U.S. Department of the Interior
Bureau of Land Management - Farmington Field Office
Bureau of Indian Affairs - Navajo Regional Office

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Farmington Mancos-Gallup 2020 Affected Environment Supplemental Report

MISSION STATEMENTS

BLM

It is the mission of the Bureau of Land Management to sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations.

BIA

The Bureau of Indian Affairs' mission is to enhance the quality of life, to promote economic opportunity, and to carry out the responsibility to protect and improve the trust assets of American Indians, Indian tribes, and Alaska Natives.

Cover Photo: View of Angel Peak Scenic Area. Photo taken by EMPSi.

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ACRONYMS AND ABBREVIATIONS

	Full Phrase
µg/m³	micrograms per cubic meter
AAQS	Ambient Air Quality Standards
ACEC	area of critical environmental concern
ACHP	Advisory Council on Historic Preservation
ACS	American Community Survey
afy	acre-feet per year
AIRFA	American Indian Religious Freedom Act
APD	Application for Permit to Drill
AQI	air quality index
AQRV	Air Quality Related Value
ARPA	Archaeological Resources Protection Act
AUM	animal unit month
BCF	billion cubic feet
BE	biological evaluation
BEA	United States Bureau of Economic Analysis
BIA	United States Department of the Interior, Bureau of Indian Affairs
BLM	United States Department of the Interior, Bureau of Land Management
BOR	United States Department of the Interior, Bureau of Reclamation
BTU	British thermal unit
CARMMS	Colorado Air Resources Management Modeling Study
CASTNET	Clean Air Status and Trends Network
CBM	coal bed methane
CCNHP	Chaco Culture National Historical Park
CDPHE	Colorado Department of Public Health and Environment
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CIMPP	culturally important property
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COA	condition of approval
CWA	Clean Water Act
dBA	a-weighted decibel
DOI	The United States Department of the Interior
EIA	Energy Information Administration
EIS	environmental impact statement
EMNRD	New Mexico Energy, Minerals, and Natural Resources Department
ENA	Eastern Navajo Agency
EO	executive order
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
ESD	ecological site description
FAR	functional-at risk
FFO	Farmington Field Office
FIMO	Federal Indian Minerals Office

FLPMA	Federal Land Policy and Management Act of 1976
FMG	Farmington Mancos-Gallup
GHG	greenhouse gas
GIS	geographic information system
GMU	game management unit
GRT	gross receipts tax
H_2S	hydrogen sulfide
HAP	hazardous air pollutant
HPD	Historic Preservation Division
HUC	hydrologic unit code
IMPROVE	Interagency Monitoring of Protected Visual Environments
IPCC	Intergovernmental Panel on Climate Change
ITA	Indian trust asset
mcf	thousand cubic feet
MMT	million metric tons
MOU	memorandum of understanding
NAAQS	National Ambient Air Quality Standards
NADP	National Atmospheric Deposition Program
NAGPRA	Native American Graves Protection and Repatriation Act
NASS	National Agricultural Statistics Service
NCDC	National Climatic Data Center
NEI	national emissions inventory
NEPA	National Environmental Policy Act of 1969
NESL	Navajo Endangered Species List
NHPA	National Historic Preservation Act of 1966 (54 U.S.C. 300101)
NHT	National Historic Trail
NIIP	Navajo Indian Irrigation Project
NMBGMR	New Mexico Bureau of Geology and Mineral Resources
NMCRIS	New Mexico Cultural Resource Inventory System
NMDGF	New Mexico Department of Game and Fish
NMED	New Mexico Environment Department
NMOCD	New Mexico Oil Conservation Division
NMPIF	New Mexico Partners in Flight
NNC	Navajo Nation Code
NNCRPA	Navajo Nation Cultural Resources Protection Act
NNDFW	Navajo Nation Department of Fish and Wildlife
NNDPS	Navajo Nation Division of Public Safety
NNEPA	Navajo Nation Environmental Protection Agency
NNHP	Navajo Nation Natural Heritage Program
NNHHPD	Navajo Nation Heritage and Historic Preservation Department
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NPS	United States Department of the Interior, National Park Service
NRCS	USDA Natural Resources Conservation Service
NRHP	National Register of Historic Places
NRO	Navajo Regional Office
NSA	noise-sensitive area
NTL	notice to lessee

NTN	National Trends Network
NTSA	National Trail System Act of 1968
OHV	off-highway vehicle
ONRR	Office of Natural Resources Revenue
OSNHT	Old Spanish National Historic Trail
PFC	proper functioning condition
PFYC	potential fossil yield classification
PILT	payments in lieu of taxes
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
PM_{10}	particulate matter less than 10 microns in diameter
ppb	parts per billion
ppm	parts per million
PRPA	Paleontological Resources Preservation Act
RCP	Biological Resource Land Use Clearance Policies and Procedures
RCRA	Resource Conservation and Recovery Act
REA	rapid ecoregional assessment (climate model)
RFD	reasonably foreseeable development scenario
RMP	resource management plan
RMPA	resource management plan amendment
RNA	research natural area
ROD	Record of Decision
ROW	right-of-way
SDA	specially designated area
SEZ	solar energy zone
SO_2	sulfur dioxide
SRMA	special recreation management area
SRP	special recreation permit
SUYL	sheep units year-long
SWReGAP	Southwest Regional Gap Analysis Project
TCP	traditional cultural property
TDS	total dissolved solids
THPO	Tribal Historic Preservation Officer
TMDL	total maximum daily load
UCR	uniform crime rate
UNESCO	United Nations Educational, Scientific and Cultural Organization
USACE	US Army Corps of Engineers
USDA	US Department of Agriculture
USFWS	United States Department of the Interior, Fish and Wildlife Service
USGS	United States Geological Survey
VCC	vegetation condition class
VRI	visual resource inventory
VOC	volatile organic compound
VRM	visual resource management
WRCC	Western Regional Climate Center
WRI	Word Resource Institute
WSA	Wilderness Study Area

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Farmington Mancos-Gallup 2020 Affected Environment Supplemental Report

AE.1 INTRODUCTION

The purpose of this supplemental report is to describe the existing biological, physical, and socioeconomic characteristics of the planning area, including human uses that could be result from implementing the alternatives described in Chapter 2 of the Farmington Mancos-Gallup (FMG) Resource Management Plan Amendment/Environmental Impact Statement (RMPA/EIS). Discussions of topic areas are divided into resources, resource uses, special designations, 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).

Topic areas were identified for inclusion in this report, based on their presence or absence in the planning area and whether they were identified as issues of concern in internal and external scoping. For example, certain types of resources that may be present in other planning areas do not exist in the FMG planning area; therefore, they are not covered in this report.

Travel management is not included as a stand-alone section because the scope of the FMG RMPA/EIS is such that no decisions are being made for travel management. Although travel management was identified as a resource issue in public scoping comments, the issues raised by the public relate to impacts from travel on other resources, such as wildlife, air quality, vegetation, and public health and safety. As a result, discussion of transportation or travel management, as applicable, is addressed in those sections.

Information from broad-scale assessments helped set the context for the planning area. The information and direction for Bureau of Land Management (BLM) resources and resource uses has been further broken down into fine-scale assessments and information. The level of information presented in this report is sufficient to assess the potential impacts discussed in **Chapter 3** of the FMG RMPA/EIS, based on the alternatives presented in **Chapter 2** of the FMG RMPA/EIS.

Acreage figures and other numbers are approximated using geographic information system (GIS) technology and do not reflect exact measurements or accurate calculations.

AE.2 RESOURCES

AE.2.1 Air Resources

Regulatory considerations, indicators, current conditions, and trends in air quality in the region are all discussed, particularly their relationship to criteria air pollutants, hazardous air pollutants (HAPs), visibility, and atmospheric deposition.

Air quality in the United States is regulated by both federal and state legislation. The Clean Air Act is the primary federal legislation and provides the framework for protecting air quality at the national, state, and local level. The act designates the United States Environmental Protection Agency (EPA) as the chief governing body of air resources in the United States; however, it also provides states and, in some cases, tribal governments management authority to implement their own air quality legislation, monitoring, and control measures.

The EPA and State of New Mexico have designated the New Mexico Environment Department (NMED) Air Quality Bureau as the authority that regulates air pollution and quality in the state, with the exception of Bernalillo County and tribal lands. This authority originates from the Clean Air Act, as well as New

Mexico's Environmental Improvement Act, Air Quality Control Act, and the State Implementation Plan approved by the EPA.

Tribal lands in New Mexico are regulated by the Four Corners Air Quality Task Force. This authority is derived from the Clean Air Act, specifically the Tribal Authority Rule in Section 301(d), which authorizes eligible tribes to implement their own air quality programs. Standards in New Mexico's Environmental Improvement Act, Air Quality Control Act, State Implementation Plan, and the Four Corners Air Quality Task Force must meet or exceed the air quality standards delineated in the Clean Air Act.

Regulatory Environment

Air quality is measured by the concentration of air pollutants and visual appearance in a geographic area. Wind, temperature, humidity, geographic features, vegetation, and wildfire are biological factors that could affect the resource.

Air Quality

Criteria Air Pollutants

Ambient Air Quality Standards (AAQS) are a set of regulations implemented by New Mexico's Air Quality Act (20.2.3 NMAC). The legislation is established from the federally designated National Ambient Air Quality Standards (NAAQS), which are established by the EPA (40 CFR, Part 50).

Under the authority of the Clean Air Act, the EPA has set time-averaged NAAQS for six criteria air pollutants considered to be key indicators of air quality: carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, lead, and two categories of particulate matter (particulate matter less than 10 microns in diameter [PM_{10}] and particulate matter less than 2.5 microns in diameter [$PM_{2.5}$]).

NAAQS consist of primary standards, which provide requirements for public health, particularly that of sensitive populations, such as asthmatics, children, and the elderly. Secondary standards incorporate public welfare provisions, such as the protection of visibility, wildlife, crops, vegetation, and buildings. National, Tribal, and New Mexico AAQS are listed in **Table AE-1**; as noted in the table, the Navajo Nation uses the NAAQS as the tribal AAQS.

Criteria pollutants that are used as indicators for the FMG RMPA/EIS are carbon monoxide, nitrogen dioxide, ozone, sulfur dioxide, PM_{10}, and $PM_{2.5}$. Additionally, volatile organic compounds (VOCs), which can be a precursor pollutant to ozone formation, also are used as an indicator pollutant. Emissions of lead in the planning area due to oil and gas activities are extremely low (BLM, Ramboll Environ US Corporation, and Kleinfelder, Inc. 2016); therefore, lead is not discussed further in this analysis. Detailed information on each criteria pollutant, as well as sources of criteria pollutant emissions in the planning area, is provided in the BLM New Mexico State Office's Air Resources Technical Report for Oil and Gas Development (BLM 2018a).

Table AE-1
National, Tribal, and New Mexico Ambient Air Quality Standards

Pollutant	Averaging Time	National Standards/Navajo Standards			New Mexico Standard[4]
		Primary	Secondary	Form	
Ozone	8-hour	0.070 ppm[1]	Same as primary	Annual 4th-highest daily maximum 8-hr concentration, averaged over 3 years	—
Carbon monoxide	8-hour	9 ppm	—	Not to be exceeded more than once per year	8.7 ppm
	1-hour	35 ppm	—		13.1 ppm

Pollutant	Averaging Time	National Standards/Navajo Standards			New Mexico Standard[4]
		Primary	Secondary	Form	
Nitrogen dioxide	Annual (arithmetic mean)	53 ppb	Same as primary	Annual mean	0.05 ppm
	24-hour	—	—	—	0.10 ppm
	1-hour	100 ppb	—	98th percentile of 1-hour daily max. concentration, averaged over 3 years	—
Sulfur dioxide	Annual (arithmetic mean)	—	—	—	0.02 ppm
	24-hour	—	—	—	0.10 ppm
	3-hour	—	0.5 ppm	Not to be exceeded more than once per year	—
	1-hour	75 ppb[2]	—	99th percentile of 1-hour daily max. concentrations, averaged over 3 years	—
Particulate Matter (PM_{10})	24-hour	150 µg/m^3	Same as primary	Not to be exceeded more than once per year on average over 3 years	—
Particulate Matter ($PM_{2.5}$)	Annual (arithmetic mean)	12 µg/m^3	15 µg/m^3	Annual mean, averaged over 3 years	—
	24-hour	35 µg/m^3	Same as primary	98th percentile, averaged over 3 years	—
Lead[3]	Rolling 3-month average	0.15 µg/m^3	Same as primary	Not to be exceeded	—
Hydrogen sulfide (H_2S)	1-hour (statewide)	—	—	—	0.010 ppm
	0.5 hour (within 5 miles of municipalities > 20,000)	—	—	—	0.003 ppm
Total reduced sulfur	0.5 hour	—	—	—	0.003 ppm

Sources: EPA 2019a; New Mexico Administrative Code 20.2.3
Cells with a dash (—) indicate that there is no standard for that pollutant or averaging time
[1]ppm—parts per million. Final rule signed October 1, 2015, and effective December 28, 2015. The previous (2008) ozone standards additionally remain in effect in some areas. Revocation of the previous (2008) ozone standards and transitioning to the current (2015) standards will be addressed in the implementation rule for the current standards.
[2]ppb—parts per billion. Final rule signed June 2, 2010. The 1971 annual and 24-hour sulfur dioxide standards (0.03 ppm annual and 0.14 ppm 24-hour) were revoked in that same rulemaking; however, these standards remain in effect until 1 year after an area is designated for the 2010 standard. One exception is in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.
[3]µg/m^3—micrograms per cubic meter. Final rule signed October 15, 2008. The 1978 lead standard (1.5 µg/m^3) remains in effect until 1 year after an area is designated for the 2008 standard. The one exception is in areas designated nonattainment for the 1978 standard, where the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.
[4]The New Mexico AAQS for total suspended particulates were repealed on September 28, 2018.

Hazardous Air Pollutants

In addition to criteria pollutants, the Clean Air Act regulates toxic air pollutants, or HAPs, that are known or suspected to cause cancer or other serious health effects or adverse environmental impacts. The HAP regulatory process identifies specific chemical substances that are potentially hazardous to human health and sets emission standards to regulate the amount of those substances that can be released by individual facilities or by specific types of equipment. Controls are usually required at the source to limit the release of these air toxics into the atmosphere.

Federal emission standards for HAPs have been promulgated as National Emission Standards for Hazardous Air Pollutants and as Maximum Available Control Technology standards. New Mexico and the Navajo Nation have adopted these federal standards. HAP emissions used as indicators for the FMG RMPA/EIS include formaldehyde, n-hexane, benzene, toluene, ethylbenzene, and xylenes. All are pollutants emitted during well development and production (BLM, Ramboll Environ US Corporation, and Kleinfelder, Inc. 2016).

Hydrogen Sulfide

Hydrogen sulfide (H_2S) is a naturally occurring byproduct of oil and gas development in some oil and gas production zones, primarily in the New Mexico Permian Basin (BLM 2018a); H_2S also may occur in the planning area (BLM 2010a). While there is no NAAQS for H_2S, New Mexico has set a state AAQS (see **Table AE-1**). H_2S is also included on the federal Emergency Planning and Community Right-to-Know Act list as a toxic chemical. New Mexico regulates H_2S from oil and gas development and production through New Mexico Oil Conservation Division Rule 118. It requires that certain actions be taken to limit public exposure for wells, facilities, or operations with H_2S concentrations that exceed 100 ppm (NMOCD 2005).

Air Quality-Related Values

Air Quality-Related Values (AQRVs) are defined as resources that may be impaired by changes in air quality. The most notable examples of AQRVs are visibility and atmospheric deposition that can affect the scenic, cultural, physical, biological, ecological, or recreational areas of a region.

