a kit fox just north of Badger Wash, and surveyors reported finding one possible kit fox den near Horse Mountain, just south of the Town of Palisade, in 2010. Kit fox are known to occur and active dens exist in Utah, just a few miles west of the Colorado border. In 2012, a four-month camera survey was conducted with approximately 15 cameras deployed across the Grand Valley on BLM land. No kit foxes were documented, probably due to the abundant presence of other carnivores more habituated to the urbanization in the area (CPW 2013).

River Otter (Lontra canadensis). This state threatened species inhabits riparian areas along rivers and streams. Otters require water year-round and feed on fish and crustaceans (Armstrong et al. 2011). River otters were extirpated in Colorado until 1976, when the CPW began reintroducing them into major waterways. River otter occur on the Colorado, Gunnison, and Dolores Rivers in the GJFO planning area.

Spotted Bat (Euderma maculatum). This bat has been documented in ponderosa pine, pinyon-juniper woodlands, and open semidesert shrublands. They roost in crevices in cliffs (Armstrong et al. 2011). A mummified specimen of a lactating female was collected in the summer of 2011 from the Loma area providing evidence for this species in the Grand Valley. In addition, the species has been captured in Sinbad Valley on two different occasions.

Townsend's Big-Eared Bat. This bat occurs in semidesert shrublands, pinyon-juniper woodlands, and open montane forests. It roosts in caves, mines, abandoned buildings, and cliffs (Armstrong et al. 2011). The Townsend's big-eared bat is known to occur in the planning area. There are two known maternity roosts in the planning area, one of which, the Pup Tent mine site, was withdrawn in 2008 from settlement, sale, location, or entry under the general land laws, including the mining laws, subject to valid existing rights. The second location is within a leased coal area.

White-tailed Prairie Dog. This colonial rodent occurs primarily in semidesert shrublands in Colorado (Armstrong et al. 2011). Their colonies provide habitat for numerous other species. White-tailed prairie dogs and the many species that are associated with this keystone species are present in the lower elevations of the GJFO planning area. Persitence of white-tailed prairie dogs is uncertain given periodic plague outbreaks, but populaitons appeard to be stable when last surveyed (in 2011). The prairie dog populations north of the Colorado River seem to have recovered from a large plague event in the Grand Valley in the

early 1990s, while the prairie dog towns south of the Colorado River are still sparsely occupied.

Invertebrates

BLM Sensitive Species
One special status invertebrate is known to occur in the GJFO planning area.

Great Basin Silverspot (Speyeria nokomis nokomis). This butterfly occurs in permanent spring-fed meadows, seeps, marshes, and boggy streamside meadows associated with flowing water in arid country (Selby 2007). The Unaweep Seep ACEC (**Figure 2-65**, Alternative A: Areas of Critical Environmental Concern) was established in part to protect this sensitive butterfly species.

Trends
For most of the special status species, habitat loss and fragmentation have been and remain the primary cause of their imperiled status. Some of these species have also suffered from historic efforts to extirpate them, and some suffer competition or predation from species that have expanded their range or that have been introduced. Management efforts by the BLM, USFWS, CPW, and others have reversed the downward trend for a number of these populations, but none of the populations are near their historic levels, and most remain at levels that are biologically insecure, regardless of their legal status. In addition to continued threats from habitat loss and fragmentation, variability in habitat condition is an ongoing factor in the distribution and density of these special status species. For example, population viability for special status plant, fish, and amphibian species varies with hydrologic conditions. Soil conditions further influence the populations of plants.

The GJFO does not have monitoring data for most special status species. However, the CPW maintains monitoring data for some species and a few local and national trends have been documented by the BLM and others including::

- Declines in the distribution of Colorado River cutthroat trout have been documented in a number of sources (Behnke and Zarn 1976; Binns 1977; Martinez 1988; Young 1995).
- Peregrine falcon and bald eagle have been delisted in recent years because they met the goals set for recovery of each species.
- Consistent lek counts using standardized methodology were implemented in 1995 for this population. The number of males attending leks has varied over time, from a high of 34 in 2005 to 11 in 2012. The CPW began augmenting the population in 2010, while immediate results of increased males in lek counts were not observed the number of males on leks did increase in 2013 to 31. This large jump is partly due to finding a new lek with eight birds on it but is also believed to be due to the augmentation efforts.

- CPW reintroduced Canada lynx to Colorado starting in 1999 and the population appears to be expanding (CPW 2009b).

3.2.9 Wild Horses

Wild horse management on BLM-administered lands of the GJFO follows the Wild Free-Roaming Horse and Burro Act of 1971 (Public Law 92-195) and 43 CFR 4700 – Protection, Management and Control of Wild and Free-Roaming Horses and Burros. There is one herd of horses within the GJFO planning area. These horses are found within the Little Book Cliffs Wild Horse Range (LBCWHR). The LBCWHR Management Plan was signed on September 24, 1979, and was updated in 1984, 1990, and 1992. On November 7, 1980, the area was dedicated as the third National Wild Horse Range in the country. In June 2002, the LBCWHR Population Management Plan was written, which amended the original plan (BLM 2002). Wild horses within the range are managed to maintain a healthy, thriving wild horse herd while maintaining or improving rangeland conditions and remaining compliant with the Colorado Standards and Guidelines that became effective in 1997.

Current Conditions

The LBCWHR is part of the larger Little Book Cliffs Herd Area (approximately 52,600 acres), which was established after passage of the 1971 Wild and Free-Roaming Horses and Burros Act. The LBCWHR is 10 miles northeast of Grand Junction and 20 miles west of DeBeque, Colorado, atop the Book Cliffs escarpment. It is 13 miles long and encompasses 36,014 acres, of which 35,189 are public and 925 are private. The Little Book Cliffs WSA makes up about two-thirds of the range (**Figure 2-4**, Alternatives A, B, C, and D: Little Book Cliffs Wild Horse Range). As reflected in the Population Management Plan, the appropriate management level changed in 2002 from a range of 65 to 125 horses, to a range of 90 to 150 horses. The boundary of the range is composed of natural barriers, along with some fencing to prevent wild horses from leaving the range. There are no fences within the range, allowing horses to roam freely within the confines of the defined boundary. There is no authorized livestock grazing within the range.

The LBCWHR is characterized by numerous deep canyons interspersed with rugged mesas, ridges, and small drainages. Elevation varies from 7,412 feet in the far northwestern corner to 5,000 feet in Main Canyon at the southwestern boundary. The area receives 8 to 16 inches of annual precipitation, and the climate is typical of the Rocky Mountain Region, with warm summers and cold winters. Vegetation types within the LBCWHR include sagebrush/bunchgrass, saltbush, mountain shrub, and pinyon-juniper woodlands.

Several vegetation treatments have occurred at the upper elevations to improve forage for wild horses and to reduce fuel loading, particularly in the pinyon-juniper and sagebrush vegetation types. Treatments included chaining, prescribed burning, hydro-axing, and rollerchopping. Seeding the area was

included in most of these treatments. Until the 1,700-acre Cosgrove Fire in 2011, wildfire had not played a major role within the range.

Besides the vegetation treatments to improve forage for wild horses, 17 springs have been developed to improve water availability. Maintenance on these springs and on fences occurs annually with the help of volunteers.

Monitoring within the LBCWHR includes exclosures, vegetation trend studies, and vegetative utilization estimates that measure grazing use by the wild horses in various areas of the range. These studies are used along with census data to determine when population reductions through gathers are needed.

The estimated population in 2008 was 121 head, which included 16 new foals. The current wild horse population is estimated to be within the current management range. The mare/stud ratio is maintained at approximately 50/50, which enables the horses to sustain smaller bands of 3 to 8 head.

Trends

To maintain populations at a sustainable level, the herd has been gathered 12 times between 1975 and 2007. Frequency of gathers has been two to four years, depending on range conditions. It is the GJFO's intent to reduce the frequency of gathers by continuing the implementation of fertility control measures. Selective removal and the introduction of wild horses from other management areas have increased the genetic diversity of the herd as well as increased the diversity of color and overall conformation.

In 2002, a fertility control research program in the LBCWHR was initiated in coordination with the Biological Research Division of the USGS. The goal of this program was to reduce the growth rate of the population. The fertility program has reduced the population growth for the herd but still allows for some reproduction to improve or maintain genetic diversity. The use of contraceptives has long been recognized as a humane means of limiting the growth of wild horse herds while providing less disruption to the herd gene pool. Individual contracepted mares have their genetic contributions delayed but not removed. Thus far the use of fertility control has increased the timeframe between gathers, with associated cost benefits and reduction of resource impacts.

A continuation of the fertility control program should provide for a viable horse population, while reducing the number of horses removed from the range over time as a result of fewer gathers. Fewer gathers is based on a decrease in the annual population growth.

3.2.10 Wildland Fire Management

Fire, as the main disturbance agent within ecosystems of the GJFO planning area, plays a critical role in shaping vegetative characteristics. Fire suppression practices of the twentieth century have pushed some ecosystems outside their

historic range of variability due to increased fuel accumulations, higher densities of trees and shrubs, and increased ladder fuels. As a result, these areas of the planning area are prone to higher-intensity wildfires than historically experienced.

Current fire management direction encourages use of planned fire, unplanned fire, and nonfire fuel reduction treatments to restore natural fire regimes and to promote the overall ecological health of public lands. Fire management decisions reflect the protection of human life as the single, overriding priority. BLM's management actions include suppression of natural and human-caused wildfires, vegetation treatments to control fire in appropriate areas (e.g., the Wildland-Urban Interface [WUI]), and the use of both planned and unplanned fire events to manage plant succession, restore ecosystem characteristics, and improve wildlife habitat.

The occurrence of wildland fire varies from year-to-year depending on weather, climatic, and other conditions. Fire occurrence and size can depend on a range of factors, including elevation, vegetative community, fuel moisture, precipitation or lack of precipitation, the ability of fire to carry in specific types of vegetation, and other climatic dynamics such as dry summer weather following a wet spring or extended periods of drought.

Current Conditions

Fire History

From 1980 to 2008, the GJFO averaged 67 fires a year covering 2,863 acres annually. The weather and fuel structure provide an opportunity for ignitions from frequent summer storms, and lightning fires have traditionally been an integral factor in the formation and arrangement of vegetation types across the GJFO planning area. Lightning accounts for 85 percent of all starts and approximately 50 percent of the acres burned. Historically, the area has displayed a moderate to high frequency of fires (BLM 2009d).

More recently, the combination of wildfire suppression and changing land use patterns has altered the natural cycle and role of fire. Suppression actions have resulted in large, unnatural fuel loads across the landscape, while invasive species such as cheatgrass and saltcedar are fire-adapted and tend to become monoculture after a fire occurs on lower elevations (below 7,500 feet). Wildland fires will burn with greater intensities and spread more rapidly, consuming more acres than in the past under these altered landscape conditions.

The fire season for the GJFO planning area normally extends from late April to early November. The most critical fire conditions are often present from mid-June until late summer, when monsoonal moisture pushes into the area, and again from late August through October, before season-ending winter weather arrives.

Fires are categorized on the basis of period of occurrence, size class, regime, and condition class. Size class classifications range from A (one-fourth acre or less) to G (5,000 acres or more). From 1980 to 2008, 94.1 percent of the wildfires that occurred within the GJFO planning area were less than 100 acres in size, or Class A to Class C incidents. **Table 3-18**, Fire Occurrence 1980 to 2008, displays the size and number of fires by size class in the GJFO planning area for that timeframe.

Table 3-18
Fire Occurrence 1980 to 2008

Size Class[1]	A	B	C	D	E	F	G
Number of fires	1,301	369	175	41	32	21	2
Number of acres	158	982	5,375	8,788	16,849	39,965	10,917

Source: BLM 2010a
[1]Size classes are as follows: A: 0.1- 0.25 acres; B: 0.26- 9.9 acres; C: 10-99.9 acres; D: 100-299.9 acres; E: 300- 999.9 acres; F: 1,000- 4,999.9 acres; G: ≥5,000 acres

Fire Regimes

Fire regimes are used as part of the fire regime condition class (FRCC) discussion to describe fire frequency (average number of years between fires) and fire severity (effect of the fire on the dominant overstory vegetation—low, mixed, or stand replacement). These regimes represent fire intervals prior to Euro-American settlement and are calculated and classified by analyzing natural vegetation, known fire cycles, and fire history data. **Table 3-19**, Fire Regimes in the GJFO Decision Area, categorizes BLM land within the planning area into the five historical fire regime groups. Much of the BLM lands within the planning area are grouped in regime groups III through V. Many of those areas have sparse fuels and other natural barriers that limit fire spread; most are dry sites where the age-class distribution is moderate to old.

Table 3-19
Fire Regimes in the GJFO Decision Area

Fire Regime	Acres	Percent of Area
I (0-35 year frequency and low to mixed severity-surface fires most common)	42,346	4
II (0-35 year frequency and high severity-stand replacement fires)	18,800	2
III (35-100+ year frequency and mixed severity)	539,158	51
IV (35-100+ year frequency and high severity-stand replacement fires)	190,180	18
V (200+ year frequency and high severity-stand replacement fires)	194,734	18
Unclassified (water, barren, and alpine/tundra)	77,496	7

Source: BLM 2008b, 2010a

Fire Regime Condition Class

FRCC is a classification system that describes the amount of departure an area or landscape has experienced from its historic regime to the present condition. It is used to classify existing ecosystems by looking at conditions of ecosystem components. Departures from the historic fire regimes are caused by fire

exclusion, timber harvesting, grazing, introduction and establishment of exotic plant species, insects and disease, and other management activities. Wildland fire and fuels management works towards restoring ecosystem components to their historic range (FRCC 1). As displayed in **Table 3-20**, Condition Class Definitions and Acreages, a majority of the decision area falls within FRCC 2, meaning fire regimes have been moderately altered from their historic range.

Table 3-20
Condition Class Definitions and Acreages

Condition Class	Fire Regime Example Management Options
Condition Class 1 Acres: 252,177 24 percent of decision area	Fire regimes are within a historical range, and the risk of losing key ecosystem components is low. Vegetation attributes (species composition and structure) are intact and functioning within a historical range. Where appropriate, these areas can be maintained within the historical fire regime by treatments such as managing fire for resource benefit.
Condition Class 2 Acres: 710,788 67 percent of decision area	Fire regimes have been moderately altered from their historical range. The risk of losing key ecosystem components is moderate. Fire frequencies have departed from historical frequencies by one or more return intervals (either increased or decreased). This results in moderate changes to one or more of the following: fire size, intensity and severity, and landscape patterns. Vegetation attributes have been moderately altered from their historical range. Where appropriate, these areas may need moderate levels of restoration treatments, such as fire use and hand or mechanical treatments, to be restored to the historical fire regime.
Condition Class 3 Acres: 67,519 6 percent of decision area	Fire regimes have been significantly altered from their historical range. The risk of losing key ecosystem components is high. Fire frequencies have departed from historical frequencies by multiple return intervals. This results in dramatic changes to one or more of the following: fire size, intensity, severity, and landscape patterns. Vegetation attributes have been significantly altered from their historical range. Where appropriate, these areas may need high levels of restoration treatments, such as hand or mechanical treatments, before fire can be used to restore the historical fire regime.
Other Acres: 30,740 3 percent of decision area	Developed, barren, water-covered areas.

Source: BLM 2008b, 2010a

Fuel Conditions

In many parts of the GJFO planning area, fuel conditions have changed from historic conditions due to management practices and the spread of nonnative species.

Fire exclusion, in the form of fire suppression, has greatly affected fuel conditions. This management practice results in increased fuel loadings because fires are more infrequent than historic fire-return intervals. Fire suppression is allowing mountain shrub (oak brush) communities to become more mature,

dense, and less productive (i.e., large dead component), and, to a lesser extent, pinyon-juniper to invade sagebrush sites and conifers to advance into aspen stands. Higher-elevation fuel types and pinyon-juniper ecosystems are least affected by fire exclusion due to their long fire-return intervals. Cheatgrass occurrence has increased from scattered pockets to a dominant fine-fuel component intermixed with sagebrush and pinyon-juniper stands. Its presence is increasing the intensity and size of fires by providing the fine fuels that fire needs to spread into areas where vegetation was previously too sparse for fire to spread (BLM 2008b). Lower-elevation (below 6,500 feet) sites that are dominated by sagebrush, pinyon-juniper, and salt desert shrub have shown the greatest change in fuels conditions due to the increase of cheatgrass. Most other vegetation types in the GJFO planning area have altered fuel conditions due to an influx of cheatgrass but to a lesser degree than these low-elevation sites.

Along riparian areas within the GJFO planning area, nonnative saltcedar has significantly increased fuel loading. These higher fuel loads have resulted in high-intensity fires that cause mortality of associated cottonwood galleries.

Wildland Fire Management

The Fire Management Plan for the Colorado National Monument and BLM Grand Junction Field Office (BLM 2008b) provides guidance for management of wildland fires, prescribed fire, vegetation treatments, emergency stabilization and rehabilitation, community assistance, fire preparedness, fire prevention, fire danger, and other fire management activities. The Fire Management Plan is reviewed annually and updated as needed to reflect changes in policy, current issues, conditions, procedures, and resource management. During multiple wildfire events or when resources are limited, priorities are derived from the Fire Management Plan in conjunction with local, state, and national guidance (BLM 2008b).

The Fire Management Plan also identifies areas where unplanned wildfire can be managed for resource benefit. Response to fire in these areas is determined on a case-by-case basis using ecological and resource constraints along with human health and safety. The decision to manage fire for resource benefit is made by the field office manager with input from fire staff, resource advisors, and resource staff (BLM 2008b).

Since 1995, the GJFO fire management program has been part of the Upper Colorado River Interagency Fire Management Unit, a consortium that provides a full range of fire management services to participating federal, state, and local jurisdictions in western Colorado. The Upper Colorado River Interagency Fire Management Unit consists of the GJFO, Colorado River Valley Field Office, White River National Forest, Grand Valley District of the Grand Mesa, Uncompahgre, and Gunnison National Forests, and the Colorado National Monument. This partnership has increased the capability, efficiency, and coordination of the fire management program for the GJFO. The Upper

Colorado River Interagency Fire Management Unit fuels program works with local stakeholders to identify and treat fuels in WUI settings to reduce the potential for wildfire.

The GJFO fire and fuels management program also collaborates with the Colorado State Forest Service, Mesa and Garfield Counties, and local Fire Protection Districts to identify fuels treatments and fire management activities.

Vegetation treatments are used to reduce hazardous fuels, improve wildlife habitat, restore ecosystems, and reduce wildfire threat to the WUI. These vegetation treatments may include prescribed fire, mechanical treatments, manual treatments, chemical and biological treatments, and seeding.

Most fuel treatments were historically limited to prescribed fire projects used to meet range and wildlife objectives. In the 1980s and 1990s, prescribed fire projects occurred in the canyon bottoms in the Book Cliffs, Corcoran Wash, Maverick Canyon, and the LBCWHR. With the 2001 review and update of the 1995 Federal Wildland Fire Management Policy, fuels treatment targets have increased, and more fuels treatments are occurring on BLM-administered lands within the GJFO planning area, especially along the WUI. Prescribed fire projects normally emphasize the reduction of hazardous fuel conditions and maintaining and restoring vegetation to FRCC 1.

Fire and fuels management strategies across the major vegetation types in the GJFO planning area currently include:

- Aspen – Fire (planned and unplanned) and other fuel treatments can be used to manage disease, age class diversity, and ecosystem health.
- Black brush – Use of planned and unplanned fire should be avoided in this vegetation type. Other treatments may be used to manage plant succession and ecosystem health
- Douglas fir and mixed conifer – Fire (planned and unplanned) and other fuel treatments can be used to manage disease, age class diversity, and ecosystem health.
- Greasewood – Use of planned and unplanned fire should be avoided in this vegetation type. Other treatments may be used to manage plant succession and ecosystem health
- Mountain shrub – Fire (planned and unplanned) and other fuel treatments can be used to manage disease, age class diversity, wildlife habitat, and ecosystem health.
- Pinyon-juniper – Fire (planned and unplanned) and other fuel treatments can be used to manage disease, age class diversity, wildlife habitat, and ecosystem health.