Visibility

Part C of the Clean Air Act prohibits areas that are in attainment of the NAAQS from being polluted up to the level of the standards. The Clean Air Act mandates the EPA to classify areas as Class I, Class II, or Class III. Class I areas allow for minimal degradation of air quality to preserve the condition of those areas. Class II areas allow for a moderate degradation of air quality to allow for industrial growth. Class III areas allow for the greatest level of degradation, though no Class III areas have ever been designated by the EPA.

Class I areas include national parks and wilderness areas of a certain size that were in existence before 1977 or additional areas, such as national monuments and wildlife refuges that have since been designated by federal regulation. The Class I areas nearest to the planning area boundary are shown in **Table AE-2**. There are no Tribal Class I areas in or near the planning area.

Table AE-2
Class I Areas Near the Planning Area

Area	Location
Mesa Verde National Park, Colorado	11 miles north
San Pedro Parks Wilderness, New Mexico	Next to the southeast border of the planning area
Bandelier National Monument, New Mexico	29 miles southeast
Weminuche Wilderness	30 miles north

Source: WFDSS GIS 2009; **Appendix J**, Figure 4-1

Class II areas are the remaining areas in the United States, except for nonattainment and maintenance areas. The planning area is in a Class II area.

The National Park Service (NPS), the United States Fish and Wildlife Service (USFWS), and the Forest Service land managers may identify Class II lands under their jurisdiction that are sensitive to air pollution. These are referred to as sensitive Class II areas and may include wilderness areas, national wildlife refuges, national monuments, national historic parks, and national recreation areas that were not formally designated as Class I areas.

Federal land managers identified sensitive Class II areas as part of the Colorado Air Resources Management Modeling Study (CARMMS) with Updated Mancos Shale Modeling (BLM, Ramboll Environ US Corporation, and Kleinfelder, Inc. 2016). Sensitive Class II areas in and near the planning area are shown in **Table AE-3** and on Figure 4-1 in **Appendix J**.

Table AE-3
Sensitive Class II Areas in and Near the Planning Area

Area	Approximate Distance and Location from the Planning Area
Chaco Culture National Historical Park (CCNHP)	In the planning area
Aztec Ruins National Monument	In the planning area
Canyon de Chelly National Monument	65 miles west
Monte Vista National Wildlife Refuge	55 miles northeast
Northern Rio Grande National Heritage Area	45 miles east
Petroglyph National Monument	55 miles southeast
El Malpais National Monument	65 miles south
South San Juan Wilderness	25 miles northeast
Cruces Basin Wilderness	30 miles east
Chama River Canyon Wilderness	10 miles east
Dome Wilderness	40 miles southeast
Sandia Mountain Wilderness	65 miles southeast

Sources: WFDSS GIS 2009; BLM, Ramboll Environ US Corporation, and Kleinfelder, Inc. 2016; **Appendix J**, Figure 4-1

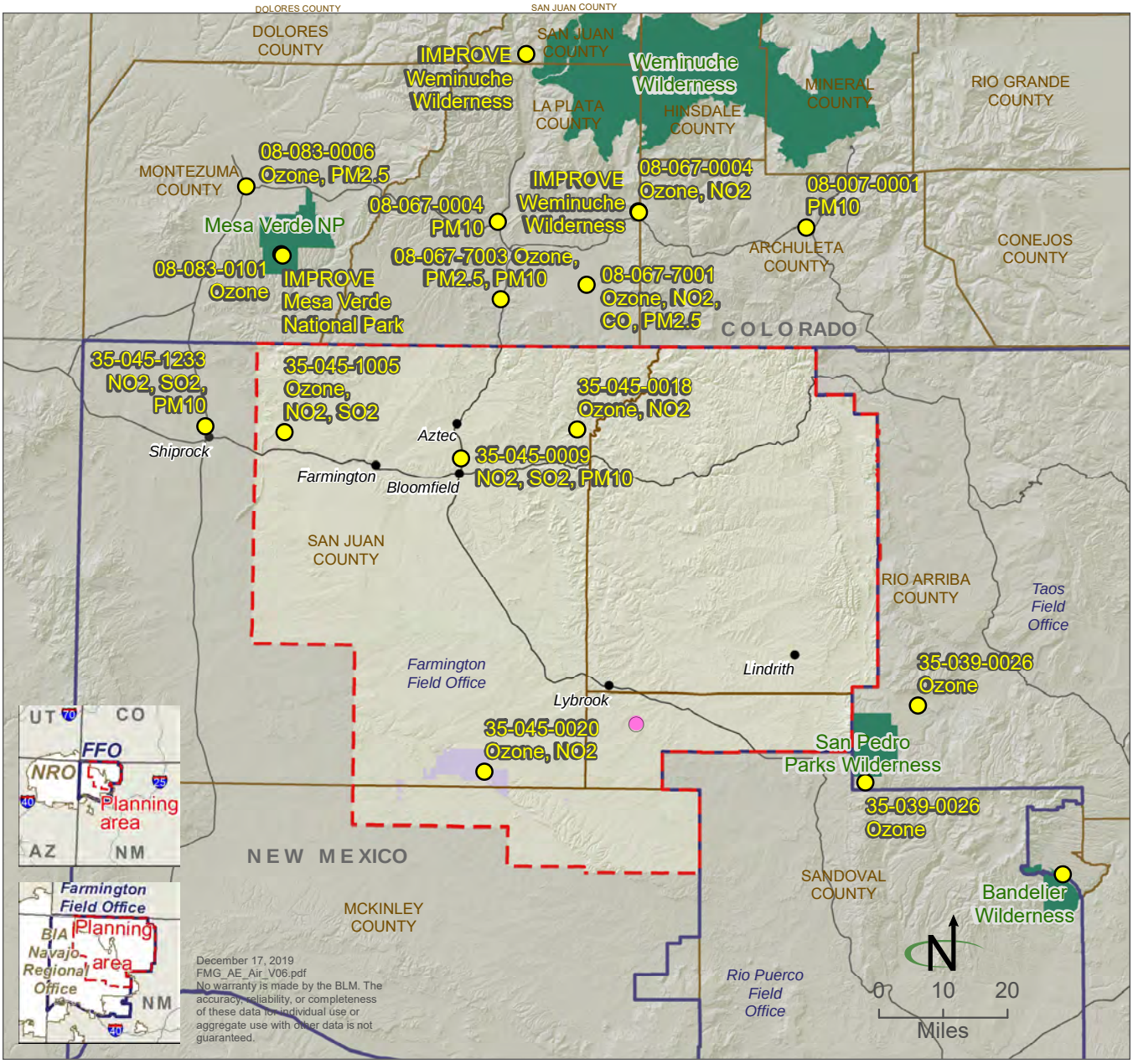
Visibility in federal Class I areas is monitored through the Interagency Monitoring for the Protection of Visual Environments (IMPROVE) monitoring program. This program evaluates current visibility conditions and identifies chemical species and emission sources responsible for visibility impairment in federal Class I areas.

The EPA uses the IMPROVE network to monitor the visibility in Class I areas. Monitors are present in some, but not all, Class I areas; however, several monitors measure for visibility in multiple vicinities (BLM 2018a). In 1999, the EPA promulgated the Regional Haze Rule, which requires states to develop long-term strategies for making reasonable progress in preventing any future and remedying any existing visibility impairment in Class I areas resulting from human-made air pollution.

The haze rule requires states to establish reasonable progress goals for each affected Class I area. These include improving visibility on the 20 percent haziest (most impaired) days and ensuring that no degradation occurs on the 20 percent clearest (least impaired) days. The goal is to reach natural background conditions in mandatory Class I areas by 2064 (EPA 1999, 2017 *Federal Register* Notice). The EPA revised the Regional Haze Rule in December 2016 to update state reporting requirements between 2018 and 2028.

Visibility is monitored at four IMPROVE (stations near the planning area: Mesa Verde National Park, Weminuche Wilderness, San Pedro Parks, and Bandelier National Monument (**Figure AE-1**, Air Quality Monitoring Stations). There has been a slight improvement in the visibility on the 20 percent clearest days at all four monitoring stations since the early 2000s. Similarly, there has been a slightly improving trend in visibility on the 20 percent haziest days over this time frame, though there have been spikes in haze levels during specific years (BLM 2018a, Figure 1).

Figure AE-1
Air Quality Monitoring Stations



Source: BLM GIS 2020

- Air monitoring station
- Temporary NNEPA monitoring station (2016)
- Class 1 airshed
- Planning area
- National Park Service
- Field office boundary

Deposition

Atmospheric deposition is the process in which air pollutants are removed from the atmosphere and subsequently deposited in both aquatic and land-based ecosystems. This can occur through precipitation or through the dry gravitational settling of particles into soil, water, and vegetation.

A chief concern of atmospheric deposition is the formation of acids, particularly nitrogen and sulfur species. This leads to acid rain and the subsequent deterioration of lakes, streams, soils, nutrient cycling, and biological diversity. Additional compounds that result from atmospheric deposition are air toxins (e.g., pesticides, herbicides, and volatile organic compounds), heavy metals (e.g., mercury), and nutrients (e.g., nitrates and ammonium; BLM 2018a).

Deposition is measured through two networks. The National Acid Deposition Program (NADP)/National Trends Network (NTN) measures concentrations and depositions rates of constituents removed from the atmosphere by precipitation. It focuses on those that affect rainfall acidity and those that may cause adverse ecological effects.

The Clean Air Status and Trends Network (CASTNET) measures air quality and deposition trends in rural areas. In conjunction with other national monitoring networks, CASTNET data are used to assess relationships between regional pollution and total deposition patterns and to evaluate the effectiveness of national and regional emission control programs.

There are no NADP or CASTNET monitoring stations in the planning area; however, data from the nearby CASTNET monitoring site at Mesa Verde National Park can be useful for estimating deposition rates in the planning area (BLM 2018a). Both nitrogen and sulfur deposition rates have shown a downward trend since monitoring began in 1995 (CSU 2019).

Current Conditions

The planning area consists of parts of four counties, including the eastern two-thirds of San Juan County, the northern portion of McKinley County, and the western portions of Sandoval and Rio Arriba Counties. The area of analysis can extend for up to 300 miles, as some pollutants are emitted directly and others form through chemical reactions in the atmosphere, particularly in the presence of sunlight.

Air Quality Standards

Attainment Status

The Clean Air Act requires each state to identify areas that have ambient air quality in violation of federal standards, using monitoring data collected through state monitoring networks. Areas that violate air quality standards are designated as nonattainment areas for the relevant criteria air pollutants. Areas that comply with air quality standards are designated as attainment areas for the relevant criteria air pollutants. Areas that have been redesignated from nonattainment to attainment are considered maintenance areas. Areas of uncertain status are generally designated as unclassifiable but are treated as attainment areas for regulatory purposes.

All of the planning area is in attainment or unclassified for each of the NAAQS EPA 2019b); however, air monitoring data show that 3-year average ozone concentrations in the planning area are within 95 percent of the 8-hour ozone NAAQS. Pursuant to New Mexico Statute 74-2-5.3, if NMED determines that emissions from sources within its jurisdiction cause or contribute to ozone concentrations in excess of 95 percent of the NAAQS for ozone, it shall adopt a plan, including regulations, to control emissions of oxides of nitrogen and volatile organic compounds to provide for attainment and maintenance of the standard. NMED has initiated the Ozone Attainment Initiative to address ozone levels in the area (NMED 2019).

Air Monitoring Data

The NMED manages the network of air monitoring stations in New Mexico, except in Bernalillo County and on Tribal lands. The Albuquerque-Bernalillo County Air Quality Control Board oversees air quality programs in Bernalillo County, while Tribal entities, such as the Navajo Nation, implement air quality programs on Tribal lands. There are five NMED monitoring stations and one NPS monitoring station (CCNHP) in the planning area.

The Navajo Nation operates monitoring stations in Shiprock, New Mexico, and Apache County, Arizona, both of which west of the planning area.

There are six air monitoring stations in La Plata and Montezuma Counties, Colorado, immediately north of the planning area. These stations are operated by the Southern Ute Indian Tribe, the NPS, the Forest Service, or the Colorado Department of Public Health and Environment (CDPHE).. Data from these monitoring stations are shown in **Table AE-4**. These data include the pollutants monitored, pollutant concentrations for the most recent 3 years of data, and the 3-year average concentration compared with the NAAQS. The locations of these monitors are shown on **Figure AE-1**, Air Quality Monitoring Stations.

Table AE-4
Air Quality Monitoring Values in the Planning Area

Pollutant	Averaging Time	2016	2017	2018	3-Year Average[1]	NAAQS	Percent of NAAQS[1]
NPS; Site ID 350450020; Chaco Culture NHP; San Juan County, New Mexico							
Ozone (ppm)	8-hour	—	0.064	0.068	—	0.070	—
Nitrogen dioxide (ppb)	Annual	—	0.76	0.68	—	53	—
	1-hour	—	11	5	—	100	—
NMED; Site ID 35-045-1005; Shiprock Electrical Substation; San Juan County, New Mexico							
Ozone (ppm)	8-hour	0.062	0.071	0.074	0.069	0.070	99
Nitrogen dioxide (ppb)	Annual	4.54	4.55	3.49	4.19	53	8
	1-hour	34	32	25	30.33	100	30
Sulfur dioxide (ppb)	1-hour	8	16	9	11	75	15
PM_{10} ($\mu g/m^3$)	24-hour	55	19	87	53.67	150	36
NMED; Site ID 35-045-0009; 2200 N Ist Street, Bloomfield; San Juan County, New Mexico							
Ozone (ppm)	8-hour	0.065	0.068	0.074	0.069	0.070	99
Nitrogen dioxide (ppb)	Annual	9.88	10.44	10.04	10.12	53	19
	1-hour	35	33	34	34	100	34
Sulfur dioxide (ppb)	1-hour	2	2	2	2	75	3
NMED; Site ID 35-045-0018; 423 Highway 539, Navajo Dam; San Juan County, New Mexico							
Ozone (ppm)	8-hour	0.067	0.069	0.074	0.070	0.070	100
Nitrogen dioxide (ppb)	Annual	5.64	5.51	5.95	5.7	53	11
	1-hour	25	28	23	25.33	100	25
NMED; Site ID 35-039-0026; 21 New Mexico 96, Coyote; Rio Arriba County, New Mexico							
Ozone (ppm)	8-hour	0.063	0.070	0.070	0.068	0.070	97
NMED; Site ID 350431001; 600 Oak Street, Bernalillo; Sandoval County, New Mexico							
Ozone (ppm)	8-hour	0.064	0.067	0.073	0.068	0.070	97

Pollutant	Averaging Time	2016	2017	2018	3-Year Average[1]	NAAQS	Percent of NAAQS[1]
Navajo Nation; Site ID 35-045-1233 Shiprock; San Juan County, New Mexico							
Ozone (ppm)	8-hour	0.064	0.061	0.069	0.065	0.070	92
Nitrogen dioxide (ppb)	Annual	4.74	7.35	3.13	5.07	53	10
	1-hour	28	31	23	27.33	100	27
Sulfur dioxide (ppb)8.3375 11Sulfur dioxide (ppb)	1-hour	7	7	11	0.06	75	92
Navajo Nation; Site ID 04-001-1235; Nazlini; Apache County, Arizona							
$PM_{2.5}$ -Monitor 1 ($\mu g/m^3$)	24-hour	9	7	4	6.67	35	19
	Annual	2.3	2.6	2.0	2.30	12	19
$PM_{2.5}$ -Monitor 2 ($\mu g/m^3$)	24-hour	9	7	8	8.00	35	23
	Annual	2.4	2.7	2.5	2.53	12	21
Southern Ute Indian Tribe; Site ID 08-067-7001; Ignacio on County Road 517; La Plata County, Colorado							
Ozone (ppm)	8-hour	0.071	0.069	0.067	0.069	0.070	99
Nitrogen dioxide (ppb)	Annual	4.23	4.63	4.21	4.36	53	8
	1-hour	23	22	19	21.33	100	21
Carbon Monoxide (ppm)	8-hour	1.3	1	0.6	0.97	9	11
	1-hour	5.1	1.1	1.3	2.5	35	7
$PM_{2.5}$ ($\mu g/m^3$)	24-hour	6	—	—	—	35	—
	Annual	2.9	—	—	—	12	—
Southern Ute Indian Tribe; Site ID 08-067-7003; 7571 Highway 550; La Plata County, Colorado							
Ozone (ppm)	8-hour	0.072	0.069	0.067	0.069	0.070	99
Nitrogen dioxide (ppb)	Annual	5.01	5.66	5.35	5.34	53	10
	1-hour	22	27	26	25.00	100	25
$PM_{2.5}$ -Monitor 1 ($\mu g/m^3$)	24-hour	7	6	33	15.33	35	44
	Annual	3.2	—	—	—	12	—
$PM_{2.5}$ -Monitor 3 ($\mu g/m^3$)	24-hour	7	9	7	7.67	35	22
	Annual	3.3	—	—	—	12	—
CDPHE; Site ID 08-067-0004; 1235 Camino Del Rio, Durango; La Plata County, Colorado							
PM_{10} ($\mu g/m^3$)	24-hour	104	38	147	96.3	150	64
Forest Service; Site ID 08-067-1004; Weminuche Wilderness Area; La Plata County, Colorado							
Ozone (ppm)	8-hour	0.065	0.066	0.071	0.067	0.070	96
Nitrogen dioxide (ppb)	Annual	1.04	0.81	1.13	0.99	53	2
	1-hour	7	10	7	8	100	8
NPS; Site ID 08-083-0101; Mesa Verde National Park; Montezuma County, Colorado							
Ozone (ppm)	8-hour	0.066	0.066	0.072	0.068	0.070	97
CDPHE; Site ID 08-083-0006; 106 W. North St, Cortez; Montezuma County, Colorado							
Ozone (ppm)	8-hour	0.064	0.059	0.067	0.063	0.070	90

Source: EPA 2019c

Cells with an em dash (—) indicate that no monitoring data were available for that year for that monitor or pollutant. If data were not available for a given year, then the 3-year average and percent of NAAQS were not calculated.