- Ponderosa pine – Fire (planned and unplanned) and other fuel treatments can be used to manage disease, age class diversity, wildlife habitat, and ecosystem health.
- Riparian – Use of planned and unplanned fire should be avoided in this vegetation type. Other treatments may be used to manage plant succession and ecosystem health.
- Sagebrush (below 7,500 feet) – Avoid use of planned and unplanned fire that results in converting sagebrush shrublands into invasive species. Other treatments may be used to manage plant succession, age class diversity, wildlife habitat, and ecosystem health.
- Sagebrush (above 7,500 feet) – Fire (planned and unplanned) and other fuel treatments can be used to manage disease, age class diversity, wildlife habitat, and ecosystem health.
- Salt desert shrub – Use of planned and unplanned fire should be avoided in this vegetation type. Other treatments may be used to manage plant succession and ecosystem health.

Wildland-Urban Interface

The GJFO planning area contains a large amount of WUI. The intermixed landscape of public and private lands means wildland fires have a heightened potential to spread onto private property, destroying homes and valued landscapes. The BLM coordinates with other federal, state, county, and local agencies and participates in proactive community projects to reduce wildfire risks and damages. Where public lands are adjacent to WUI areas, federal funding is available to plan and implement fuel treatments to mitigate risk, for education and prevention efforts, and to complete plans, inventories, and assessments.

The BLM works with other fire departments and local and state government to identify communities and other WUI values at risk from wildfire and to set priorities for the mitigation of those threats. Within the GJFO planning area, the WUI includes areas in Glade Park, Unaweep Canyon, Plateau Valley, and near Whitewater, Mesa, DeBeque, and Gateway.

Effective fire prevention is critical because of the values at risk. Fuels treatments in these areas are designed to reduce the potential of fires moving into the WUI. Treatments in the WUI are often mechanical and are sometimes followed with pile burning for fuels reduction.

Trends

The trend in FRCC is likely to continue as vegetation types move further outside their historic fire regime due to fire suppression and an increase in nonnative species. Fires in areas infested with cheatgrass have and will continue to become more frequent, with potential to burn once every few years. The WUI will continue to expand, bringing urban development to these vegetative

communities. In response, suppression and fire exclusion activities will increase in an effort to protect economic values. The expansion of energy exploration and recreation creates higher potential for human-caused fires in the GJFO planning area. Costs to protect associated infrastructure from wildland fires will also increase.

3.2.11 Cultural Resources

Cultural resources are past and present expressions of human culture and history in the physical environment. The term "cultural resource" can refer to archaeological and architectural sites, structures, or places with important public and scientific uses, and includes locations (i.e., sites, natural features, or places) of traditional cultural or religious importance to specified social and/or cultural groups. Cultural resources as defined by the BLM are contained within a definite location of human activity, occupation, or use identifiable through field inventories (i.e., surveys), historical documentation, or oral evidence (BLM Manual Section 8110, Identifying and Evaluating Cultural Resources). Cultural resources are concrete, material places and things that are located, classified, ranked, and managed through the system of identifying, protecting, and utilizing for public benefit. Historic properties are defined by the National Historic Preservation Act (NHPA) as cultural resources that meet specific eligibility criteria found at 36 CFR 60.4 for nomination for listing on the National Register of Historic Places (NRHP). Used in this context the words "Historic Properties" have no connotation of age or cultural affiliation, only their status in consideration for NRHP eligibility.

For the purposes of this document, cultural resources have been organized into prehistoric resources, historic resources, and ethnographic resources. Prehistoric resources refer to any material remains, structures, and items used or modified by people before Euro-Americans established a presence in the planning area. Historic resources include material remains and the landscape alterations that have occurred since the arrival of Euro-Americans, including those associated with Native Americans. Ethnographic resources are places associated with the cultural practices or beliefs of living communities. These sites are rooted in the community's history and are important in maintaining cultural identity. These sites are typically thought of as primarily related to Native American use, but can also refer to other groups. These categories often overlap at a single location.

Cultural resources are fragile, irreplaceable resources subject not only to natural forces of change but also to the effect of increasing demands placed on them for public, educational, and recreational purposes or for scientific and experimental uses, as well as their unique traditional cultural or religious importance.

However, the constraints of a traditional cultural resources definition do not fully express the meaning of these resources for the Indigenous peoples of the

project area, the Northern Ute, Ute Mountain Ute, and Southern Ute Tribes (see Section 3.6.1, Native American Tribal Uses). The tribes and many other stakeholders "are pushing for inclusions of more permeable perspectives regarding landscape-scale cultural and heritage resources" (Ott 2010). There are often intangible cultural values that not readily captured as part of a cultural resources discussion, but are part of the cultural and heritage landscapes for the tribes. Ongoing, meaningful consultation with the noted tribes will integrate the Ute understanding and perspective of the cultural landscape into this cultural resource discussion.

Current Conditions

Federal agency responsibilities with regard to cultural resource management are addressed by a number of laws, regulations, executive orders, programmatic agreements, and other requirements. The principal federal law addressing cultural resources is the National Historic Preservation Act of 1966, as amended (16 USC Section 470), and its implementing regulations (36 CFR 800). The NHPA describes the process for identifying and evaluating historic properties, for assessing the effects of specific federal actions on historic properties, and for consulting with not only the State Historic Preservation Officer but with the Public and the Tribes to avoid, reduce, or minimize adverse effects. The NHPA also requires federal agencies to fully integrate the management of cultural resources in ongoing programs and to proactively identify, evaluate, nominate, and protect historic properties. Agencies are not required to preserve all historic properties, but agencies must follow a process to ensure that their decisions concerning the treatment of these places result from meaningful consideration of cultural and historic values and the options available to protect the properties.

In 2012, the BLM entered into a national programmatic agreement with the Advisory Council on Historic Preservation and the National Conference of State Historic Preservation Officers on planning for and managing historic properties under the BLM's jurisdiction or control (BLM et. al 2012). This programmatic agreement replaces one signed in 1997 (BLM 1997e). In each state that was a party to the programmatic agreement, the BLM is updating protocol agreements with the State Historic Preservation Officer (SHPO). The national programmatic agreement and the current Colorado Protocol (BLM 1998b) provide alternative procedures for implementing 36 CFR 800 and substitutes for Sections 106, 110, 111(a), and 112(a) of the NHPA. These procedures allow the BLM to identify and evaluate those cultural resources that meet criteria listed in 36 CFR Part 60.4 for NRHP eligibility and determine effects according to 36 CFR 800.9 without consulting with the SHPO for each routine undertaking. The protocol outlines how the BLM and SHPO would continue to interact, cooperate, and share information to ensure that the alternate procedures are consistent with the goals of the NHPA.

BLM management objectives encourage responsible use of cultural resources, ensuring that they will be available for appropriate uses by present and future generations. This is accomplished by continuing to identify and evaluate cultural resources and by setting priorities for protecting and preserving significant cultural resources and administering them accordingly on public lands in accordance with existing laws, regulations, and guidelines. BLM will continue to identify all historic properties and sacred sites on all lands that are within the APE of a BLM undertaking and ensure that the identification of cultural resources is conducted in accordance with professional standards detailed in the Secretary of the Interior's Standards and Guidelines. The 1987 GJFO RMP was completed prior to passage of a number of laws, most notably the Native American Graves Protection and Repatriation Act, and there have been additions and changes in BLM program policy. The 1987 RMP does not have specific resource management goals and actions that address these and other directives.

Methods used to identify the presence of cultural resources vary among the resource types and the scale of the action. Identifying archaeological resources, for example, typically requires a systematic pedestrian survey. Identifying historic buildings and historic transportation or water systems would more appropriately start with archival research, followed by fieldwork to document the current buildings or structures. Identifying any traditional cultural properties or religious sites requires direct consultation with Native American and other potentially affected communities.

Following identification, significance is determined by evaluating the resource against the criteria for listing on the NRHP. For this, a site, district, building, structure, or object must meet at least one of four criteria, in that they:

- Are associated with events that have made a significant contribution to the broad patterns of history;
- Are associated with the lives of persons significant in the past;
- Embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; possess high artistic value; or represent a significant and distinguishable entity whose components may lack individual distinction; and
- Have yielded, or may be likely to yield, information important in prehistory or history.

In addition to meeting these criteria, the historic properties must have integrity of "location, design, setting, materials, workmanship, feeling, and association" to convey its significance (36 CFR, Part 60).

Since 1974, Class II (statistical-based sample) and Class III (systematic intensive pedestrian) cultural resource inventories for compliance for ground-disturbing

projects, and infrequently for research purposes, have been completed on public and private lands in the planning area. This work has been completed by BLM archaeologists or by cultural resource consultants who are permitted to conduct cultural inventory surveys for BLM projects. During these surveys, cultural sites have been recorded and field evaluated for NRHP eligibility. In accordance with the NHPA and more recently by the national programmatic agreement and with Colorado Protocol, BLM submits its NRHP determinations to the SHPO for concurrence. Archaeologists also record isolated features and artifacts that do not meet the criteria to be classified as sites, but are nonetheless indicative of cultural activity and use. Surveys conducted for extractive resource exploration and development, land exchanges, ROWs, recreational developments, grazing projects, and research have resulted in an ever-increasing database of inventory reports and cultural resource records.

Concurrent with the development of this RMP, a Class I overview of the planning area was written (Grand River Institute 2011). A Class I overview is a compilation and analysis of all available cultural resource data and literature, and it provides a management-focused interpretive and narrative overview and synthesis of the data. The last Class I inventory of the planning area was completed by O'Neil in 1993 and was entitled *The Archaeology of the Grand Junction Resource Area: Crossroads to the Colorado Plateau and the Southern Rocky Mountains* (O'Neil 1993). The data for the Class I inventory prepared in 1993 were based upon records current through June 30, 1989, and included lands now within NCAs.

The Class I overview under preparation is using an updated Geographic Information System (GIS) database with cultural resource information meeting current BLM and Colorado Office of Archaeology and Historic Preservation standards current to Spring of 2009. The Class I overview is a confidential document for BLM internal use that includes a cultural resource narrative of the prehistory, history, and ethnology of the planning area; a discussion of the past environmental factors that have influenced cultural resources; a discussion of present research emphasis and the management actions needed to address data gaps; a site classification system derived from the data synthesis and applied to practical management by site allocation; and sensitivity maps based on resource significance and complexity. Preliminary information from this study and the previous Class I inventory are incorporated in the goals, objectives, and actions of this RMP and the description of the affected environment.