[1] 3-year averages and percent of NAAQS were calculated only for monitoring stations with 3 consecutive years of data.

Monitoring data show that pollutant concentration levels are below NAAQS for most monitored pollutants; however, ozone concentration levels are approaching the revised NAAQS for ozone at all monitoring stations listed.

In February of 2016, the Navajo Nation Environmental Protection Agency (NNEPA) Air Quality Control Program entered into an agreement with the Counselor Chapter of the Navajo Nation to monitor ambient SO_2, PM_{10}, ozone, and NO_2 within the vicinity of Counselor, New Mexico. This monitoring was

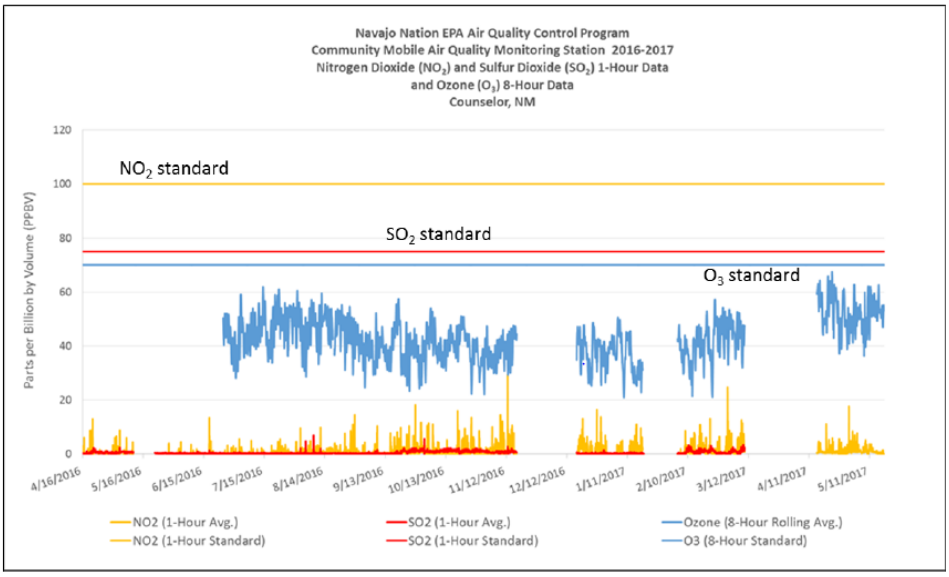
done due to concerns by residents that oil and gas development was impacting local air quality. NNEPA set up an EPA-compliant monitoring station to collect data for one year (**Figure AE-1** for location information). The observed criteria air pollutant concentrations are shown in **Table AE-5** and depicted on **Figure AE-2** and **Figure AE-3**. As shown in this table and figures, criteria pollutant concentrations did not exceed their respective NAAQS values. NO_2 and SO_2 concentrations were well below the NAAQS for each pollutant, while ozone and PM_{10} concentrations were approaching their respective NAAQS values.

Table AE-5
Air Quality Monitoring Values at Counselor Chapter (2016-2017)

Pollutant	Measured Concentration	NAAQS
Nitrogen Dioxide	29.4 ppb	100 ppb
Sulfur Dioxide	7 ppb	75 ppb
Ozone	67.5 ppb	70 ppb
PM_{10}	140.8 µg/m^3	150 µg/m^3

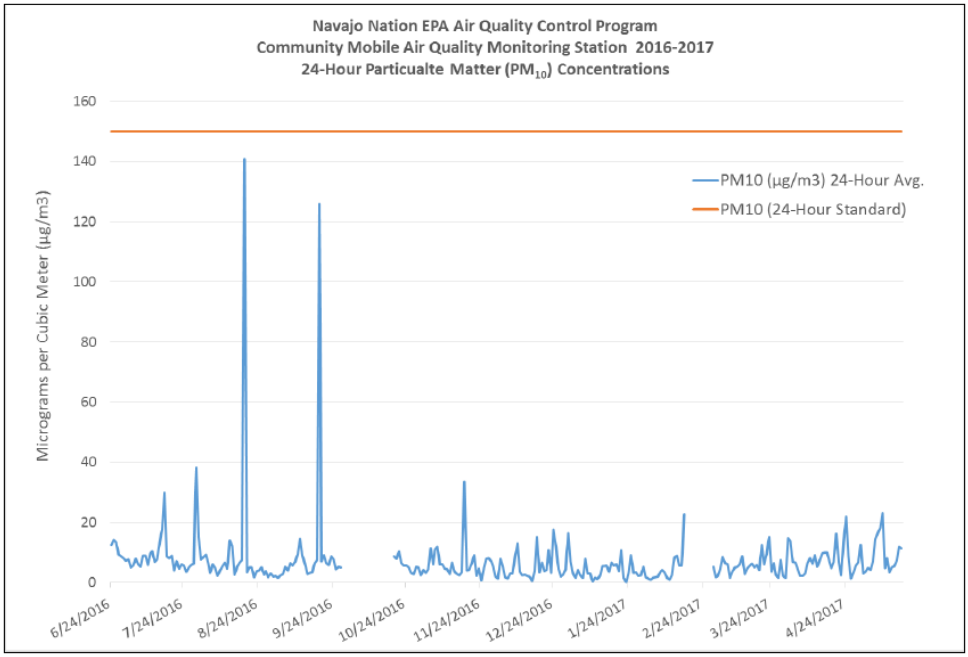
Source: NNEPA 2017

Figure AE-2
NO_2, SO_2, and Ozone Air Monitoring Data, Counselor, New Mexico, 2016-2017



Source: NNEPA 2017

Figure AE-3
PM_{10} Air Monitoring Data, Counselor, New Mexico, 2016-2017



Source: NNEPA 2017

Air Quality Index

The Air Quality Index (AQI) is used for reporting daily air quality. It describes how clean or polluted the air is by geographic area and what the associated health effects may be. The EPA calculates the AQI based on concentrations of criteria air pollutants measured at air monitoring stations. The daily AQI is assigned a number between 0 and 500. An AQI value of 100 generally corresponds to the NAAQS for the pollutant, which is the level the EPA has set to protect public health. Levels below 100 are considered satisfactory, while values above 100 may be unhealthy for some of the population.

The AQI is divided into six categories. Each category corresponds to a different level of health concern, as follows:

- "Good" AQI is 0 to 50. Air quality is considered satisfactory, and air pollution poses little or no risk.
- "Moderate" AQI is 51 to 100. Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people. For example, people who are unusually sensitive to ozone may experience respiratory symptoms.
- "Unhealthy for Sensitive Groups" AQI is 101 to 150. Although the general public is not likely to be affected at this AQI range, people with lung disease, older adults, and children are at a greater risk from exposure to ozone. People with heart and lung disease, older adults, and children are at greater risk from the presence of particles in the air.
- "Unhealthy" AQI is 151 to 200. Everyone may begin to experience some adverse health effects, and members of the sensitive groups may experience more serious effects.
- "Very Unhealthy" AQI is 201 to 300. This would trigger a health alert signifying that everyone may experience more serious health effects.
- "Hazardous" AQI greater than 300. This would trigger health warnings of emergency conditions. The entire population is likely to be affected (EPA 2019d).

Table AE-6 shows the annual AQI for the planning area counties of Rio Arriba, San Juan, and Sandoval for the last 3 years of complete data; AQI is not calculated in McKinley County.

Table AE-6
Air Quality Index Summary Report (2014-2016)

Year	No. of Days with AQI	Good Days	Moderate Days	Unhealthy for Sensitive Groups Days	Unhealthy Days	Very Unhealthy Days	Hazardous Days
Rio Arriba County							
2016	361	303	58	0	0	0	0
2017	360	269	88	3	0	0	0
2018	362	246	113	3	0	0	0
San Juan County							
2016	366	273	91	2	0	0	0
2017	365	230	129	6	0	0	0
2018	365	213	136	16	0	0	0
Sandoval County							
2016	361	292	69	0	0	0	0
2017	364	269	94	1	0	0	0
2018	354	224	118	12	0	0	0

Source: EPA 2019d

National Emissions Inventory

The EPA prepares a national emissions inventory (NEI) every 3 years to provide a comprehensive and detailed estimate of emissions from all air emission sources in the country. Emissions in the inventory are presented by county. The inventories are based on emission estimates and model inputs provided by state, local, and Tribal air agencies for sources in their jurisdictions. This is supplemented by data developed by the EPA.

Table AE-7 summarizes the mobile and stationary source emissions that occurred in the planning area counties of San Juan, McKinley, Rio Arriba, and Sandoval in 2014, the date of the most recent inventory. This baseline emissions summary is a conservative overestimate of planning area emissions. That is because it includes emissions from all of the counties and not just the portions that are in the planning area.

Table AE-7
Summary of 2014 Annual Emissions for San Juan, McKinley, Rio Arriba, and Sandoval Counties (Tons)

Source Category County	Volatile Organic Compounds[1]	Carbon Monoxide	Nitrogen Oxides	Sulfur Dioxide	PM_{10}	$PM_{2.5}$
Agriculture (Crops and Livestock Dust)						
McKinley County	—	—	—	—	120	24
Rio Arriba County	—	—	—	—	553	111
Sandoval County	—	—	—	—	231	46
San Juan County	—	—	—	—	978	196
Subtotal	—	—	—	—	*1,882*	*377*

Source Category County	Volatile Organic Compounds[1]	Carbon Monoxide	Nitrogen Oxides	Sulfur Dioxide	PM_{10}	$PM_{2.5}$
Bulk Gasoline Terminals						
McKinley County	11	—	—	—	—	—
Rio Arriba County	20	—	—	—	—	—
Sandoval County	19	—	—	—	—	—
San Juan County	115	—	—	—	—	—
Subtotal	*165*	—	—	—	—	—
Commercial Cooking						
McKinley County	3	9	—	—	24	22
Rio Arriba County	1	2	—	—	6	6
Sandoval County	4	11	—	—	28	25
San Juan County	4	12	—	—	32	30
Subtotal	*12*	*34*	—	—	*90*	*83*
Dust (Construction, Paved Road, and Unpaved Road Dust)						
McKinley County	—	—	—	—	44,804	4,649
Rio Arriba County	—	—	—	—	21,875	2,247
Sandoval County	—	—	—	—	27,005	2,817
San Juan County	—	—	—	—	48,187	5,062
Subtotal	—	—	—	—	*141,871*	*14,775*
Fire (Prescribed, Agricultural Field Burning, and Wildfire)						
McKinley County	259	1,105	17	9	115	97
Rio Arriba County[1]	4,342	18,452	228	131	1,857	1,573
Sandoval County[1]	1,137	4,829	82	41	508	430
San Juan County	6,907	29,365	333	200	2,928	2,481
Subtotal	*12,645*	*53,751*	*660*	*381*	*5,408*	*4,581*
Fuel Combustion (Commercial/Institutional, Electrical Generation, Industrial Boilers, and Residential, All Fuel Types [Biomass, Coal, Natural Gas, Oil, Wood, and Other])						
McKinley County	145	1,43	3,175	754	125	111
Rio Arriba County	621	1,966	1,205	11	116	115
Sandoval County	210	1,595	1,12186	86	192	157
San Juan County	1,297	13,598	22,800	5,038	567	552
Subtotal	*2,273*	*17,159*	*139,366*	*5,889*	*1,000*	*935*
Gas Stations						
McKinley County	360	—	—	—	—	—
Rio Arriba County	139	—	—	—	—	—
Sandoval County	401	—	—	—	—	—
San Juan County	496	—	—	—	—	—
Subtotal	*1,396*	—	—	—	—	—
Industrial Processes (Mining, Oil and Gas Production, Petroleum Refineries, Storage and Transfer, and Not Elsewhere Classified)						
McKinley County	432	141	222	39	2,881	380
Rio Arriba County	26,650	12,601	9,113	3	154	111
Sandoval County	2,470	454	319	0	71	14
San Juan County	33,403	19,132	13,926	166	2,382	499
Subtotal	*62,955*	*32,328*	*23,580*	*208*	*5,488*	*1,004*
Miscellaneous Nonindustrial NEC						
McKinley County	8	34	1	0	2	2
Rio Arriba County	6	24	1	0	2	1
Sandoval County	12	113	2	0	8	6
San Juan County	14	71	2	0	5	4
Subtotal	*40*	*242*	*6*	*0*	*17*	*13*

Source Category County	Volatile Organic Compounds[1]	Carbon Monoxide	Nitrogen Oxides	Sulfur Dioxide	PM_{10}	$PM_{2.5}$
Mobile Sources (Aircraft, Locomotives, Non-Road Equipment, and On-Road Vehicles)						
McKinley County	1,281	10,903	7,784	44	313	244
Rio Arriba County	810	5,912	1,268	14	84	52
Sandoval County	1,570	14,779	4,405	17	269	165
San Juan County	1,616	16,625	3,733	19	253	149
Subtotal	*5,277*	*48,219*	*17,190*	*94*	*919*	*610*
Solvents (Consumer and Commercial Use, Degreasing, Dry Cleaning, Graphic Arts, Industrial Surface Coating and Solvent Use, and Nonindustrial Surface Coating)						
McKinley County	590	—	—	—	—	—
Rio Arriba County	253	—	—	—	—	—
Sandoval County	1,050	—	—	—	—	—
San Juan County	1,239	—	—	—	—	—
Subtotal	*3,132*	—	—	—	—	—
Waste Disposal						
McKinley County	47	568	24	6	133	105
Rio Arriba County	29	358	14	4	65	56
Sandoval County	179	2,511	80	26	298	232
San Juan County	67	773	30	8	138	117
Subtotal	*322*	*4,210*	*148*	*44*	*634*	*510*
TOTAL MANMADE EMISSIONS	**88,217**	**155,943**	**180,950**	**6,616**	**157,309**	**22,888**
Biogenics (Vegetation and Soil)						
McKinley County	45,359	9,816	1,084	—	—	—
Rio Arriba County	53,977	10,060	705	—	—	—
Sandoval County	36,022	640	7,435	—	—	—
San Juan County	51,939	11,627	1,078	—	—	—
TOTAL BIOGENIC EMISSIONS	**135,358**	**20,516**	**9,224**	**—**	**—**	**—**

Source: EPA 2016a

Cells with an em dash (—) indicate that the emission source described does not emit that criteria pollutant.

[1]VOCs, while not a criteria air pollutant, are included in the NEI because they are an ozone precursor emission (they mix with other pollutants to form ozone). Lead, another criteria pollutant, is collected but not presented in this table because it is not a pollutant of concern in the planning area.

Trends

In 2007, criteria air pollutants, notably ozone, nitrogen oxides, and particulate matter, showed trends of increasing concentrations, due to increased oil and gas production, energy generation from power plants, and general growth in the region. Increased ozone levels, and volatile organic compounds in particular, were the result of supplemental oil and gas development, as well as energy generating plants being produced and constructed in the planning area (Four Corners Air Quality Task Force 2007). Since that time, changes described below were implemented to address ozone concerns in the region.

In 2013, the NMED, the Public Service Company of New Mexico (PNM), and the EPA approved the termination of two units at San Juan Generating Station and subsequent installation of selective non-catalytic reduction technology at the remaining units by the end of 2017. These actions helped meet the requirements of the federal haze rule and significantly reduced the emissions levels of several pollutants. Expected results from these actions included reductions of 67 percent in sulfur dioxide, 62 percent in nitrogen oxides, 50 percent in particulate matter, 44 percent in carbon monoxide, 51 percent in VOCs, 50 percent in carbon dioxide, and 50 percent in mercury (BLM 2018a).

In addition to the shutdown of the two units at the San Juan Generating Station, three coal-fired generators were shut down at the Four Corners Power Plant in December 2013. In 2018, selective catalytic reduction technology was installed at the remaining two coal-fired generators, satisfying the EPA's best available retrofit technology requirements. Like the changes to the San Juan Generating Station, this action will meet federal regional haze rule requirements and reduce emissions. Expected results include a reduction of 36 percent of nitrogen oxides, 61 percent of mercury, 43 percent of particulate matter, 30 percent of carbon dioxide, and 24 percent of sulfur dioxide (BLM 2018a).

In 2014, a memorandum on Mancos Shale oil and gas emissions showed that recent trends in gas production in the south San Juan Basin point to a consistent decline since 2006, a reversal compared with the previous decade. Between 2006 and 2013, gas production dropped an average of 42 billion cubic-feet (BCF) per year; between 2012 and 2013, gas production dropped 64 BCF, the largest decline in production over this time period. The report predicted that in a 10-year period between 2011 and 2021, the average rate of decline would lead to a 420 BCF drop in production, while the most recent maximum rate of decline would lead to a decrease of 640 BCF (BLM, Ramboll Environ US Corporation, and Kleinfelder, Inc. 2016).

PNM issued an Integrated Resource Plan in July 2017. The purpose of this plan, which is updated every 3 years, is to identify the most cost-effective resource mix that would meet the projected electricity demands of its customers over the next 20 years. This plan recommended eliminating coal-fired generation from its energy portfolio by 2031 to provide a long-term cost savings to its customers. Under this scenario, the San Juan Generating Station would be retired in 2022, and PNM would exit its 13 percent share in the Four Corners Power Plant after 2031 (PNM 2017). The New Mexico Public Regulation Commission must approve this plan before it can be implemented.

The Arizona Public Services Electric Company owns most of the Four Corners Power Plant. It released its Integrated Resource Plan in April 2017 (Arizona Public Services Electric Company 2017). Under this plan, it would continue operations at Four Corners Power Plant but would reduce emissions by installing selective catalytic reduction technology in 2018, as described above. It also would replace older gas-fired turbines with new turbines and modernized air pollution controls in 2019.

Overall, air pollutant concentrations such as ozone, nitrogen oxides, and particulate matter, increased as recently as 2006. These increases negatively influenced air resources in the region, including increased deposition rates of mercury and nitrogen and reduced visibility near Class I areas. Since 2006 this trend has reversed, largely due to new regulations limiting emissions from oil and gas development and coal-fired power plants, as well as changing technologies. This trend of decreased air pollutant emissions and continued improvement in AQRVs would likely continue due to the planned actions at area power-generating facilities, described above and reductions in gas production predicted to continue through 2021; however, the rate or direction of this trend may slow or reverse if production of oil and gas development were to increase in the planning area for other reasons, such as favorable economic conditions or continued new technological advances in the industry, or if regulations that limit emissions are rolled back or rescinded.

Climate

The planning area experiences an arid continental climate characterized by cool, dry winters and warm, dry summers. The climate is characterized by an abundance of sunshine and clear skies, leading to large variations between daytime and nighttime temperatures. Average total precipitation is highest in the late summer and fall, as moisture from the Gulf of Mexico travels through the region. Oceanic moisture has little influence on climate due to the large distance between the two areas. Winds typically originate from the west or southwest, although local wind conditions are highly variable due to the diverse topography in the planning area. Elevated and mountainous portions of the planning area experience colder and wetter conditions than other portions of the planning area.

Table AE-8 is a summary of monthly temperature and precipitation data for six towns or cities within the planning area. It illustrates typical climate normals in the region, which are three-decade averages of climatological variables produced by the National Oceanic and Atmospheric Administration (NOAA) and National Climatic Data Center (NCDC). Summary tables of these data were obtained from the Western Regional Climate Center (WRCC).

Table AE-8
Average Temperatures and Precipitation in the Planning Area (1981-2010)

Location	Average Maximum Temperature (°F)			Average Minimum Temperature (°F)			Average Precipitation (in inches)			Average Snow in Inches
	Jan.	Jul.	Annual	Jan.	Aug.	Annual	June	Aug.	Annual	
Shiprock	46.4	96.4	71.9	19.1	59.8	38.8	0.22	1.24	8.21	3.9
Farmington	42.0	90.6	66.7	19.3	58.4	38.9	0.29	1.16	8.59	10.9
Bloomfield	44.0	92.0	68.7	20.1	60.0	39.6	0.36	1.34	9.27	11.4
Navajo Dam	40.2	90.5	65.5	20.1	59.6	39.1	0.57	1.76	14.13	11.6
Lybrook	38.4	83.6	60.8	16.5	54.8	36.1	0.63	2.00	10.84	25.5
Lindrith	39.9	84.4	61.5	10.9	50.1	30.2	0.98	2.34	15.37	59.4

Source: WRCC 2014a, b, c, d, e, f
°F=degrees Fahrenheit

Climate Change and Greenhouse Gas Emissions

Climate is the collective typical weather conditions, such as temperature and precipitation, in a region, generally averaged over a series of years. Climate change is a statistically significant and long-term alteration of these conditions and is considered a deviation from average climate patterns.

Climate change can occur due to both natural and human sources. Natural causes of climate change are volcanic eruptions, fluctuation in solar radiation, and movement of tectonic plates. Examples of human activities that contribute to climate change are fossil fuel combustion, land use modifications, and industrial development (BLM 2018a).

Climate change analysis has two components to be considered in a land use planning document and National Environmental Policy Act (NEPA) analysis. The first is the effect climate change has on the resources and resource uses in the planning area, and the second is the effect that activities and management actions authorized by the land use planning document have on greenhouse gas (GHG) emission levels that contribute to climate change.

This section provides an overview of the sources and levels of GHG emissions at a state and national scale. Information on how climate change is affecting specific resources and resource uses in the planning area are described under *Trends* in the individual resource sections in this chapter. More information on climate change can be found in the *Air Resources Technical Report for Oil and Gas Development* (BLM 2016a).

GHGs are released into the atmosphere through both natural processes and human activities, while others are created and emitted solely through human activities. The production, transport, and use of oil, gas, and coal are one of the chief causes of rising GHG emissions, particularly due to the release of carbon dioxide, methane, nitrous oxide, and fluorinated gases.

These emissions contribute to the GHG effect, a process by which the GHGs in the atmosphere absorb and trap heat energy radiated by earth's surface, causing the temperatures to warm (BLM 2018a). According to the Intergovernmental Panel on Climate Change (IPCC), there is a 95 to 100 percent probability that human influence is the leading source of the observed warming beginning in the mid-twentieth century (IPCC 2013).

Despite the strong correlation between GHG emissions and climate change, assessing the impacts between the two phenomena is extremely difficult. This is due to the complex intricacies, mechanisms, interrelationships, and sources between the two factors. Applying global climate models to regional or local scales leads to ambiguous results; thus, the ability to quantify the environmental consequences of GHGs to smaller scales is limited.

In spite of this uncertainty, there are still methods for demonstrating the effects GHG emissions have on the environment. Climate data, such as yearly temperature or precipitation averages, are effective for illustrating the consequences of climate change and associated GHG emissions. This is the case as long as the trends are robust and have been transpiring for long periods, such as over at least several decades (BLM 2018a).

Global Emissions. The World Resources Institute's (WRI's) Climate Analysis Indicators Tool provides data on GHG emissions from 186 countries and all 50 states (WRI 2019a). In 2014, the most recently reported year, global GHG emissions were 45,741 million metric tons of carbon dioxide equivalent (MMT CO_2e). Since 1990, global GHG emissions have increased by 42 percent, or at an average annual rate of 1.9 percent. From 1970 to 2000, GHG emissions increased at an average annual rate of 1.3 percent, while in the decade from 2000 to 2010, emissions increased at an average annual rate of 2.2 percent.

Over the last four decades, the biggest contributors to global carbon dioxide emissions have been fossil fuel combustion and industrial processes, which accounted for 78 percent of the total GHG emissions. Since 2000, GHG emissions have been increasing in all sectors, except agriculture, forestry, and other land use. In 2010, electricity and heat production accounted for 25 percent of direct GHG emissions; agriculture, forestry, and other land use accounted for 24 percent; industry accounted for 21 percent; and transportation accounted for 14 percent (IPCC 2014).

US Emissions. The WRI's Climate Analysis Indicators Tool reports total US GHG emissions of 6,371 MMT CO_2e in 2014 (WRI 2019a); this represented 14 percent of the total global emissions.

The GHG emission inventory prepared by the EPA reported that US GHG emissions were 6,457 MMT CO_2e in 2017. Between 1990 and 2017, overall US GHG emissions increased by 1.3 percent. Between 2016 and 2017, emissions decreased by 0.5 percent, due to a decrease in carbon dioxide emissions from fossil fuel combustion. This was due to such factors as the change from coal to natural gas in the electric power sector and a milder winter that reduced heating fuel use compared with prior years (EPA 2019e).

Electricity generation, transportation, and industry were the largest sources of GHGs in 2017, at 28 percent, 29 percent, and 22 percent. The contribution of GHGs from the energy sector in 2017 was over 84 percent of total US emissions; the energy sector includes fossil fuel combustion, nonenergy fuel use, natural gas systems, petroleum systems, coal mining, and waste incineration (EPA 2019e).

State Emissions. The WRI's Climate Analysis Indicators Tool reports 2014 statewide GHG emissions in New Mexico of 78 MMT CO_2e. This accounts for 1 percent of 2014 US GHG emissions (WRI 2019b).

GHG emissions in New Mexico increased 3 percent annually from 1990 to 2000 but decreased by 6 MMT CO_2e from 2000 to 2013. The largest sources of GHG emissions in 2013 were electricity generation (35 percent), the fossil fuel industry (26 percent), and transportation fuel use (17 percent). The fossil fuel industry (production, processing, and transportation of natural gas, oil, and coal) emissions in 2013 were 21.1 MMT CO_{2e}, the lowest since 2000 and a sharp decline from 2010 (NMED 2016).

Planning Area Emissions. The EPA's 2014 National Emissions Inventory included emissions of carbon dioxide, methane, and nitrous oxide for some source categories in planning area counties (EPA 2016a).

These emissions are shown in **Table AE-9**. Note that there are limited regulatory requirements to track GHG emissions; therefore, emissions from the fossil fuel and other industries are not included in this inventory.

Table AE-9
Summary of 2014 Annual Reported GHG Emissions by Source Category

Source Category	Emissions (Tons)		
	Carbon Dioxide (CO_2)	Methane	Nitrous Oxide
McKinley County			
Fire (prescribed and wildfire)	14,075	54	—
Mobile sources (non-road and on-road)	1,022,458	90	17
Rio Arriba County			
Fire (prescribed and wildfire)	204,435	897	—
Mobile sources (non-road and on-road)	345,344	31	10
Sandoval County			
Fire (prescribed and wildfire)	65,288	238	—
Mobile sources (non-road and on-road)	1,161,706	80	31
San Juan County			
Fire (prescribed and wildfire)	309,357	1,422	—
Mobile sources (non-road and on-road)	1,094,733	84	29

Source: EPA 2016a
Cells with an em dash (—) indicate that the emission source described does not emit that criteria pollutant.

The EPA Facility Level Information on Greenhouse Gases Tool (FLIGHT; EPA 2019f) database reports annual GHG emissions from facilities emitting more than 25,000 metric tons of CO_2e per year that are subject to the EPA's Greenhouse Gas Reporting Program (GHGRP) under 40 CFR 98. This includes emissions from most large, stationary sources of GHGs[1] and emissions from most end uses of fossil fuels. Nationally, the GHGRP accounts for 85 to 90 percent of total GHG emissions accounted for in the EPA's Inventory of US Greenhouse Gas Emissions and Sinks (EPA 2019d). Reported 2018 emissions for all generators by county are as follows:

- McKinley, 1.65 MMT CO_2e
- Rio Arriba, 0.51 MMT CO_2e
- Sandoval, 0.16 MMT CO_2e
- San Juan, 16.22 MMT CO_2e

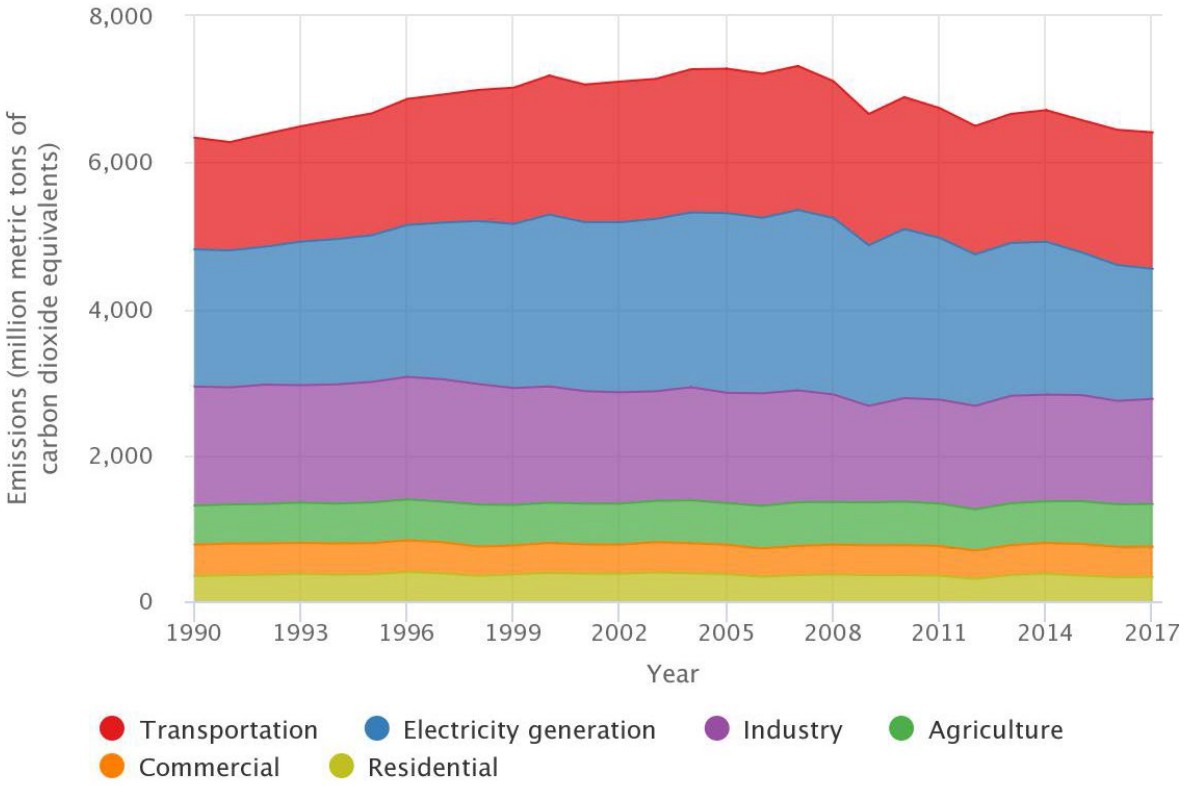
Most GHG emissions in the planning area originate in San Juan County, which contained 4 power plants and 7 petroleum and natural gas system sources in 2018 (the most recent year reported). In 2018, there were 4 petroleum and natural gas system sources reported in Sandoval County (though with no emissions were reported); 1 power plant, 1 refinery, and 1 petroleum and natural gas system source in McKinley County; and 1 petroleum and natural gas system source in Rio Arriba County (EPA 2019f).