Many of the early Class III inventories were not conducted or reported to current standards. There was great variability in the reports and the site forms used, and this is clearly reflected in the type and quality of the information collected. In many cases records are the result of a single visit several decades ago, and there is no updated information. The quality of records is variable in terminology, detail, site boundary definition, and functional interpretations and in the researchers' familiarity with the local cultural and natural resources. In

most cases the current condition is not known and the existence of the resource as reported is not verifiable.

The quality of survey and site recording, as well as data management, has improved with standards established by both the Colorado Office of Archaeology and Historic Preservation and the BLM. Today over 1,920 cultural resources and 2,933 isolated finds have been recorded, and approximately 15 percent of the planning area as a whole has been surveyed. Inventories cover approximately 149,342 acres of the planning area. These numbers do not include lands within the Dominguez-Escalante and McInnis Canyons NCAs, other federally administered lands, and private land (Grand River Institute 2011).

The 1993 Class I overview suggested that 99 percent of the reports and site records had been generated by Section 106 compliance work involving natural resource and energy development for coal, water, oil and gas, and locatable minerals. The current data are still geographically biased towards surveys conducted in areas of energy development. Adding some geographical balance to the data set, and a major contributor to the survey and site database, are the results from large block surveys conducted since 2000 for hazardous fuels reduction projects as a result of implementing the National Fire Plan.

Native American Religious Concerns

The 1987 RMP does not contain any specific decision guidance related to Native American issues or concerns. There was no documented Native American consultation for the 1987 RMP. Consultation with the tribes between 1987 and 2000 was not documented. Native American consultation on both a programmatic and project-specific basis began in a systematic manner in 2001 to identify any traditional cultural properties or areas of importance to Native American Tribes, sacred/religious sites, and special use areas through letters, phone calls, and on-site visits. Field site visits were conducted to share the results of compliance projects where sites that were affiliated to the Ute Tribes are recorded. The Ute Ethnobotany Project was started in 2006 in partnership with the Ute Indian Tribe and the US Forest Service to bring Ute students and elders to their traditional lands, work with botanists to identify plants that were traditionally used, and seek possible connections between plant communities and Ute sites. The Ute Ethnohistory Project began in 2007 as a long-term partnership and research project with the Ute Tribes. "The broad goals of the project are to identify areas and sites of cultural and religious importance to the Ute people, to preserve and protect Ute cultural heritage values that are embedded in public lands, and to encourage and support the Utes' traditional use of those lands…A primary goal of this project was to integrate Ute perspectives into the land management planning activities of the three BLM field offices comprising the study area [Grand Junction, Uncompahgre, and Glenwood Springs], insofar as they relate to cultural resources management (CRM) and Ute heritage needs" (Ott 2010).

Monitoring

Both BLM cultural program staff and volunteers periodically monitor and document at-risk and potentially at-risk cultural sites for evidence of degradation from natural processes (erosion and fire) and from erosion impacts exacerbated by human activities, including, but not limited to, construction, maintenance, livestock grazing, recreation, wildlife impacts, fluid and locatable mineral exploration and development, mineral material disposal, and habitat restoration/fuel reduction. Since any BLM-initiated or authorized action recognizes and mitigates the effect of authorized actions on cultural resources by virtue of standard operating procedures, the other human activity that may damage these resources is unplanned public use. These activities include unauthorized recreational vehicle use, deliberate theft by illegal collection or excavation, vandalism, or the use of cultural sites that results in damage (fires, occupation of historic structures, new age ceremonial features, etc.). The location of these activities is impossible to predict and may occur in spite of measures designed to eliminate or limit them. A more formal monitoring program is directed at the several cultural areas, including Calamity Camp and Bangs Canyon SRMA, and sites that have significant values. Sites with physical barriers and signs are also monitored annually for maintenance and repair of these facilities.

Partnerships/Collaboration Practices

The GJFO has an active partnership program and over the last 20 years has worked with the Colorado Archaeological Society, Colorado State University Lab of Public Archaeology, Dominguez Archaeological Research Group, and Colorado Historical Society to conduct research projects. Tribal partnership projects include the Ute Ethnobotany Project with the Ute Indian Tribe (Northern Ute), US Forest Service, Colorado Mesa University, Colorado State University Agricultural Extension Service, and Museum of Western Colorado. Historic partnership projects include the Mesa County Oral History Project and the Calamity Camp restoration/interpretation project with the Museum of Western Colorado, Gateway Canyons Resort/Hendricks Foundation, and Heritage Preservation Resources. The Heritage Adventures Project brings hands-on archaeology and programs to the public through the Museum of Western Colorado and Dominguez Archaeological Research Group. Through partnership with the Dominguez Archaeological Research Group, the GJFO also supports the Colorado Wickiup Project to inventory and document "at-risk" sites.

Interpretation

The GJFO cultural program has provided interpretation at several trailheads and, working with funding support from Colorado Historical Society grants, has other projects in various stages of interpretive development.

Characterization

The planning area has been occupied with varying levels of intensity for almost 10,000 years. The complexity of the cultural resources of the planning area is influenced by its geographic location between the Canyon Lands and Uinta Basin of the Colorado Plateau, the Southern Rocky Mountains, the Wyoming Basin, and the Middle Rocky Mountain Physiographic Provinces. It includes multiple hydrological basins that have provided many resources through time. Cultural influences from the Southwest, Great Basin, Great Plains, and Mountain cultural traditions are present in the archaeological record.

Cultural resources recorded in the planning area include prehistoric and historic archaeological and architectural resources, as well as Native American traditional cultural and religious properties. Prehistoric properties include lithic scatters, quarries, temporary camps for seasonal hunting and gathering, extended camps, rock shelters, hunting/kill/butchering sites, game processing areas, tree scaffolds, eagle traps, vision quest sites, rock shelters and caves, rock art panels, trails, and isolated finds. Sites that date to the transition between the prehistoric and historic period include all of the prehistoric site types as well as wickiup villages, tree platforms, brush corrals and fences, and trails. Historic properties include homesteads, trails and roads, railroads, irrigation ditches, reservoirs, mining sites, corrals, line camps, cabins, trash scatters and dumps, aspen art carvings, and isolated finds. Native American traditional cultural and religious properties or areas of importance to Native American Tribes include plant gathering locations, trails, landscape features, burials, and group ceremonial sites.

Through scientific study of cultural resources, the story of adaptation and technological change can be told. Archaeologists simplify the description of prehistory and history by naming time periods that roughly correspond to cultural attributes or traditions manifested as artifact assemblages and features.

Five broad time periods are used to record human behavior in the area. These periods make generalizations about both behavior and technology. These periods, along with their significance and research potential, include the following:

- Paleoindian (Before 6400 BC). Archaeologists refer to the earliest hunters and gatherers as Paleoindians. Paleoindian sites are rare and evidence of occupation in the GJFO planning area prior to 7,600 BC is limited to isolated Folsom and Clovis points and surfaces that are postulated to date to this period and have the potential to hold these sites. Scientific excavation of Paleoindian sites in the GJFO planning area is nonexistent. After approximately 7,600 BC, there are indications of occupation or use and some radiocarbon dates from this period are included in the archaeological record. These sites have significant scientific value for environmental information

and their potential for studying subsistence strategies in the planning area. Information on physical site development and mapping areas where intact soils remain from this period is important for identifying and preserving these sites. Another research consideration is that sites may not be excavated to a depth that would produce cultural materials from this time period. Excavating sites past levels that are often misinterpreted as sterile could produce new information.

- Archaic (6400 BC to AD 0). The beginning of this period coincides with the last extinctions of megafauna at a time when vegetation communities were radically changing in response to climate changes. It is seen as a transition from a mobile hunting subsistence style to a semi-sedentary hunting and gathering lifeway. Four periods have been described by some archaeologists to subdivide the Archaic era. More Archaic era sites need to be excavated and more complex excavations need to be conducted, not only to collect dates and subsistence information, but to identify habitation structures and settlement patterns. Like the Paleoindian period sites, excavation at Archaic sites needs to be based on an understanding of the local deposition. Sites may be deeply buried. The cultural transition to the next era is poorly understood and the effectiveness of the hunting and gathering lifestyle, given the abundant resources of the planning area, makes this an important research subject.
- Formative (AD 0 to AD 1350). The Formative period in most areas of the Southwest represents the introduction of horticulture and a more sedentary subsistence pattern. Evidence of the cultivation of corn has been found in the GJFO planning area, however, strong evidence of site types indicating a more sedentary subsistence pattern are lacking. More study is needed of the cultural dynamics that led to variations in the archaeological record during this period. The complexities of the Formative period in the GJFO planning area are in part due to the geographic influences, both socio-cultural as well as the physical environment. It is proposed that the pattern of summer monsoons may not have been consistent in the planning area as in the Southwest and thus agriculture played less of a dominant role. Some groups continued a hunting and gathering lifestyle throughout the late Formative. The late Formative coincides with a period of intense drought and the arrival of Numic speakers from the Southwest and Great Basin, which is another area that needs to be explored.
- Aboriginal Protohistoric/Historic (AD 1350 to AD 1900). This period marks the transition from late prehistoric times through initial contact and subsequent forced removal from the GJFO planning area by Euro-Americans. These sites are important for their research potential but perhaps more important for developing

management considerations to protect their potential to provide important heritage connection to the planning area for the Ute who traditionally occupied the area.

- Historic (After circa 1860). Euro-American historic sites have the potential to provide additional insight and often provide a new perspective on the development of the modern community and the diversity of the people who contributed to it as we experience it today. Evidence of continued use of the planning area by the Ute people after their forced removal is also present in the historic period. These fragile sites have the potential to add to the historic knowledge of the area and demonstrate that many Utes living today on reservation lands in Colorado and Utah remain culturally and spiritually connected to their ancestral Colorado homelands.

A large number of Native American sites have not been assigned to a particular time period or time periods. The majority of the sites have either not been recorded with enough detail to estimate a time period, or have had unauthorized surface collection, which has removed the information that could estimate a date. Many of these sites have dateable features and with limited testing could contribute significant information on the distribution of prehistoric sites. Conversely, with current chronometric technology, no determination for some sites can be made as to what temporal period or group is responsible for a cultural manifestation. Often these include cairns or rock alignments or enigmatic features with no associated artifacts.