Trends

The most recent GHG emission inventory prepared by the EPA (EPA 2019e) shows GHG emissions data for 1990 to 2017 by economic section (**Figure AE-4**). Emissions were slightly higher in 2017 than in 1990 but lower than the peak in 2007.

[1] Smaller emitters are not required to report.

Figure AE-4
US GHG Emissions by Economic Sector, 1990–2017



Source: EPA 2019e

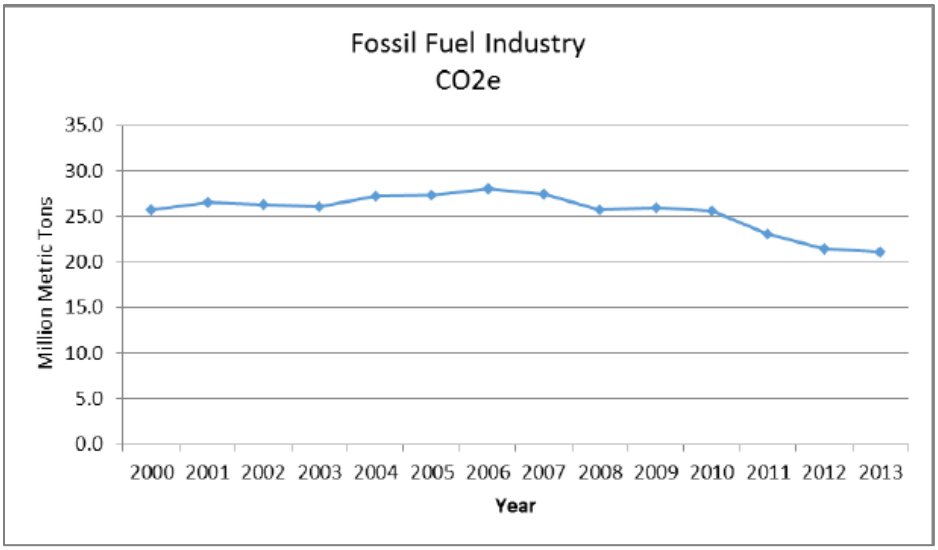
While unavailable by county, the trend in GHG emissions for the fossil fuel industry (oil, coal, and gas) in New Mexico may be indicative of the planning area. As shown in the New Mexico GHG trends report (NMED 2016), GHG emissions from this sector decreased from 2000 to 2013 (**Figure AE-5**). This represents the most recently compiled information for the state.

The US Energy Information Agency's Annual Energy Outlook 2018 report (EIA 2018) predicts that based on current regulations, energy-related CO_2 emissions from the industrial sector would grow 0.6 percent annually between 2017 and 2020, while electric power sector emissions would remain flat, commercial sector emissions would grow 0.1 percent annually, and natural gas emissions would grow 0.8 percent annually. It also states that:

- In the near term, the cumulative effect of increased coal plant retirements, lower natural gas prices, and lower electricity demand would be a reduction in CO_2 emissions from electric generators, even without the Clean Power Plan.
- By 2030, when most of the additional coal unit retirements will have occurred and in the absence of the Clean Power Plan, CO_2 emissions from electric generators would stabilize.

In the planning area, scheduled changes in operations at the San Juan Generating Station and Four Corners Power Plant, described under *Air Quality Trends* above, would result in a localized decrease in GHG emissions from these sources, as reflected in the discussion above.

Figure AE-5
Fossil Fuel Industry CO2e, New Mexico



Source: NMED 2016

AE.2.2 Geology

Current Conditions

Geologic Setting

The following discussion describes current conditions for geologic resources throughout the planning area, including the BLM and Bureau of Indian Affairs (BIA) decision areas shown in **Figures 1-3** and **1-5**. The generalized geology of the San Juan Basin is an asymmetrical syncline in the Colorado Plateau. It extends from northwestern New Mexico into southwestern Colorado and is about 200 miles long and 130 miles wide; it covers approximately 21,600 square miles.

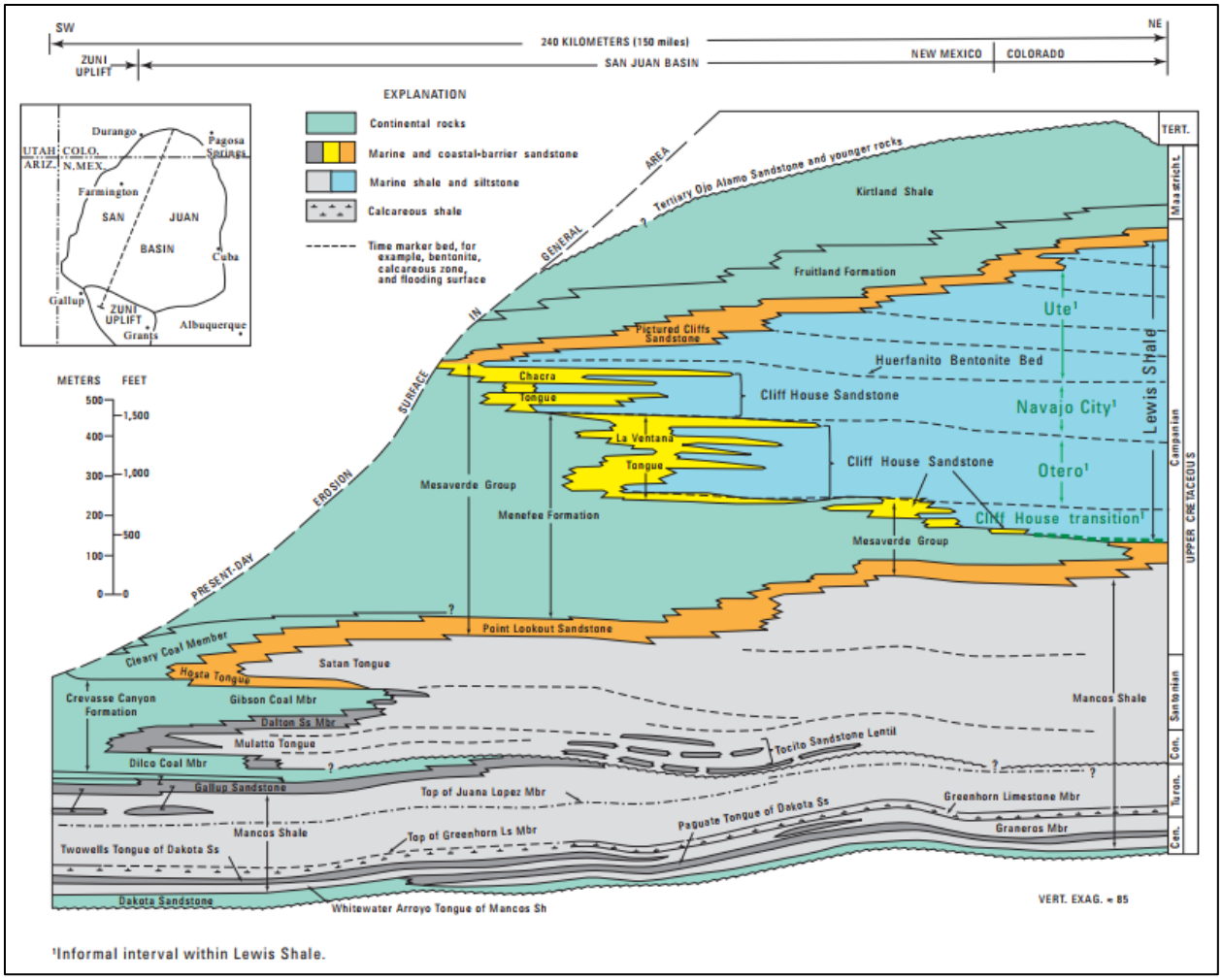
The surface geology of the basin consists primarily of Quaternary to Cretaceous (2.6 to 145 million years) aged alluvium material. This includes unconsolidated silts, sands, clays, and gravels and sandstones, siltstones, shales, limestones, conglomerates, and coal (BLM 2015). **Figure AE-6**, Stratigraphic Cross Section of the San Juan Basin Highlighting Depositional Facies and Units in the Lewis Shale Total Petroleum System*, is an illustration of the geological characteristics of the area.

The San Juan Basin is bordered on the north by the San Juan dome, on the south by the Chaco slope and the Zuni uplift, on the east by the Nacimiento uplift, and on the west by the Defiance uplift and the Chuska Mountains. There are basement rock outcrops, including eroded cores of the Zuni, Jemez, and Nacimiento uplifts that form the edge of the San Juan Basin on the south and east (BLM 2015).

The lithological units in the San Juan Basin range in age from Cambrian to Quaternary. They include mainly shales and sandstones of varying grain size, as well as coals and some carbonates and igneous rocks. Sedimentary rocks display an aggregate thickness of over 14,000 feet on the Colorado/New Mexico state line. The top of the Precambrian basement rocks is more than 7,500 feet below sea level at the deepest part of the basin (BLM 2015).

Formations representing the Permian period through the Pennsylvanian period consist mainly of shales and sandstones. The Cretaceous-age rocks represent 6,000 feet of sandstones, siltstones, shales, and coals (BIA, undated). Cretaceous formations were downwarped into the San Juan Basin during the late

Figure AE-6
Stratigraphic Cross Section of the San Juan Basin Highlighting Depositional Facies and Units in the Lewis Shale Total Petroleum System*



* Cen. = Cenomanian; Turon. = Turonian; Con. = Coniacian; Maastricht. = Maastrichtian; Tert. = Tertiary; Ss = Sandstone; Ls = Limestone; Mbr = Member
Source: Dubiel 2013

Cretaceous until the early Tertiary Laramide tectonic event. By the end of the Laramide uplift, Cretaceous rocks reached their maximum depth of burial, and the San Juan Basin achieved its current structural configuration. Subsequent regional heating enhanced the thermal maturation of deeply buried organic matter to a level that generated gas in the center of the San Juan Basin and oil at its margins (Engler et al. 2001).

The predominant hydrocarbon reservoirs of the San Juan Basin are all Cretaceous; they are the Fruitland Formation, Pictured Cliffs Sandstone, Mesaverde Group, Mancos/Gallup Formation, and Dakota Sandstone. These formations contain both source rocks and natural reservoirs for oil and gas. Slow decomposition of plant and animal material in the source rocks resulted in hydrocarbon deposits.

Going down the stratigraphic column in northwestern New Mexico, the first major primary hydrocarbon reservoir is the Fruitland Formation. It overlies and interfingers with the Pictured Cliffs Sandstone. The

Fruitland Formation is composed of interbedded sandstones, siltstones, shale, carbonaceous shales, and coal; it contains the coal resources that produce coal bed methane and minable coal (BIA, undated).

The Pictured Cliffs Sandstone is a gas reservoir, consisting of shoreline sandstone, composed of an upper, medium to thick-bedded, ledge-forming sandstone and a lower, thick, very fine-grained sandstone, with interbedded shales and siltstone.

The Mesaverde Group is a series of gas reservoirs and represents a single regression and transgression cycle of the epicontinental Cretaceous sea. These are not blanket sands but are discontinuous shoreline deposits. The main gas-producing sandstones are the Cliff House at the top of the group and the Point Lookout at the bottom.

The thick Mancos shale is distributed throughout much of the western United States by the Western Cretaceous Interior Seaway. In the San Juan Basin, this organic rich shale is primarily a gas reservoir in the center, deepest portion of the basin. It is an oil play on shallower up-dip portions, such as Chaco slope. Oil production is from interbedded shales and sandstones of the Gallup interval of the lower Mancos Shale Formation.

The Dakota Sandstone is a gas reservoir consisting of a transgressive sequence, composed of sandstone, shale, minor conglomerates, and coal. The upper Dakota Sandstone represents shoreline and offshore marine sand deposits.

Oil plays and mineral resources are further discussed under **Section AE.3.2**, Minerals.

The planning area also contains unique geological features and stratigraphic units that are managed to protect these resources from degradation, which is the focus of this section.

Geologic Features

There are two formations with unique geologic significance in the planning area: Angel Peak and Beechatuda Tongue. The BLM manages them as specially designated areas (SDAs) to protect them from damage by surface- and subsurface-disturbing activities.

Angel Peak features a rare geologic feature in the shape of an angel with one uplifted wing. It visually dominates the area known as the Kutz Canyon Badlands and is an unusual example of extreme erosion patterns. The canyon is a barren badland of blue and gray-layered shale, carved through the centuries. The tip of Angel Peak is hard sandstone, which stands alone, because the land around it was washed and blown away. Various other mineral deposits add reds, yellows, browns, and lavenders to the blue and gray shale strata of the canyon walls.

The Beechatuda Tongue Geologic Formation of the Cliff House Sandstone is a rock stratigraphic unit mapped in, and named for, Beechatuda Draw in T.30N, R.15W, Section 5, W/4. This area is the type locality for the unit; as such, it is of interest to scientists and educators as a site for comparison and study and for possible further refinement of the stratigraphic nomenclature. It is important that the unit be preserved to allow these studies and comparisons. There are 100 acres within the boundary of the Beechatuda Tongue Geological Formation, all of which is BLM-managed land and all of which contains federal minerals.

Additionally, there are named geologic formations and stratigraphic units in the planning area, such as the Mancos Shale and Morrison Formation. These areas are not managed specifically for their protection or preservation.

Trends

Angel Peak and the Beechatuda Tongue stratigraphic unit are expected to continue normal erosion patterns and to continue to be sites of interest to the public. Angel Peak is expected to continue to draw visitors as a recreation opportunity; the Beechatuda Tongue stratigraphic unit is expected to continue to receive visitors of the scientific community for comparison values to other nearby stratigraphic units.

Traditional users gather certain minerals, such as iron pyrite, for use in their cultural practices. One Navajo belief is that Earth is the mother of the Navajo people and that its degradation, including hydraulic fracturing and oil and gas extraction from geologic formations, will also harm the Navajo people.