Table 3-21, Summary of Cultural Resources by Resource Management Units, displays the frequency of sites across management units, which indirectly suggests density. Because a site is counted as one unit regardless of the acreage of the site (relative to the acreage of the unit), it is not considered a true representation of density. In addition, site numbers can vary based on a previous recorder's tendency to lump or split out cultural loci. The Class I inventory is further refining the management tools available to BLM by correlating the results from surveys within each management area with other indicators to define sensitivity zones for archaeological sites. These indicators include elevation, vegetation zone, topography, hydrology, shelter, lithic (stone) material sources, and other environmental factors. Data on early land patents were also plotted as an indicator of sensitivity for historic sites.

As noted previously, much of the information on cultural resources in the planning area was developed from compliance projects for energy and mineral development. Therefore, the samples used to project sensitivity are not randomly distributed across the landscape. In addition, many sites, especially older sites, are buried and do not have any surface manifestations. Some cultural resources such as locations important to tribes or those consisting of ephemeral or perishable materials may not have been recognized or recorded in the past. In recent years there have been ongoing efforts to address these issues.

Table 3-21
Summary of Cultural Resources by Resource Management Units

Resource Type	Bangs Canyon	Book Cliffs	Gateway	Glade Park	Grand Mesa Slopes	Grand Valley	Plateau Valley	Roan Creek
Prehistoric Sites	299	46	226	264	191	83	257	140
Historic Sites	36	28	31	13	33	83	26	53
Multi-component Sites	11	3	17	10	18	15	6	8
Unknown Sites	3	0	0	1	0	2	5	12
Total Sites	349	77	274	288	242	183	294	213
Isolated Finds	354	45	412	553	592	189	522	267
Total Recorded Cultural Resources	703	122	686	841	834	372	816	480
Acres Surveyed	8,187	22,665	13,202	15,709	14,782	31,085	17,230	21,413
Ratio of Resources to Acres	1:12	1:19	1:19	1:19	1:18	1:84	1:21	1:55

Source: Grand River Institute 2011

The condition of cultural resources in the planning area varies considerably as a result of the diversity of terrain, geomorphology, access, visibility, and past and current land use patterns. Adherence to Section 106 of the NHPA provides for the continued identification of cultural resources, and the BLM policy of avoiding cultural resources is the preferred mitigation for cultural resource sites threatened by projects. The cultural resources program primarily supports the other BLM renewable and nonrenewable resource programs by completing cultural inventories in areas of proposed ground disturbance, and taking into account both the direct and indirect effects of the proposed projects. Most of the field inventory work is contracted to meet the timeframes of the applicants. Cultural sites discovered during inventory are evaluated for eligibility for listing on the National Register of Historic Places (NRHP) and protected through site avoidance, where possible. If avoidance is not possible, testing for NRHP site eligibility and mitigation of impacts through data recovery may be necessary. Consultation with the SHPO is completed through the Section 106 process. Avoidance of direct impact is not preservation, and many sites continue to degrade through negligence. The proactive component of the cultural resource program pursuant to Section 110 of the NHPA includes providing interpretation and education programs to the public and the identification, treatment, and protection of significant sites and areas.

Trends

Ongoing trends and management actions within the planning area that have the potential to impact cultural resources include oil and gas development, wildfire, prescribed fire, vegetation treatments, grazing, recreation, land exchanges, road and utility rights-of-ways and leases, and the designation of roads and trails through travel management. As described above, most cultural program work is completed from a compliance-driven reactive process that accounts for direct

impacts from identified projects. This approach fails to address the impacts on sites from natural disturbances such as wind and water erosion, intrusion by animals, development and maintenance activities, and human intrusion, including theft and vandalism. Limited site patrol and stabilization completed by the GJFO cultural staff and volunteers protect and preserve only a few well-known cultural sites.

The last large-scale, research-based inventory in the GJFO planning area was conducted in 1983 (Kvamme 1983). The dearth of research-based inventories has led to an understanding of the cultural resources of the planning area based only on where disturbance has previously occurred, rather than on where sites are likely to occur. Because recorded sites are manifested by discovery of exposed artifacts, features, and structures, they are easily disturbed by natural elements such as wind and water erosion, natural deterioration and decay, animal and human intrusion, and development and maintenance activities.

As part of Chapter 2 in the RMP, the BLM is allocating all cultural resources known and projected to occur in the planning area to appropriate use categories. These use categories, which include scientific use, conservation for future use, traditional use, public use, and experimental use, are defined in BLM Manual Guidance 8110, Identifying and Evaluating Cultural Resources (BLM 2004d). These allocations pertain to cultural resources, not to areas of land. These are recommendations of suitable uses for each cultural property or class of properties, and the recommendations consider the properties' characteristics, condition, setting, location, and accessibility, and especially their perceived values and potential uses. A cultural property may be allocated to more than one use category, or it may pass from one category to another when appropriate.

Categorizing cultural resources according to their potential uses broadly establishes what resources need to be protected, and when or how use should be authorized. All cultural resources have uses, but not all of these resources should be managed or used in the same way. Safeguards against incompatible land and resource uses may be imposed through withdrawals, stipulations on leases and permits, design requirements, and similar measures to meet the desired outcome. The implementation of the use categories should assist planners and applicants in proactively reducing potential conflicts that arise between specific cultural resources and other land uses. It does not replace the requirements of the NHPA.

Another trend is the increased recognition that a more comprehensive approach is needed for the inventory of cultural resources in order to identify and evaluate buried sites, to recognize resources consisting of ephemeral or perishable materials, and to identify traditional cultural properties.

Consultation with the Ute tribes and evaluation of the archaeological and historic record reiterate that the planning area is part of the Ute tribes'

ancestral homeland. There is potential for traditional cultural properties and sacred sites to be present. Many Ute tribal members have never been on the public lands in the GJFO and are only familiar with the general area as they travel through. At present, no locations within the GJFO planning area have been identified as sacred or religious sites by the Ute tribes, as defined by the current laws and executive orders. However, through consultation the Ute have emphasized that they have a generalized concept of spiritual significance that is not easily transferred to Western models or definitions. As such the BLM recognizes that the Ute have identified sites that are of concern because of their association with Ute occupation of the area as part of their traditional lands. Other known cultural resources that are affiliated to the Ute such as rock art, wickiup camps, trails, eagle traps, and battle locations are known to be of interest to the Ute. It is anticipated that the understanding of cultural resources as heritage sites important to the Ute will change as programs continue to be developed to work with students, adults, and elders to reconnect them to their traditional lands and resources. Cultural sites attributed to the Navajo have been recorded in the planning area, and consultation with that nation has just begun. Based on current research, additional consultation with other tribes will be conducted by the GJFO in the future.

3.2.12 Paleontological Resources

Paleontology is the study of fossils and related remains. A fossil is defined as any trace of a past life form. The term "paleontological resources" includes any fossilized remains, traces, or imprints of organisms that are preserved in or on the earth's crust, are of paleontological interest, and provide information about the history of life on earth. Paleontological resources constitute a fragile and nonrenewable scientific record of the history of life on earth. BLM policy is to manage paleontological resources for scientific, educational, and recreational values and to protect or mitigate these resources from adverse impacts. To accomplish this goal, paleontological resources must be professionally identified and evaluated, and paleontological data should be considered as early as possible in the decision-making process. Paleontological resources are managed according to the BLM Manual Section 8270, Paleontological Resource Management, BLM Handbook H-8270-1, General Procedural Guidance for Paleontological Resource Management, and applicable BLM instructional memoranda and bulletins. Additional preservation measures have been enacted under the Paleontological Resources Preservation Act, as part of the Omnibus Public Lands Act 1 of 2009. The BLM is currently developing regulations to implement the requirements of this law.

Recent BLM guidance (BLM IM 2008-009, Potential Fossil Yield Classification (PFYC) System for Paleontological Resources on Public Lands) defines a new classification system for the classification of paleontological resources. This system is intended to provide a more uniform tool to assess potential occurrences of paleontological resources and evaluate potential impacts. It is intended to be applied in broad approach for planning efforts and as an

intermediate step in evaluating specific projects. This is part of a larger effort to update BLM Handbook H-8270-1.

Occurrences of paleontological resources are closely tied to the geologic units (i.e., formations, members, or beds) that contain them. The probability for finding paleontological resources can be broadly predicted from the geologic units present at or near the surface. Therefore, geologic mapping can be used for assessing the occurrence potential of paleontological resources.

Using the PFYC system, geologic units are classified based on the relative abundance of vertebrate fossils or scientifically significant invertebrate or plant fossils and their sensitivity to adverse impacts. A higher class number indicates a higher potential. This classification is applied to the geologic formation, member, or other distinguishable unit, preferably at the most detailed mappable level. It is not intended to be applied to specific paleontological localities or small areas within units. Although significant localities may occasionally occur in a geologic unit, a few widely scattered important fossils or localities do not necessarily indicate a higher class; instead, the relative abundance of significant localities is intended to be the major determinant for the class assignment. Five classes were developed: Class 1 has very low potential for containing fossils, and Class 5 has very high potential.

Current Conditions

In the GJFO planning area, fossil-bearing sedimentary rocks range in age from Pennsylvanian to Quaternary and include parts of the three eras (great periods of earth history) during the last 540 million years: the Paleozoic Era (245 million to 540 million years ago); the Mesozoic Era (65 million to 245 million years ago); and the Cenozoic Era (present to 65 million years ago). Roughly 20 percent (270,000 acres) of the GJFO has either Morrison or Wasatch Formation on the surface, and these formations have produced many scientifically significant fossils. These areas often have mining or oil and gas activities proposed on them.

Since the 1987 RMP, numerous paleontological fossil sites have been discovered and continue to be surveyed and recorded. There are several quarry sites in the GJFO for scientific research and educational purposes, and the public has become increasingly more aware of paleontological resources. Some paleontological resource sites within the GJFO, like the Douglas Pass area along Highway 139, have been impacted by heavy public use.

Three formations in the GJFO are rated as PFYC 4-5 and often require paleontology surveys prior to any surface disturbance. These are the Wasatch, Morrison, and Chinle Formations.

The geology of the GJFO spans a time of roughly 1.8 billion years. From youngest to oldest, **Table 3-22**, Paleontological Resources by Geologic Rock Unit, contains a list of major rock units, their PFYC, and some of the fossils that have been found in each unit.