Seismic Activity

There have been no major earthquakes in or near the planning area. The planning area is under extensional deformation (Zoback 1989), or a "stretching" pressure on the rock. Extensional deformation produces a much slower energy buildup than compressional deformation, or a "squeezing" pressure on the rock; accordingly, earthquakes are less likely to occur and, when they do occur, are of a low intensity.

Thus, in the planning area, the earthquake peak ground acceleration with a 2 percent chance of being exceeded in 50 years is of such a small value (USGS 2014) that an observer in the planning area would likely not feel any ground movement.

Seismicity can be caused by human activity in areas with certain types of faults and a critical state of stress in the rocks. Pore pressure, or stress, on a fault may change when fluids are injected into or extracted from a well. This change may lead to movement along that fault, resulting in a seismic event. Increased seismicity in the central United States in recent years has been linked to injection of wastewater or other fluids in high volumes over an extended period in deep disposal wells (Petersen et al. 2015).

The United States Geological Survey (USGS) has created a seismic hazard model that incorporates induced seismicity into predictions of probability of future seismic events. The model is updated each year to reflect additional earthquake data. For 2017, the model indicates a probability for damage from an earthquake of less than 1 percent for the planning area. The model also predicts a chance of an earthquake of 4 or greater on the Modified Mercalli Intensity Scale to be 1 percent for the planning area (Petersen et al. 2017). A 4 on the Modified Mercalli Intensity Scale is described as "Shaking light, felt indoors by many, outdoors by few."

The USGS has identified 17 areas in the central and eastern United States that contain seismicity suspected to have been induced by fluid injection or removal; these areas are called induced seismicity zones. New Mexico has two such zones—Dagger Draw in the southeast and the Raton Basin near the New Mexico/Colorado border, approximately 40 miles east of Taos, New Mexico.

While earthquakes recorded in these zones could be natural, the USGS believes they may be induced seismicity due to human activity. This is because the earthquakes are all located near deep fluid injection wells or other industrial activities capable of inducing earthquakes (Petersen et al. 2015). Neither of the induced seismicity zones in New Mexico is in or near the planning area. The overall risk of induced seismicity in the planning area is extremely low to nonexistent.

AE.2.3 Water Resources

Water resources in the planning area are surface waters and groundwater. Surface waters are lakes and ponds, rivers, and springs; groundwater is all water below the ground surface. Groundwater exists in the pore spaces of unconsolidated materials, such as alluvial sediments that fill river valleys; however, it is also in consolidated materials, such as sandstone and shale.

Permeable materials that readily yield groundwater to a well are called aquifers. Less permeable materials that yield water very slowly are called aquitards. Very low permeability or impermeable materials that prevent the flow of groundwater are called aquicludes. Several aquifers may exist in a vertical sequence below the surface, separated from each other by aquitards and aquicludes.

The water information in this section is applicable to both BLM- and BIA-managed lands. When available, information specific to the BLM or BIA is also identified and is labeled throughout this section. Any Indian Trust Assets (ITAs) involving water resources are discussed under Section AE.5.1, Native American Tribal Interests and Uses. For additional discussion on riparian areas and wetlands, see Section 3.4.4.

Current Conditions

Water Supply

Surface Water

Watersheds in the United States and the Caribbean were delineated by the US Geological Survey using a national standard hierarchical system. This is based on the watersheds' surface hydrologic features, which are classified into four types of hydrologic units: first-field (region), second-field (subregion), third-field (accounting unit), and fourth-field (cataloging unit).

The boundary between watersheds is defined as the topographic dividing line from which water flows in two directions; however, the scale at which the landscape is examined is relevant for identifying and defining watersheds. A watershed could be small and represent a single tributary in a larger system, or it could be quite large and cover thousands of miles.

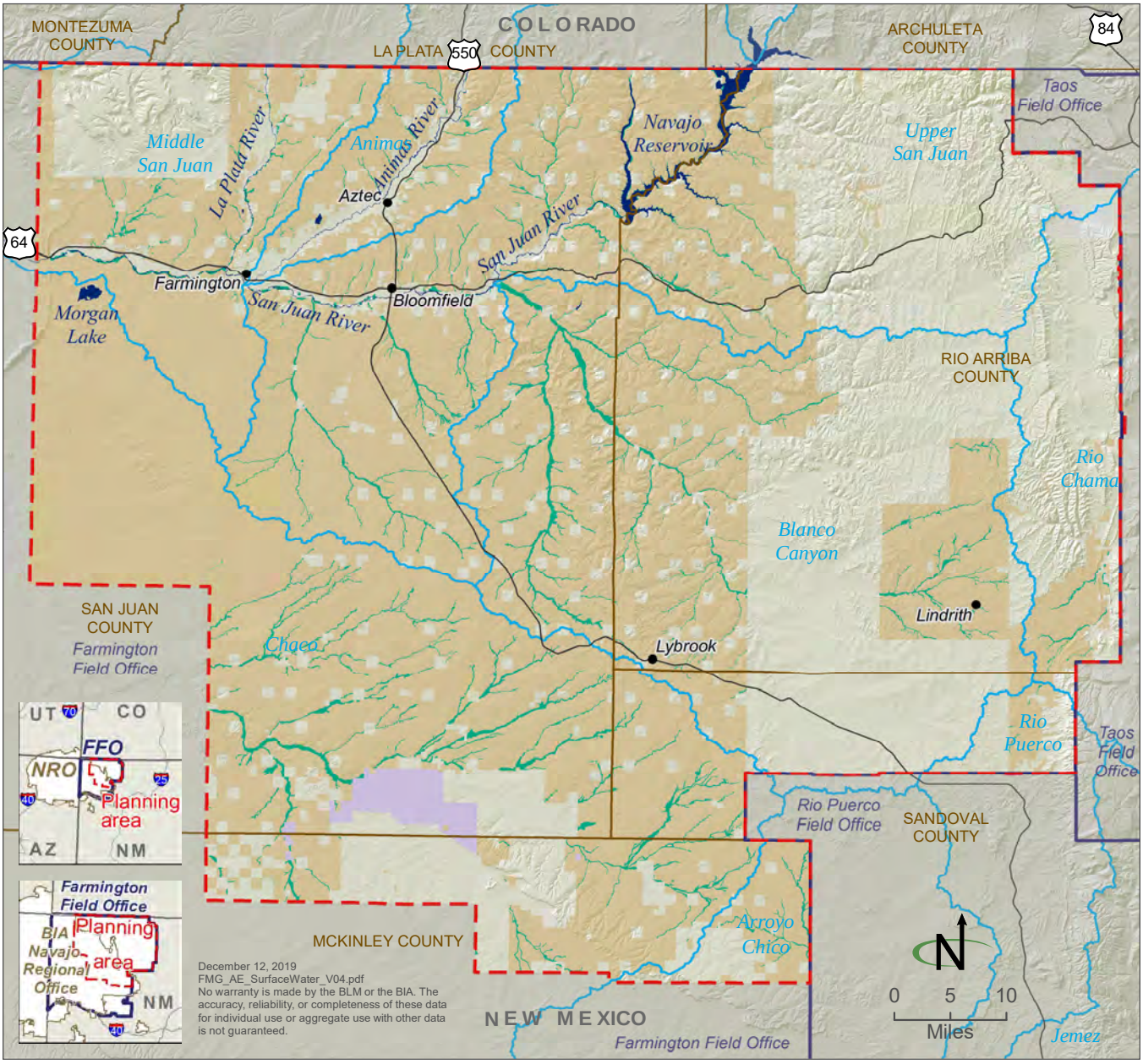
The planning area contains nine cataloging units (organized as fourth-level hydrologic unit codes [HUCs]; NHD GIS 2016). See **Table AE-10**, below. In the planning area, there are approximately 7,800 miles of **perennial**, **intermittent**, and ephemeral streams on BLM-managed lands and approximately 3,600 miles of perennial, intermittent, and ephemeral streams on Navajo Tribal trust lands and individual Indian allotments. (NHD GIS 2016). See **Figure AE-7**, Surface Water, for a representation of HUC boundaries and major waterways and reservoirs in the planning area.

Table AE-10
BLM and BIA Surface Decision Area Watersheds

Watershed	Acres
Animas	102,200
Arroyo Chico	43,900
Blanco Canyon	594,700
Chaco	904,700
Mancos	400
Middle San Juan	245,900
Rio Chama	40,200
Rio Puerco	14,500
Upper San Juan	654,600
Total	**2,601,200**

Figure AE-7
Surface Water

Watersheds in the United States were delineated by the US Geological Survey using a national standard hierarchical system based on surface hydrologic features. The boundary between watersheds is defined as the topographic dividing line from which water flows in two different directions. The planning area contains 8 cataloguing units (organized as fourth-level hydrologic unit codes [HUC 8]).



Source: BLM GIS 2020

- Major lake and reservoir
- Major river and stream
- Watershed (HUC 8)
- 100-year floodplain
- BLM and BIA decision area
- Planning area
- National Park Service
- Field office boundary

The San Juan River arises on the western slope of the Continental Divide in southwestern Colorado. It flows from the San Juan Mountains north of Pagosa Springs, Colorado. It enters northwestern New Mexico through the Navajo Reservoir in Rio Arriba County, west of the Jicarilla Apache Reservation and the Carson National Forest. Then the river turns westward for approximately 140 miles through New Mexico before returning to Colorado in the Four Corners region. It then continues west through southern Utah to its confluence with the Colorado River.

The San Juan River basin encompasses lands in four New Mexico counties: all of San Juan County, most of the northern half of McKinley County and the western half of Rio Arriba Counties, and a small portion of Sandoval County. Parts of the Navajo Nation and Jicarilla Apache reservations are in the basin, where the United States Bureau of Reclamation (BOR) operates Navajo Dam and Reservoir for water conservation, storage, and flood control. The reservoir also supplies irrigation water for the Navajo Nation on the Navajo Indian Irrigation Project (NIIP).

The eastern portion of the analysis area is in a third-order watershed of the Rio Grande, called Rio Grande-Elephant Butte; it is designated as HUC 130202. The analysis area lies in three subareas of the Rio Grande-Elephant Butte watershed: the Rio Puerco, the Arroyo Chico, and the Rio San Jose.

The principal perennial surface waters in the planning area are the San Juan River, the Animas River, the La Plata River, and the Rio Grande. **Table AE-10**, above, identifies all watersheds in the planning area and the HUC associated with each.

The Upper San Juan hydrologic unit includes the subwatersheds of Pump Canyon, Navajo Reservoir, Kutz Canyon, and Gobernador; the Blanco Canyon hydrologic unit includes the subwatersheds of Blanco, Largo, and Carrizo; the Middle San Juan hydrologic unit includes the La Plata sub-watershed.

The San Juan River headwaters are on the Continental Divide, north of Pagosa Springs, Colorado. The San Juan flows westward through the planning area. The headwaters of a number of perennial tributaries to the San Juan River in New Mexico rise in southern Colorado; major perennial tributaries are the Animas and the La Plata Rivers. Other major tributaries that rise in the southern portion of the San Juan Basin are Canyon Largo, Gallegos Canyon, and the Chaco River, all of which are ephemeral streams.

Groundwater

To expand on the definition above, an aquifer is a groundwater resource contained in the pore space of geologic media in such quality and quantity that it may be readily available for use via springs or wells.

The United States can be divided into numerous groundwater provinces (regions). The two most successful and most useful subdivisions are those proposed by Meinzer in 1923 and by Thomas in 1952. Meinzer divided the country into 21 groundwater provinces, primarily on the basis of the rock units that serve as the principal sources of groundwater. Thomas reduced Meinzer's 21 provinces to 10 regions by combining provinces where differences in groundwater conditions are minor. This resulted in a very useful regional classification, which has been used many times since 1952 in national summaries of groundwater conditions (USGS 1984).

The planning area is in the Colorado Plateau and Wyoming Basin Region. This region encompasses an area of 160,000 square miles in Arizona, Colorado, New Mexico, Utah, and Wyoming. It is a region of canyons and cliffs and sparse vegetation adapted to the arid and semiarid climate.

The New Mexico Bureau of Geology and Mineral Resources (NMBGMR) study, the Hydrologic Assessment of Oil and Gas Resource Development of the Mancos Shale in the San Juan Basin, New Mexico (2014), summarizes groundwater resources. Located in the San Juan Basin, the study was done to

investigate the availability of groundwater for oil and gas resource development of the Cretaceous Mancos Shale.

The ten major confined aquifers in the San Juan Basin are as follows:

- Ojo Alamo Sandstone
- Kirtland Shale/Fruitland Formation
- Pictured Cliffs Sandstone
- Cliff House Sandstone
- Menefee Formation
- Point Lookout Sandstone
- Gallup Sandstone
- Dakota Sandstone
- Morrison Formation
- Entrada Sandstone

Most of the groundwater in the San Juan Basin is developed in Cenozoic to Mesozoic sandstones that are separated by low-permeability shale to mudstone intervals. Freshwater in the San Juan Basin is generally at depths of less than 2,500 to 3,500 feet. The remainder of the water at depth in the central basin is brackish to saline.

Occurrences of potable water farther out in the basin suggest fast recharge pathways that likely are controlled by geologic structures. Saline water from depth also migrates upward along fractures and slowly through confining layers.

The total volume of water in the ten confined aquifers (and two major aquitards, the Mancos Shale and Lewis Shale) is on the order of 3.25 million acre-feet, at depths of less than 2,500 feet below the ground surface. This calculation of groundwater volume in the San Juan Basin represents the approximate maximum total predevelopment volume of water. Also, there are about 83 million and 1.2 million acre-feet of water in storage in the San Jose and Nacimiento aquifer, for unconfined and confined conditions; thus, the total range of calculated groundwater storage volumes for the San Juan Basin varies between 4.5 and 86 million acre-feet, depending on the assumptions used (NMBGMR 2014).

Water Quality

Surface Water

BLM. Water resources are particularly important in the semiarid environment that characterizes the planning area. The BLM manages water resources both for resource values (e.g., watershed function, wildlife, and riparian systems) and resource uses (e.g., recreation, stock water, livestock grazing), within a framework of applicable federal, state, and Tribal water laws and agency policies.

The BLM manages water quality under the Clean Water Act (CWA). The CWA protects, restores, and improves water quality, enables states to establish programs for regulating and managing nonpoint source pollution, and directs federal agencies to comply with state water quality laws.

In accordance with Section 305(b) of the CWA, states are required to develop lists of impaired water. These waters do not meet federal or state water quality standards; however, the law requires a priority ranking for waters on the lists to be established and total maximum daily loads (TMDL) to be developed (EPA 2016b). TMDLs determine the amounts of pollutant loading that a given water body can receive and still meet water quality standards. Common parameters to measure water quality improvement are temperature, sediment, turbidity, pH, bacteria, dissolved oxygen, and nutrients (NMED 2014).

New Mexico's Water Quality Standards define water quality goals by designating uses for rivers, streams, lakes, and other surface waters, setting criteria to protect those uses, and establishing antidegradation provisions to preserve water quality. The standards were adopted by the Water Quality Control Commission and then approved by the EPA under the federal CWA.

The New Mexico Clean Water Act, Section 303(d)/Section 305(b) Integrated Report identifies streams that have impaired water quality. Watersheds containing impaired streams are summarized in **Table AE-11**, below, with miles of 303(d) impaired streams on BLM- and BIA-managed land.

Table AE-11
Impaired Water Quality by Watershed

Watershed Name/HUC	Miles on BLM-Managed Land	Miles on BIA-Managed Land	Total Miles in the Planning Area
Animas	0.7	0.0	36.6
Middle San Juan	4.3	12.4	48.0
Upper San Juan	6.4	0.0	101.9
Total	**11.4**	**12.4**	186.6

Source: NHD GIS 2016

Water body impairments are classified into five primary categories. Category 5 streams are most commonly discussed, because they are the 303(d)-listed streams for which TMDLs are required, they have violated water quality standards, and they do not have a TMDL or pollution control plan.