Table 3-22
Paleontological Resources by Geologic Rock Unit

Rock Unit Map Symbol/Description	Potential Fossil Yield Classification	Paleontological Finds
(Q) Quaternary	3	Pleistocene finds include mammoth teeth, musk ox, extinct and modern bison, and other vertebrates, invertebrates, and plants
(Qa) Modern alluvium	2	Modern bison (buffalo)
(Qg) Gravels and alluviums (Pinedale and Bull Lake Age)	3	Mammoth teeth
(Qgo) Older gravels and alluviums, Pre-Bull Lake Age	3	None known
(QTa) Ancient alluvium	3	Musk ox, invertebrates, and plants
(Qe) Eolian deposits	3	None known
(Qd) Glacial drift of Pinedale and Bull Lake glaciations	3	None known
(Ql) Landslide deposits	3	None known
(Tbb) Basalt flows and associated tuff, breccia, and conglomerate of late-volcanic bimodal suite, age 3.5 to 26 million years	1	None known
(Tu) Uinta	3	None known at present immediately in the GJFO planning area
(Tg) Green River	3	Primate and other mammals, crocodilians, gar and other fish, amphibians, turtles, birds, over 300 species of insects, fossil wood, and plant fragments (including leaves from numerous species of trees and bushes)
(Tgp) Green River Formation, Parachute Creek member	3	Primate and other mammals, crocodilians, gar and other fish, amphibians, turtles, birds, over 300 species of insects, fossil wood, and plant fragments (including leaves from numerous species of trees and bushes)
(Tgl) Green River Formation, lower part	3	"Algal" layers, ostracodes, gastropods (snails), pelecypods (clams), fish, turtles, crocodiles, and plants
(Tw) (Two) Wasatch Formation (DeBeque)	4-5	Archaic mammals, including horses, primates, artiodactyls (deer-like, even-toed), other perissodactyls (odd-toed), pantodonts, creodonts, carnivores, marsupials, multituberculates, insectivores, rodents, condylarths, and others; gar and other fish; lizards; turtles; crocodilians; birds; freshwater clams, gastropods (snails), and other invertebrates; petrified wood, leaves, and other plant fragments; algal heads (stromatolites)
(Two) Ohio Creek Formation	3	Mammals

Table 3-22
Paleontological Resources by Geologic Rock Unit

Rock Unit Map Symbol/Description	Potential Fossil Yield Classification	Paleontological Finds
(Kmv, Kmvu, Kmvl, Kh, Kmgh) Mesaverde Group: Hunter Canyon, Mount Garfield, Sego sandstone, etc.	3	Dinosaur tracks, eggs, and bones; turtles, crocodilians, fish, petrified wood, and other plant and invertebrate material
(Kmv) Mesaverde, undivided	3	Same as for Mesaverde Group
(Km) Mancos shale	3	Dinosaurs (two duck-billed dinosaurs), marine reptiles (plesiosaurs and mosasaurs), fish, sharks, clams, oysters, ammonites, scaphites, baculites, mollusks, plants, crinoids, and others
(Kd) Dakota sandstone	3	Dinosaur tracks, plant fragments
(Kdb, KJd, KJdw) Burro Canyon sandstone	3	Dinosaurs, including a meat-eating theropod; petrified wood, cycads, Tempskya (fern) wood, and plant impressions that include leaves and flowers
(Jm, Jmw, Jme, Jmse, Jmwe) Morrison	4-5	Dinosaurs, including the large plant-eating sauropods: *Apatosaurus* ("Brontosaurus"), *Barosaurus*, *Brachiosaurus*, *Camarasaurus*, *Diplodocus*, *Supersaurus*, and "Ultrasaurus"; the meat-eating theropods: *Allosaurus*, *Ceratosaurus*, *Torvosaurus*, and others; and the bird-hipped ornithopods: *Dryosaurus*, *Camptosaurus*, an iguanodontid, *Stegosaurus*, *Mymoorapelta*, and others; fish (*Coccolepis*, and one other), lizards, turtles, crocodilians (including *Fruitachampsa* and *Goniopholis*), a pterosaur and five families of small primitive mammals (including docodonts, triconodonts (including *Priacodon fruitaensis*), multituberculates, symmetrodonts, dryolestid eupantotheres, and possibly monotremes, and a new form named *Fruitafossor windscheffeli*; various invertebrates, including fresh water clams, gastropods (snails), ostracods, conchostrachans, and others; and plants, including conifer trees, seed fern trees, horse tails, cycads, and others.
(Jmse) Summerville	3	Gastropods (snails)
(Jme, Jmse, Jmwe) Entrada	3	Tracks of small meat-eating dinosaurs
(JTRgc) Navajo	3	No fossils known
(TRkc) Kayenta	3	Possible tracks of small meat-eating dinosaurs
(TRkc, TRwc) Wingate	3	Tracks of small meat-eating dinosaurs
(JTRgc) Glen Canyon group	3	See Navajo, Kayenta, and Wingate
(JTRsc, JTRmc, TRkc, TRwc, TRcc, TRc) Chinle	4-5	Metoposaurs (giant amphibians), phytosaurs (large "armored crocodiles"), tracks of various amphibians and reptiles, lungfish burrows, insect tracks, and worm and other invertebrate burrowings
(TRm) Moenkopi	3	Tracks of various insects, amphibians, and reptiles
(Pc) Cutler	3	Segmented and other plants

Table 3-22
Paleontological Resources by Geologic Rock Unit

Rock Unit Map Symbol/Description	Potential Fossil Yield Classification	Paleontological Finds
(Pennh) Hermosa	2	No fossils
(Xb) Biotitic Gneiss, Schist, Migmatite	1	No fossils
(Yg) Granitic rocks of 1,400 million years	1	No fossils
(Xg) Granitic rocks of 1,700 million years	1	No fossils
(YXg) Granitic rocks of 1,400 and 1,700 million years	1	No fossils

Source: Armstrong and Kihm 1980 and updated by info from BLM Colorado (GJFO-related) Paleontological Resource Use Permit reports

Characterization

Paleontological resources are indicated by both the presence of and potential for these resources. Paleontological resources are typically discovered through exposure by erosion or by excavation often associated with other resource uses. The current trend of paleontological resource use permits and scientific activity would likely continue or increase slightly in the future. Clearances and monitoring of surface-disturbing activities are anticipated to be the primary means of identifying paleontological localities. The discovery and mapping of resources would potentially allow future research and interpretive uses and protective measures.

The current management direction and forecast for paleontological resources is to implement the new PFYC throughout the planning area and to identify and record new findings. This RMP revision addresses opportunities to designate areas with significant paleontological resources for special management. One such area under consideration for special management designation is the Dolores River corridor near Gateway, Colorado. There are hundreds of dinosaur and ancient mammal tracks and track ways found in slabs of Wingate Formation sandstone along the Dolores River near Gateway.

Areas like Douglas Pass along Highway 139 have been experiencing high use, which is expected to continue. Special management strategies may be required to minimize impacts to paleontological and environmental resources for such high-use areas within the planning area. New monitoring strategies for these sites may also be developed.

Paleontological resources need to be surveyed, recorded, and monitored as recreational and mineral development activity continue to increase in the general area. Area population will likely increase over the next 20 years, so special management designation may be required to better protect the

paleontological resources. Preservation measures for paleontological resources enacted under the Paleontological Resources Preservation Act, as part of the Omnibus Public Lands Act of 2009 will be implemented by the GJFO when regulations are finalized.

3.2.13 Visual Resources

BLM's visual resource management system includes three components: Scenic Quality (i.e., physical qualities of the landscape), Distance Zones (i.e., visibility), and Visual Sensitivity (i.e., public sensitivity and concern). Combined, these three components describe the visual resources of the planning area. Visual impact is the creation of an intrusion or perceptible contrast that affects the scenic quality of a landscape. A visual impact can be perceived by an individual or group as either positive or negative, depending on a variety of factors or conditions (e.g., degree of change, personal experience, time of day, and weather or seasonal conditions).

Visual Resource Management System

BLM's VRM system has two broad purposes. One is to determine appropriate levels of departure from the characteristic landscape and noticeability (i.e., VRM Classes in RMPs, the administrative baseline) based upon proposed uses of the landscape and its resources. The second is to arrive at an initial baseline inventory of existing conditions (i.e., NEPA's affected environment, or the existing conditions baseline). The BLM's VRM system helps to ensure that actions taken on public lands will benefit the visual qualities associated with the described landscape.

BLM's VRM system consists of two stages, inventory and analysis (visual resource contrast rating). Visual resource inventory involves identifying the visual resources of an area and assigning them to inventory classes using the BLM's visual resource inventory process. The process involves rating the visual appeal of a tract of land, measuring public concern for scenic quality, and determining whether the tract of land is visible from travel routes or observation points. This process is described in detail in BLM Handbook H-8410-1, Visual Resource Inventory (BLM 1986a).

The results of the VRI help determine the VRM classifications that become an important component of the RMP. The RMP establishes how BLM-managed lands will be used and allocated for different purposes, and it is developed through public participation and collaboration. Visual values are considered throughout the RMP process, and the area's visual resources are then designated to the management classes with established objectives. The objectives for the four VRM classes are described in **Table 3-23**, BLM Visual Resource Management Class Descriptions.

Table 3-23
BLM Visual Resource Management Class Descriptions

VRM Class	Class Objective
I	Preserve landscape character. This class provides for natural ecological changes but does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.
II	Retain existing landscape character. The level of change to the characteristic landscape should be low. Management activities may be seen but should not attract a casual observer's attention. Any changes must repeat the basic elements of line, form, color, and texture found in the predominant natural features of the characteristic landscape.
III	Partially retain existing landscape character. The level of change to the characteristic landscape should be moderate. Management activities may attract attention, but should not dominate a casual observer's view. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
IV	Provide for management activities that require major modification of the landscape character. The level of change to the characteristic landscape can be high. Management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repetition of the basic landscape elements.
Rehabilitation Areas	Areas in need of rehabilitation should be flagged during the inventory process. The level of rehabilitation is determined through the RMP process by assigning the VRM approved for that particular area.

Source: BLM 1984

Project-level analysis involves determining whether proposed resource uses and management actions are in compliance with the objectives of the VRM classes for the area. The objectives can be met through land use planning or design adjustments. A visual contrast rating process is used for this analysis, which involves comparing the project features with the existing landscape features using basic elements of form, line, color, and texture. This process is described in BLM Handbook H-8431-1, Visual Resource Contrast Rating (BLM 1986b). The analysis is used to determine conformance to the RMP's VRM Class decisions and used as a guide for resolving visual impacts. Once every attempt is made to reduce visual impacts, BLM managers can decide whether to accept those projects found to be in conformance with the RMP, deny proposals not in conformance, or amend the land use plan VRM Class designations to a different VRM objective. Managers also have the option of attaching additional mitigation stipulations to bring the proposal into conformance. Examples of management resource uses and activities include energy development, ROW corridors, road construction, recreational activities, wildland fires, mining, vegetation treatments, and increased urban infrastructure needs and associated development on BLM- managed lands (e.g., roads, power lines, water tanks, and communication towers).

Current Conditions

The landscape of the GJFO planning area is visually diverse in both topography and vegetation. The topography of the area consists of foothills, mountains, plateaus, mesas, deep canyons, and broad and narrow river valleys. The area contains only limited areas of open, gently rolling hills with predominantly sagebrush and grassland vegetation. It also encompasses sizeable pinyon-juniper woodlands, scrub oak, and aspen and spruce in the higher elevations (Otak 2009). Some of the streams and rivers flowing through and adjacent to BLM-managed land in the planning area include the Colorado, Dolores, and Gunnison Rivers and the Blue, Rough Canyon, East, and West Creeks. Prominent features in the landscape include Mount Garfield, the cliffs of the Sinbad Valley, the Palisade, Douglas Pass, the Book Cliffs, and multiple canyons known for their scenic values.

Visual variety contributes to the distinctive character of the GJFO. Colorful landforms with reds and grays are intermingled with shades of brown and beige, all of which contrast with the deep greens, grays, and vibrant greens of the vegetation (Otak 2009). The visual character of the area also varies throughout the seasons due to changing light conditions. Sunsets in the Book Cliffs can be spectacular (Otak 2009).

While portions of the GJFO planning area are still largely undeveloped, range improvements, linear disturbances (e.g., pipelines and roads), and energy developments have altered the landscape over the past 20 years, especially in areas with high oil and gas development and areas with densely populated routes. Sources of artificial light, including from residential housing, signage on commercial buildings, and oil and gas drill rigs, have also increased.

Visual quality is a concern to most residents in the GJFO planning area. The location of BLM-managed lands and their proximity to communities and key transportation corridors, the combined effects of scenic quality, the high degree of sensitivity, and visual accessibility have resulted in 13 percent of BLM-administered lands in the planning area being managed as VRM Class I, 18 percent being managed as VRM Class II, and 27 percent being managed as VRM Class III. The remaining 42 percent of BLM-administered lands in the planning area are undesignated. The current VRM classes were chosen to emphasize scenic quality of WSAs, highly visible landscape features, the Unaweep-Tabeguache Scenic and Historic Byway, the Book Cliffs, and other prominent features.

The Town of Palisade has provided financial and political support to the Mesa Land Trust in establishing conservation easements that will preserve agricultural lands especially in the "Vinelands" that maintain the visual quality of Palisade. The Town's Comprehensive Development Plan adapted in 2007 specifically addresses this goal.

Table 3-24, Visual Resource Management Classes in the GJFO Decision Area, identifies the VRM classes for the GJFO decision area. The locations of these VRM classes are shown in **Figure 2-5**, Alternative A: Visual Resource Management. The visual resource classes were prescribed in the 1987 GJFO RMP (BLM 1987).

Table 3-24
Visual Resource Management Classes in the GJFO Decision Area

Visual Resource Management Classes	Acres
Class I	27,100
Class II	132,100
Class III	206,100
Undesignated	696,100

Source: BLM 2010a

Characterization

In 2009, a VRI was completed for the GJFO, excluding the McInnis Canyon and Dominguez-Escalante NCAs, the Colorado National Monument, and units of the State Park System. The Scenic Quality, Sensitivity, and VRI class distribution for the GJFO is presented in **Table 3-25**, Visual Resource Inventory Component Distribution. The entire field office was found to be within the foreground/middle ground distance zone. There are also no areas within the decision area that qualify for VRI Class I.

Table 3-25
Visual Resource Inventory Component Distribution

Visual Resource Inventory Component	Acres	Percent of Decision Area
Scenic Quality		
A	9,200	1%
B	776,900	73%
C	275,100	26%
Sensitivity		
High	321,600	30%
Medium	484,900	46%
Low	254,600	24%
VRI Class		
Class I	0	0%
Class II	376,100	35%
Class III	382,300	36%
Class IV	302,700	29%

Source: BLM 2010a

Trends

Management of multiple resources on BLM-managed lands can alter visual resources. With an increased amount of urban development throughout the planning area on adjacent private land, increased management activities are also occurring on BLM-managed lands. Growing pressure is being placed on the visual resources from activities such as oil and gas extraction, fire management, ROW corridors, roads and trails, communication sites, pipelines, livestock grazing, and water tanks. Public concern over preservation of visual and scenic quality is also increasing for open space and scenic backgrounds in residential areas and for recreational uses. Most gas development has taken place in the northeastern portion of the planning area, which has modified the landscape into a more industrialized setting.

In response to increasing concerns from local communities, the condition of visual resources is being assessed for the major transportation corridors, population centers, and other scenic viewsheds to determine how BLM should manage these sensitive viewsheds and corridors. Tourism also plays a major role in the economy of western Colorado, and much of the GJFO planning area is viewed en route to or from major tourist destination areas. As the state's population grows, more visitors will be attracted to public lands for recreation in natural landscapes. In addition, a high demand is being placed on scenic resources near population centers.

3.2.14 Lands with Wilderness Characteristics

The BLM's authority to conduct wilderness reviews, including the establishment of new WSAs, expired on October 21, 1993, pursuant to Section 603 of the FLPMA. However, the BLM has retained authority under Section 201 of the FLPMA to inventory public lands for wilderness characteristics and to consider such information during land use planning. Through this planning process, the BLM has discretion to determine which portions of BLM lands with wilderness characteristics would be managed for those characteristics.

The 1987 GJFO RMP did not address wilderness characteristics outside of WSAs. As such, during this current RMP revision process, the BLM completed a review of BLM-administered public lands within the GJFO to determine whether or not they possess one or more wilderness characteristics. The BLM reviewed both internal and external nominations, as well as areas identified through inventory and monitoring, and adjacent designations of other federal and state agencies. This review includes only BLM public lands and does not include portions of wilderness proposals on National Forest lands, within McInnis Canyons or Dominguez-Escalante NCAs, or within existing WSAs. Proposals involving lands exclusively within existing WSAs were not analyzed; however, any additions to the WSAs (lands outside or adjacent to) were analyzed. All wilderness characteristic proposal areas that occur within the existing designated WSAs will be managed in order to protect those wilderness characteristics under BLM Manual 6330 until Congress either designates them as

wilderness or releases them for other uses (see **Section 3.4.1**, Wilderness Study Areas). Wilderness characteristics include naturalness and outstanding opportunities for solitude and primitive and unconfined recreation. The results of the wilderness characteristics assessment are in **Appendix F**, Draft Wilderness Characteristics Assessment.

The process entails the identification of wilderness inventory units, an inventory of roads and wilderness characteristics, and a determination of whether or not the area meets the overall criteria for wilderness character. Units found to possess such character are evaluated during the land use planning process to address future management. The following factors are documented:

A. Size: Must be a roadless area with over 5,000 acres of contiguous BLM land or contiguous with designated wilderness or WSAs (or the equivalent. A roadless area of less than 5,000 acres may be considered if it is demonstrated that the area is of sufficient size to make practicable its preservation and use in an unimpaired condition.

B. Naturalness: Lands and resources exhibit a high degree of naturalness when affected primarily by the forces of nature and where the imprint of human activity is substantially unnoticeable. An area's naturalness may be influenced by the presence or absence of roads and trails, fences or other developments and the nature and extent of landscape modifications.

C. Outstanding Opportunities for Solitude and Primitive and Unconfined Types of Recreation: Visitors may have outstanding opportunities for solitude, or primitive and unconfined types of recreation when the sights, sounds, and evidence of other people are rare or infrequent; where visitors can be isolated, alone or secluded from others; and where no or minimal recreation facilities are encountered.

D. Supplemental Values: The area may contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

Current Conditions

The 1987 GJFO RMP did not provide special management for areas outside of WSAs with wilderness characteristics. In 1999, a wilderness character inventory was conducted for the Bangs Canyon and South Shale Ridge areas near Grand Junction following a detailed roadless review of the two areas and BLM's consideration of nearly 3,000 public comments. The wilderness character inventory was conducted by an interdisciplinary BLM team from three states and an ad-hoc group of citizen-observers who represented a wide range of interests. Criteria for determining wilderness character were the same as those used in BLM's original 1980 national inventory. Details of inventory findings are included below.

Numerous external groups have varying interests and have advocated wilderness designations through legislation and participation in the land use planning processes. Proposal areas and acreage figures have changed over time. In 1994, Colorado conservationists presented to BLM the *Conservationists' Wilderness Proposal for BLM Lands* that compiled numerous citizen wilderness inventories and area-by-area justification for the statewide citizens' wilderness proposal. In 2001 and 2007, citizens' groups again presented BLM with a compilation of numerous citizen wilderness inventories and area-by-area justifications for citizens' wilderness proposals for BLM lands. The recent submission that will be analyzed carries forward a modified version of this original proposal. Currently, the proposal includes 13 areas within the GJFO project area: Bangs Canyon, Cow Ridge, Demaree Canyon, Granite Creek, Hunter Canyon, Kings Canyon, Little Book Cliffs, Maverick Canyon, Prairie Canyon, Sagebrush Pillows, Sewemup Mesa, South Shale Ridge, and West Creek (the Palisade).