In order to correct persistent impairments, the CWA requires that the TMDL be determined as a first step in setting discharge limitations on the contaminants of concern.

The New Mexico Environment Department has prepared three TMDL documents to address surface water quality in the analysis area There is one for impairments of the La Plata, Animas, and San Juan Rivers from the Navajo Nation boundary at the Hogback to Navajo Dam and two others that address impairments on the Rio Puerco, in the Middle Rio Grande watershed (NMED 2005, 2007a, 2007b). Although a number of impairments are listed for water bodies in watersheds of the San Juan River in Colorado, the State of Colorado has prepared no TMDLs to date.

Fecal coliform was identified as a common cause of impairment in all segments, and a combination of sources was identified. The most significant sources are animal feeding operations, improperly installed or maintained septic systems, livestock grazing, wildlife (particularly geese), and municipal wastewater treatment plants. Ephemeral streams, such as Canyon Largo and Kutz Canyon, were also implicated as sources of high bacteria loading. Improving the water quality in these segments would likely require efforts on several fronts, including correctly identifying the most significant sources.

Quality data for the ephemeral runoff south of the San Juan River are limited to only a few observations at sampling stations. These observations are from the USGS coal hydrology program and from measurements made by the San Juan Watershed Group. Ephemeral flows are generally of very poor quality, due to the highly erosive and saline nature of the soils, sparse vegetation cover, and rapid runoff conditions that are characteristic of the area. Surface runoff in the area usually contains greater than 10,000 milligrams per liter (mg/L) of suspended sediment and greater than 1,000 mg/L of dissolved solids (BLM 2015).

A complete summary of reasons for listing waterways as impaired is provided in Appendix A of the 2014–2016 State of New Mexico Clean Water 303(d)/305(b) Integrated Report List of Assessed Surface Waters (NMED 2014).

The CWA Section 402(l)(2) provides that the EPA shall not require, nor force, a state to require a CWA Section 402 permit for discharges of stormwater runoff. Specifically, this runoff is from oil and gas exploration, production, processing, or treatment operations; or it could be from transmission facilities composed entirely of flows that are from conveyances or systems of conveyances used for collecting and conveying precipitation runoff. These are flows that are not "contaminated by contact with any overburden, raw material, intermediate products, finished product, byproduct, or waste products located on the site of such operations (EPA 2017h)."

This exemption applies to both construction and industrial activities associated with oil and gas exploration, production, processing, or treatment operations or transmission facilities.

The types of oil and gas facilities and activities subject to the waiver for stormwater permitting fall under "exploration, production, processing or treatment operations, or transmission facilities." Facilities and activities that are not exempt are typically downstream from an oil and gas exploration, production, processing, or treatment operation, or transmission facility. They involve or support the physical or chemical transformation of raw materials into final manufactured products for sale.

The trigger for stormwater from an oil or gas operation needing CWA Section 402 permit coverage is a discharge of stormwater that does the following:

- Results in the discharge of a "reportable quantity" for which notification is or was required under 40 CFR 117.21 or 302.6, at any time since November 16, 1987
- Results in the discharge of a reportable quantity for which notification is or was required under 40 CFR 110.6, at any time since November 16, 1987
- Contributes to a violation (that is to say, exceeds) of a water quality standard

The Safe Drinking Water Act is the federal law that protects public drinking water supplies throughout the nation. Under the act, the EPA sets standards for drinking water quality and, with its partners, implements various technical and financial programs to ensure drinking water safety.

BIA. Water quality on BIA-managed lands is managed under the Navajo Nation Clean Water Act (NNEPA 2017). The Executive Director of the NNEPA promulgates water quality standards that protect the public health or welfare, enhance the quality of water, and generally serve the purposes of the Navajo Nation Clean Water Act.

The standards provide for the protection and propagation of wildlife and livestock; protect agricultural, domestic, and recreational uses of water; and protect the cultural value and use of water. The standards consist of the designated uses for the waters of the Navajo Nation and the water quality criteria for such waters based on such uses. They are applicable to all waters of the Navajo Nation. The standards also include the methods and analyses to be used to determine compliance with such standards.

According to the Clean Water Act, the Executive Director of the NNEPA may grant or deny any certification, federal license, or permit necessary to conduct any activity. This includes the construction or operation of facilities that could result in a discharge into waters of the Navajo Nation, depending on whether the applicant has satisfactorily shown a willingness to comply with Sections 301, 302, 303, 306, and 307 of the Clean Water Act (NNEPA 2017).

The Navajo Nation Safe Drinking Water Act protects the health and welfare of the Navajo people and the environment. It accomplishes this by establishing appropriate drinking water standards to ensure that drinking water is safe for consumption. It also protects underground sources of drinking water from potential contamination by underground injection activities.

The Counselor Chapter conducted a health impact assessment to document health concerns expressed by community members and investigate certain water and air quality conditions in the Counselor-Nageezi area. The water samples taken from public water faucets did not detect any contaminants at levels violating EPA water quality standards. Total dissolved solids (over 600 mg/L), sodium, sulfates, and alkalinity levels were all high in the water, but not at levels that make the water unsafe to drink. A livestock pond was also sampled and was found to have lower total dissolved solids and alkalinity levels (Counselor Health Impact Assessment Committee 2017). Because the methodology for conducting the sampling was not fully explained, it is difficult to evaluate the conclusions.

Groundwater

As with surface water, New Mexico relies on several programs established under a variety of statutory authorities to protect and maintain groundwater quality. The New Mexico Water Quality Act authorizes the Water Quality Control Commission to adopt groundwater quality protection regulations and standards.

The following laws also contain provisions designed to protect groundwater quality; they implement the groundwater regulations and water quality standards directly or by reference (NMED 2014):

- New Mexico Oil and Gas Act
- Hazardous Waste Act
- Groundwater Protection Act
- Solid Waste Act
- Emergency Management Act
- Voluntary Remediation Act, Mining Act
- Environmental Improvement Act

The BLM and BIA cooperate with state and local governments to implement the various laws relevant to groundwater pollution control. In addition to the aquifers in the planning area, Tribes have expressed concern about potential degradation of those around the planning area.

Additionally, under the Navajo Nation Clean Water Act, the Executive Director of the NNEPA may develop a program to protect surface water and ground water from pollution on a watershed basis. This would consider impacts on water quality from a variety of sources and would consider cumulative impacts and discrete instances of contamination (NNEPA 2017).

In developing the program, the Executive Director of the NNEPA consulted with other Navajo Nation agencies and departments. The Director also consulted with state and federal agencies and other entities having authority over activities that may affect water quality in the Navajo Nation. Examples of such are agriculture, livestock grazing, mining and timber operations, and business development.

The Executive Director of the NNEPA may conduct studies on watershed protection in the Navajo Nation, develop guidelines and procedures to protect such watersheds, and promulgate regulations to implement the purposes of Subchapter 8, in accordance with the provisions of Section 1001 of the Navajo Nation Clean Water Act.

The quality of groundwater in the San Juan Basin generally ranges from fair to poor. In most places the total dissolved solids (TDS) content exceeds 1,000 mg/L; it can range from 500 to 4,000 mg/L (BLM 2003; USGS 2001). The Uinta-Animas Basin contains fresh to moderately saline water. Dissolved solids concentrations generally increase along the groundwater flow path in the San Juan Basin. The water is hard to very hard, and the actual chemical composition depends on location and on the producing aquifer.

Calcium or sodium is usually the predominant cation, and bicarbonate or sulfate is the predominant anion (BLM 2003).

The quality of the Mesa Verde aquifer is extremely variable. In general, areas that are recharged by infiltration from precipitation or surface water contain water that is relatively fresh. Sparse data indicate that the dissolved solids concentration ranges from about 1,000 to 4,000 mg/L in the San Juan Basin (BLM 2015).

The composition and TDS concentration of water in the Rio Grande aquifer system are affected by the quality of the water that enters the aquifer, the type and solubility of minerals in the basin fill, and the quantity of water lost by evaporation and transpiration (BLM 2015).

Soluble minerals in the rocks of the mountains next to the basins affect the quality of the water draining from the mountains, which, in turn, affects the quality of the recharge entering the aquifers. Water in the aquifer system is of varied chemical composition, in part because of the varied geology of the nearby mountains. Surface water in the Rio Grande in the reach from the headwaters to Albuquerque generally has low TDS concentrations and is of the calcium bicarbonate or calcium sulfate type (BLM 2015).

Detailed geochemical tracer studies by Riese et al. (2005), Phillips et al. (1989), and Dam (1995) provide important insights into the sources of water in the San Juan Basin, revealing the following types of water:

- Saline, connate water in the center of the basin associated with deposition of marginal marine units
- Relatively young (less than 25,000 years old) water, derived from recharge along the margins of the basin, that has migrated 3 to 20 miles of the outcrop belt; in a few places these meteoric waters appear to travel farther out into the basin to depths greater than 2,500 to 3,500 feet along northeast-striking structures
- Fossil meteoric water that infiltrated into the subsurface tens of miles from the margins of the basin during late Eocene time (35 to 40 million years ago), before and during exhumation of the basin
- Waters that interacted with silicic crustal rocks, with high uranium content, that have migrated up along fractures

Water Rights

Total water rights that have been permitted in the San Juan Basin are approximately 107,000 acre-feet per year (afy). The coal and uranium mining industries currently hold 31.1 percent (33,098 afy) of the water rights in the San Juan Basin compared with the 6.3 percent (6,674 afy) owned by the petroleum industry. About 70 percent of the petroleum industry water rights are currently not in use.

Other major water uses are domestic users and municipalities, at 28.2 percent, and food production, at 24.7 percent (NMBGMR 2014).

The Navajo Nation currently holds water rights in the San Juan Basin, for irrigation and for municipal, industrial, commercial, and domestic uses (NMOSE/ISC 2017).

Floodplains

A floodplain is a geographic area of relatively level land that is occasionally subject to inundation by surface water from rivers or streams. A 100-year flood is one that has a 1 percent probability of occurring in any given year. The 100-year flood is also referred to as the 1 percent flood, since its annual exceedance probability is 1 percent. Floodplains are summarized in **Table AE-12**, below.

Table AE-12
100-Year Floodplains in the Decision Area

Floodplain	BLM-Managed Land (Acres)	BIA-Managed Land (Acres)
100-Year	78,700	27,800

Source: FEMA GIS 2017

Trends

Water Supply

Groundwater is expected to continue to be the primary source of municipal, industrial, tribal, and agricultural water in the analysis area. Further, groundwater is currently the only source of water for many of the Navajo Nation Chapters in the planning area. Changing climate patterns could have long-term impacts on streamflows, snowpack, and groundwater recharge. Some of the potential impacts of changes in climate conditions, such as increased frequency of wildfires, increased evaporation, changes in vegetation patterns, increased erosion, and diminished snowpack, may reduce groundwater recharge (BLM 2015).

The Colorado River Basin has experienced drought conditions since 1999. As the amount of runoff from the upper portions of the watersheds of the major river systems decreases, downstream users will increasingly look for ways to better use water supplies. This could include reducing consumption, reducing waste, and possibly prioritizing uses and limiting those with lower priority (BLM 2015).

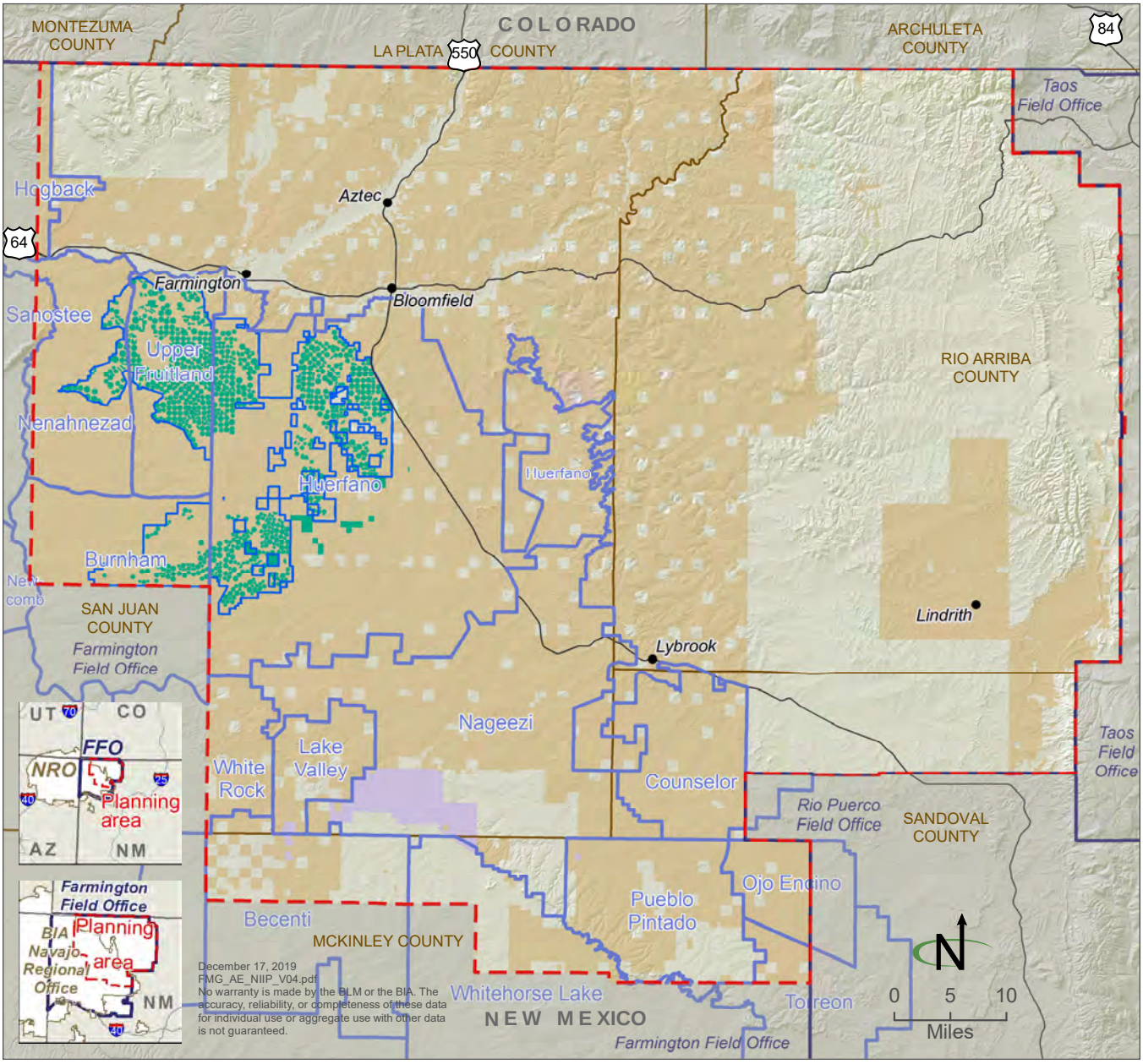
The NIIP was authorized on June 13, 1962 (Public Law 87-483, as amended by Public Law 91-416 on September 25, 1970). It is an element of the Upper Colorado River Storage Project for irrigating 110,630 acres of farmland (**Figure AE-8**, Navajo Indian Irrigation Project). The water supply is provided by Navajo Lake, the reservoir formed behind Navajo Dam on the San Juan River. The project is entitled to 508,000 afy of San Juan River water (Navajo Agricultural Products Industry 2017).