In addition to external proposals, the BLM also internally identified additional areas to inventory for wilderness characteristics in accordance with the BLM "Policy on Conducting Wilderness Characteristics Inventory on BLM Lands" under Section 201 of the FLPMA. This inventory meets the criteria of BLM Manual 6310. A total of 31 units were inventoried. **Table 3-26**, Units Inventoried for Wilderness Characteristics outside Existing Wilderness Study Areas, identifies the areas that were assessed for wilderness characteristics as part of the RMP revision process. Summaries are included below for inventory units that will be evaluated for management in at least one alternative in the EIS (see **Chapter 2**, Alternatives, and **Chapter 4**, Environmental Consequences). These areas are also depicted on **Figure 2-10**, Alternative C: Lands Managed for Wilderness Characteristics Outside Existing WSAs. More information on the evaluation of proposed wilderness units, including methodology for analysis, as well as detailed information on all inventoried units, can be found in **Appendix F**, Draft Wilderness Characteristics Assessment.

Under the authority of 43 USC 1712 (Sec. 202 of the FLPMA), the BLM has discretion to manage lands to protect and maintain wilderness characteristics and character. While the BLM is in the RMP planning process, the BLM will manage public lands so as not to forgo management options in the event that new information is presented, weighed (evaluated), and incorporated into the planning process as part of one or more alternatives.

The following sections provide descriptions of those units found to have wilderness characteristics.

Bangs Canyon

The Bangs Canyon unit was not included in the original 1980 inventory and was inventoried in a newly filed re-inventory by the BLM in 1999. This unit is also proposed in the citizens' wilderness inventory. The Bangs Canyon unit contains

Table 3-26
Units Inventoried for Wilderness Characteristics outside Existing Wilderness Study Areas

Inventory Unit	Acres Inventoried	Acreage with Wilderness Characteristics	Acres not Having Wilderness Characteristics
Bang's Canyon	20,434	20,434	0
Bang's West	6,878	0	6,878
Barrel Spring	10,169	0	10,169
The Blowout	5,105	0	5,105
Brush Mountain	5,310	0	5,310
Buck Canyon	5,009	0	5,009
Buttermilk Canyon	14,087	0	14,087
County Line	7,308	0	7,308
Cow Ridge	15,721	0	15,721
East Demaree	4,796	4,796	0
East Salt Creek	18,952	16,982	1,970
Granite Creek	14,048	0	14,048
Horse Mountain	10,303	0	10,303
Hunter Canyon	32,709	32,125	584
Kings Canyon	9,606	9,606	0
Lipan Wash	15,375	0	15,375
Little Book Cliffs WSA Expansion	1,580	0	1,580
Little Horsethief Creek	5,732	0	5,732
Lumsden Canyon	13,764	10,072	3,692
Main Canyon	12,613	0	12,613
Maverick	20,401	20,401	0
Munger Creek	23,804	0	23,804
Payne Wash	8,154	0	8,154
Prairie Canyon	17,569	0	17,569
Sagebrush Pillows	5,127	0	5,127
Sewemup Mesa[1]	23,551	0	23,551
South Shale Ridge	27,540	27,540	0
Spink Canyon	13,081	13,081	0
Spring Canyon	14,009	9,384	4,625
Unaweep[2]	7,154	7,154	0
West Creek (adjacent)	111	111	0
Total	**390,000**	**171,686**	**218,314**

[1]Acreage reflects BLM land in Colorado managed by the GJFO. The citizen-proposed wilderness unit of 70,084 acres includes lands managed by the US Forest Service, lands in Utah, and lands managed by the BLM Uncompahgre Field Office. These lands were not included in this assessment.
[2]Acreage reflects BLM land only. The citizen-proposed wilderness unit of 39,392 acres includes lands managed by the US Forest Service, as well as lands managed by the BLM that are cut off from the majority of the unit by a private road and lands. These lands were not included in this assessment.

20,434 acres of federal land. All of the area was determined to have wilderness character. This large area retains its natural appearance and provides outstanding opportunities for both solitude and primitive and unconfined recreation in many locations. It includes 35 miles of rugged, steep-walled canyon

country in Bangs Canyon, West Bangs Canyon, the canyon of North East Creek, and several of their tributary side canyons. Four specific areas within the inventory units (totaling 530 acres) do not appear natural in the landscape and lack wilderness characteristics. Livestock developments, continuously used roads, historically used camping areas adjacent to State Highway 141, and a utility line along State Highway 141 all contribute to the "unnatural in character" condition of these four areas. Three roads have been cherry-stemmed out of the inventory unit.

East Demaree

The East Demaree citizen-proposed wilderness area is exclusively BLM public lands and contains 13,830 acres. The proposal includes several additions to BLM's existing Demaree Canyon WSA boundaries. The entire inventoried area was determined to have wilderness character. This area retains its natural appearance and provides outstanding opportunities for solitude and primitive and unconfined recreation. The area contains steep granite cliffs and canyons, pinyon-juniper woodlands, and aspen-spruce forests.

East Salt Creek

The 16,879-acre East Salt Creek unit is located in Garfield County and is comprised entirely of BLM-administered lands. The entire unit was determined to have wilderness character.

The southern portion of the unit begins near the end of 16 Road, approximately 27 miles north of Fruita, Colorado. The unit is located within the Book Cliffs Range with elevations ranging from approximately 8,800 feet in the northern portion of the unit to 6,200 feet in the East Salt Creek drainage.

The combination of topography, vegetation, and size allow for outstanding opportunities for solitude. Canyons and creeks throughout the unit offer ample opportunity for concealed exploration, while the large stands of Douglas fir not only make the unit stand out in a regional context but also provide excellent screening from others within the unit.

Hunter Canyon

The Hunter Canyon citizen-proposed wilderness area encompasses 32,125 acres of BLM public lands. In the 1980 BLM intensive inventory findings, the Hunter Canyon unit described below was split into two units – the Garvey Canyon unit and the Hunter Canyon unit. The BLM now combines and analyzes these units as one. The Hunter canyon inventory unit was determined to have wilderness character. This area retains its natural appearance and provides outstanding opportunities for solitude. The unit ranges in elevation from approximately 6,200 to 8,200 feet and contains rugged canyons and cliffs of the Green River Formation. The unit also contains colorful and interestingly shaped hoodoos which are considered to be a supplemental value as they have been given special VRM consideration in the current GJFO RMP (BLM 1987). The

BLM cherry-stemmed an existing route in the bottom of Kimball Creek that contains the gas wells that are still maintained.

Kings Canyon

This citizen-proposed unit was not inventoried during the intensive wilderness inventory in 1980 because the BLM described too many affronts to naturalness due to chaining and livestock water developments. It has a contiguous boundary with the Westwater WSA managed by the BLM Moab Field Office in Utah. All 9,398 acres of the unit were found to have wilderness character. The area has returned to a natural state and includes outstanding opportunities for primitive and unconfined recreation. The unit contains varied topographic features, including canyons such as Toms and Kings with numerous smaller side canyons and interesting rock formations.

Lumsden Canyon

The 10,072-acre Lumsden Canyon unit is located in southern Mesa County, just west of the town of Gateway and Highway 141. The unit is comprised entirely of BLM-administered lands and encompasses a system of canyons which rise above the Dolores River. All lands inventoried were found to have wilderness character.

Elevation in the Lumsden Canyon unit ranges from approximately 7,000 feet where the canyons reach the mesa to 4,600 feet in the eastern portion of the unit near the Dolores River. John Brown, Lumsden, and Gateway Canyons offer impressive Entrada Sandstone formations. The scenery within the canyons and scenic views of the Palisade supplement the qualities of the unit.

Maverick Canyon

The Maverick Canyon citizen-proposed wilderness area encompasses 20,451 acres of BLM public lands within Colorado. The unit was not inventoried during the intensive wilderness inventory in 1980. All lands inventoried were found to have wilderness character. This area retains its natural appearance and provides outstanding opportunities for solitude and primitive and unconfined recreation. The Maverick Canyon unit consists of several towering red-rock canyons, including Maverick Canyon, Larson Canyon, and Blue Creek, which all cut deeply into the Uncompahgre Plateau to the east. The unit also contains Juanita Arch, one of the only natural bridges of its kind in Colorado.

South Shale Ridge

The South Shale Ridge unit was not included in the original 1980 inventory and was inventoried in a new field assessment by the BLM in 1999. The unit contains 32,393 acres of federal land. Most of the area (27,631 acres) has wilderness character. This large area retains its natural appearance and provides outstanding opportunities for both solitude and primitive and unconfined recreation in many locations. Four specific areas within the inventory unit (totaling 4,762 acres) lack wilderness characteristics. Absence of natural appearance in the landscape, gas wells, livestock developments, and continuously

used roads all contribute to the "unnatural in character" condition of these four areas. Twelve roads have been cherry-stemmed out of the inventory unit.

Spink Canyon

The 13,118-acre Spink Canyon Unit is located in Garfield County, approximately 25 miles north of Loma, Colorado. The unit is adjacent to the Demaree Wilderness Study Area, which bounds a portion of the unit to the south. The entire unit is comprised of public lands administered by the BLM. All acres inventoried were found to have wilderness character. Within the unit, there are very few human imprints, and the combination of topography, vegetation, and size allow for outstanding opportunities for solitude. Due to the remote nature of the unit, wildlife is abundant, offering outstanding hunting opportunities. High ridges in the canyon provide high visibility, which is ideal for scouting.

Spring Canyon

The 9,386-acre Spring Canyon unit is located in Garfield County, 25 miles north of Mack, Colorado, between South Canyon Road and Baxter Pass Road. The unit is part of the Book Cliffs Range and is comprised entirely of BLM-administered lands.

Elevations range from approximately 8,100 feet in the northern portion of the unit to 5,900 feet in the southeastern portion of the unit along South Canyon. Talus slopes and rock outcroppings are prevalent in the unit due to the steep topography. As the elevation increases in the northern section of the Spring Canyon unit, Douglas fir becomes present. The unit offers high ridges providing scenic views for scouting, and multiple canyons, side canyons, and other drainages that provide outstanding hiking opportunities.

Unaweep

The Unaweep citizens' proposal contains 39,392 acres, of which the 7,335 acres on BLM lands were inventoried for the GJFO RMP revision process. All acres inventoried were found to have wilderness character. This area retains its natural appearance and provides outstanding opportunities for solitude and primitive and unconfined recreation, particularly on Ute Creek canyon.

West Creek (adjacent)

The West Creek citizens' proposal includes 350 acres adjacent to the Palisade WSA. The proposed unit would close two small cherry-stemmed dirt tracks on the area's western boundary. This unit was determined to have wilderness character. The area retains its natural appearance and provides outstanding opportunities for solitude and primitive and unconfined recreation, and has similar characteristics to the adjacent WSA.