Demand for potable groundwater in the San Juan Basin has been increasing and is expected to continue to increase. The annual population growth for Gallup was estimated at 1.82 percent in the Final EIS for the Navajo-Gallup Water Supply Project (BOR 2009). Groundwater elevations in the aquifers underlying the region have shown declining trends. In response, the New Mexico State Engineer has imposed limitations on groundwater extraction by adjudicating water rights in the San Juan Basin and other basins in the analysis area. Similar trends have occurred in the portions of the San Juan Basin in Arizona, Utah, and Colorado (BLM 2015).

The State of New Mexico reached a final settlement with the Navajo Nation in 2009. As a result, the Navajo-Gallup Water Supply Project was initiated to divert 37,764 afy from the San Juan River, based on an assumed demand rate of 160 gallons per day per person. It also assumes a projected population of 250,000 in the Navajo Nation, the Jicarilla Apache Nation, and the city of Gallup by 2040. The project assumes 1,871 afy of return flows to the San Juan River (BOR 2009). Similarly, demand for water outside the basin is expected to continue to increase, while supply continues to decrease.

Hydraulic fracturing, which is expected to increase in the analysis area, can consume large volumes of water, which, if multiplied at many drilling sites over the region, could increase the demand for water. The demand for high-quality groundwater for fracturing could be reduced by using nonaqueous or reduced-water fracturing techniques and recycling and reusing water produced from hydraulic fracturing or from normal production (BLM 2015).

Figure AE-8
Navajo Indian Irrigation Project



Source: BLM GIS 2020

- Navajo Indian Irrigation Project
- Navajo Indian Irrigation Project block
- BLM and BIA decision area
- Planning area
- National Park Service
- Field office boundary
- Navajo Nation Chapter

Overall, the production of water from oil and gas wells is balanced by injection of produced water in the southern San Juan Basin in Sandoval and McKinley Counties (NMBGMR 2014). The southern part of the basin saw production decline between the late 1990s and 2008. It has seen a slight increase in production since 2008, with renewed interest in this area (NMBGMR 2014).

Produced water volumes extracted during drilling and operation in San Juan and Rio Arriba Counties has been documented as steadily increasing since 1999 (NMBGMR 2014). A decline, beginning in 2010, is thought to be a result of the aging of Fruitland Formation coal bed methane wells (NMBGMR 2014). As of 2014, the majority of the produced water was being injected back into the formation it was pulled from, via permitted produced water injection wells. Reuse of produced water for hydraulic fracturing has become more common as treatment of the water is more achievable (EPA 2016).

The development of the Mancos play will require additional freshwater for stimulation purposes. Of particular concern, are horizontal completions, which require large volumes of water for hydraulic fracturing. The average water volume used for hydraulic fracturing is 1,020,000 gallons, or 3.13 acre-feet per fracture. The reason that some wells were higher volume is due to them being extended horizontal wells or because foam was not used in their stimulation (Engler et al. 2015).

To assess the impact of water requirements for the Mancos/Gallup horizontal development, the following shows a comparison of past usage of water for stimulation in the San Juan Basin to predicted usage for horizontal well development in the Mancos shale formation. On average, Dakota, Mesaverde, and Gallup vertical wells use 105,000 gallons, (0.33 acre-feet), 150,000 gallons (0.46 acre-feet), and 207,000 gallons (0.63 acre-feet) of water.

Within the planning area, it is estimated that hydraulically fracturing the wells projected in the next 20 years under current management will require up to 2.5 billion gallons (7,683 acre-feet) of water. This is a maximum scenario, estimating that 100 percent of wells will be hydraulically fractured and not accounting for re-use or recycling of hydraulic fracturing fluid. Fracturing fewer wells and/or re-using or recycling hydraulic fracturing fluid would reduce these volumes (**Appendix I**).

In response to the water usage issue, the industry has applied completion strategies and technologies to reduce the need for freshwater for stimulation. These strategies and technologies include reduction by using produced water, reuse of flow back water, and the use of foam fracking (Engler et al. 2015).

In addition, the BLM has identified certain inspection and enforcement responsibilities to protect groundwater, which consist of the following:

- Casing and cementing plans are conducted to protect and isolate all usable water zones, lost circulation zones and abnormal pressured zones. Proper isolation of formation zones involve protection of the surface, environment, and public health and safety. Isolating means using cement to protect, separate, or segregate usable water and mineral resources.
- To assure a high-quality inspection is performed and to maintain an experienced, well-trained and a highly efficient inspection force; inspectors attend a National Training Center course to become certified as an Oil and Gas Inspector. The training specifically targets different aspects in the oil and gas industry including Code of Federal Regulations (CFR) and Onshore Orders regulations.
- Responsibilities include ensuring that there is adequate zonal isolation on all subsurface formations. Also, all casing, except the conductor casing, shall be new or reconditioned and tested casing. All casing shall meet or exceed American Petroleum Institute standards for new casing. All surface casing cement jobs must be cemented to surface, or remedial cement is required. For a quality cement bond around casing, centralizers must be used.

- The casing setting depth shall be calculated to position the casing seat opposite a competent formation. Determination of casing setting depth shall be based on all relevant factors, including: presence or absence of hydrocarbons; fracture gradients; usable water zones; formation pressures; lost circulation zones or other minerals.
- Ensuring that drilling operations are in compliance from the beginning will minimize potential problems in the long term. Particularly with regard to contamination of subsurface resources including fresh water aquifers and surface-related environmental concerns.

Water Quality

Treated municipal and industrial wastewater and irrigation return flows and increased nonpoint discharges (such as runoff from municipal and industrial areas) could increase salt loading to perennial streams. Surface water quality has been declining in urban areas. Urban growth is tied to economic activity, and much of the economic activity in the region is from oil and gas production and mining. Gas development is expected to increase in the region, due to improved extraction technologies that allow additional gas to be extracted from depleted fields (BLM 2015).

Groundwater quality has been improving as a result of protection measures, such as reducing or collecting and treating wastewater and reducing the rate of decline in groundwater levels. At the same time, increased urban, industrial, and agricultural development could increase point and nonpoint pollutant loadings to both surface water and groundwater. Concentrations of salts could be increased by reducing recharge from precipitation, increasing water use, and discharging treated municipal and industrial water and irrigation return flows (BLM 2015).

Groundwater in the northern portion of the San Juan Basin has seen impacts from production of coal bed methane (CBM) from the Fruitland Formation during the mid- to late 1990s. These impacts are from when the formation water in the coal beds was removed to stimulate gas production from the formation. Large-scale dewatering of the Fruitland Formation coal beds triggered off-gassing of CBM in areas where the coal beds outcrop at the land surface. In some cases, this apparently triggered fires in the exposed coal outcrops (Ayers 1994). CBM production has tapered off slightly from its peak from 1998 to 2000, but the San Juan Basin is still the largest producer of CBM in the United States.

Oil and gas development and production at the surface and below ground can affect water quality. At the surface, activities at a drill site or production facility, such as road and well-pad construction, leaks from pits or tanks, chemical spills, and discharge of wastewater can affect surface water and shallow groundwater quality. Below ground activities can affect shallow and deep groundwater quality. Examples of this are leaks during or following hydraulic fracturing, failed casing seals, pipeline breaks, abandoned wells, deep-well disposal of flowback or produced wastewater, and induced subsurface migration pathways (USGS 2012).

The rapid increase in use of well stimulation techniques to obtain oil and gas from tight formations or from depleted fields has triggered public demand for more assurances that the methods are safe and will not affect groundwater and the environment in general. Better understanding of the causes of past environmental problems associated with well stimulation, improved drilling and well construction techniques, and increased regulatory oversight have led to a lower risk of releases; however, the field is rapidly changing. While state regulatory agencies have gradually increased their levels of oversight and standards, the BLM has also proposed additional, more stringent requirements for lessees. This is to ensure that minimum standards are upheld and to reassure the public. This trend is likely to continue.

Inactive wells, which are non-producing wells, have the potential to also create physical and environmental hazards if operators fail to reclaim the well sites, which may involve plugging the well, removing structures, and reshaping and revegetating the land around the wells (i.e., returning well sites as close to their original

natural conditions as reasonably practical). For example, inactive wells that are not plugged or not properly plugged can leak methane or contaminate surface water and groundwater. The BLM considers both oil and gas wells on federal and Indian lands as well as the associated leased land as potential liabilities because BLM may have to pay for reclamation if the well operator fails to do so (US GAO 2018).

With one of largest oil and gas programs in the Bureau, BLM New Mexico recognizes its responsibility to monitor, plug, and reclaim abandoned oil and gas wells. The BLM New Mexico strives to conduct timely reclamation that leaves the disturbed site re-contoured and re-vegetated and will continue to monitor reclamation until the disturbed surface is determined to be successfully reclaimed. A reclamation plan is included as part of every application for permit to drill processed in BLM New Mexico Field Offices. BLM New Mexico requires companies to begin final reclamation upon plugging of the well. Plugging a well is the first step to final reclamation and ensures that the well has been properly sealed (BLM 2018b).

The Clean Air Act (1963), the Clean Water Act (1972), and the Safe Drinking Water Act (1974), including later revisions to these laws, form the basis of most federal regulation of the oil and gas industry (Allison and Mandler 2018a). BLM regulations and federal laws contain requirements aimed at managing BLM's potential oil and gas well liabilities. For example, to help ensure that operators reclaim well sites, the BLM requires operators to provide a bond before drilling operations begin. Operators are required to reclaim well sites before their bonds are released. These bonds may be surety bonds, which are third-party guarantees that operators purchase from private insurance companies, or personal bonds accompanied by a financial instrument, such as a cashier's check. Inactive wells become orphaned if an operator does not perform required reclamation and if the bond is insufficient to cover reclamation expenses and there are no other responsible or liable parties to do so. In these cases, the BLM is responsible for completing the reclamation of the well site and uses appropriated funds to perform reclamation (US GAO 2018). Orphaned wells are often abandoned without any plugging or cleanup, but even plugged wells may leak, especially those plugged in the past, when plugging procedures were less rigorous and used less durable materials (Allison and Mandler 2018b).

The Energy Policy Act of 2005 directs the Secretary of the Interior to establish a program to reclaim orphaned, abandoned, or idled oil and gas wells on federal lands. The act requires that the program identify persons providing a bond or other financial assurance and establish a means of recovering the costs of reclaiming wells (US GAO 2018).

The New Mexico Oil Conservation Division (OCD) is the primary regulator of oil and gas development and production in New Mexico. The OCD gathers oil and gas well production data, permits new wells, enforces New Mexico's oil and gas laws (70-2-1–38; 71-5-1–23; and 74-6-1–16 NMSA 1978) and rules, and ensures oil and gas development is conducted in a way that protects human health and the environment and the lands of New Mexico are protected and responsibly restored. OCD also administers oil and gas–related aspects of the Water Quality Act. When a well has reached the end of its useful life and has become depleted, or if no oil or gas is found in a well (a "dry hole" is drilled), the well is plugged and abandoned. New Mexico has a rule (19.15.25 NMAC) that guides how to properly plug and abandon a well. Wells can be temporarily or permanently abandoned. Operators must submit, and OCD must pre-approve a Form C-103 before plugging a well, which provides details about proposed procedures for plugging the well. To plug and abandon a well, cement, drilling mud, and plugs are placed in the wellbore to prevent fluid from migrating among the underground rock layers. This is done to permanently confine oil, gas, and water into the strata in which they were originally found. Integrity testing is performed before approval for abandonment is granted (NMOCD 2018).

AE.2.4 Riparian Areas and Wetlands

Regulatory Environment

Clean Water Act

Section 404 of the CWA gives the EPA and the US Army Corps of Engineers (USACE) regulatory and permitting authority for discharging dredged or fill material into "navigable waters of the United States." Section 502(7) defines this as "waters of the United States, including territorial seas." Section 328 of Chapter 33 in the Code of Federal Regulations (CFR) defines the term as it applies to the jurisdictional limits of the authority of the USACE under the CWA. Generally, this includes waters used for commerce, interstate waters and wetlands, territorial seas, water impoundments, tributaries, and waters and wetlands next to these waters, provided they have a significant hydrologic connection to the adjacent Waters of the United States.

Under Section 404 of the Clean Water Act, a permit is required from USACE before discharging dredged or fill material into the Waters of the United States, including wetlands. When an application for a Section 404 permit is submitted, the applicant must show evidence of the following:

- Taken steps to avoid impacts on wetlands or Waters of the United States
- Minimized unavoidable impacts on Waters of the United States and wetlands
- Provided compensatory mitigation for unavoidable impacts

It is required that the least damaging practicable alternative be sought after, with an emphasis on avoiding and minimizing any required aquatic impacts.

Current Conditions

BLM Manual 1737 defines riparian areas as "a form of wetland transition between permanently saturated wetlands and upland areas. These areas exhibit vegetation or physical characteristics reflective of permanent surface or subsurface water influence. Lands along, adjacent to, or contiguous with perennially and intermittently flowing rivers and streams, glacial potholes, and the shores of lakes and reservoirs with stable water levels are typical riparian areas. Excluded are such sites as ephemeral streams or washes that do not exhibit the presence of vegetation dependent upon free water in the soil." This includes marshes, shallow swamps, lakeshores, bogs, muskegs, wet meadows, estuaries, and riparian areas.

Federal policy defines wetlands as "areas that are inundated or saturated by surface or ground water 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 are mapped using a process called wetlands delineation. The methods used to delineate wetlands and other waters are based on the USACE Wetlands Delineation Manual (USACE 1987) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (USACE 2008). The wetland delineation process evaluates areas for the presence or absence of the three wetland parameters described in the USACE manual: hydrophytic (water-dependent) vegetation, wetland hydrology, and hydric (saturated) soils.

Approximately 88 miles of perennial and intermittent riparian habitats (NHD GIS 2016) are in the decision area. The perennial systems—the San Juan, Animas, and La Plata Rivers—flow continuously. The intermittent systems—portions of Largo Canyon and Cereza Canyon—flow for a portion of the year. The ephemeral systems have continuous subsurface water flow and have surface flow during precipitation. BLM Farmington Field Office (FFO) has designated riparian areas to which special management constraints are applied for development as well as livestock grazing season.

Riparian/Wetland Vegetation occupies approximately 12,100 acres (SWReGAP GIS 2016) of BLM- and BIA-managed surface acres in the planning area. There are approximately 3,100 riparian areas and 16,100 wetland areas on the BLM- and BIA-managed surface acres. The soils in these areas typically are stratified sediments of varying textures that are subject to intermittent flooding or fluctuating water tables that may reach the surface.

Springs also occur in the planning area (**Figure AE-9**, Current Inventory Wetlands, Riparian Areas, and Springs). These are an important component of the desert ecosystem for a number of reasons. Historically, springs were the only reliable source of water for humans and animals. They have become known as biodiversity hotspots that support a large proportion of the aquatic and riparian species in arid regions. Several hundred species or subspecies of fishes, mollusks, crustaceans, aquatic insects, and plant species are endemic to springs in the western United States (Sada and Pohlman 2002). Springs and seeps are often important to Tribes and may be considered CIMPPs, which are discussed greater detail in **Section 3.4.9**, Cultural Resources and **Section 3.7.**1, Native American Tribal Interests and Uses.

Plant community structure and function are determined largely by the hydrology of the system: depth to water table, frequency of flooding and ponding, and the occasional complete alteration of the channel. For example, channel position and function may be altered by floods as the channel constantly seeks equilibrium with its flow regime and constraining landscape features. Flooding of the riparian zone affects soil chemistry by producing anaerobic conditions, importing and removing organic matter, and replenishing nutrients. The varying hydrology for active floodplains and 100-year floodplains result in different plant communities.

Riparian vegetation community characteristics are described further in **Appendix G**, FFO Vegetation Communities Descriptions and Determination of FFO Vegetation Condition Classes.

Active Floodplain and 100-Year Floodplain

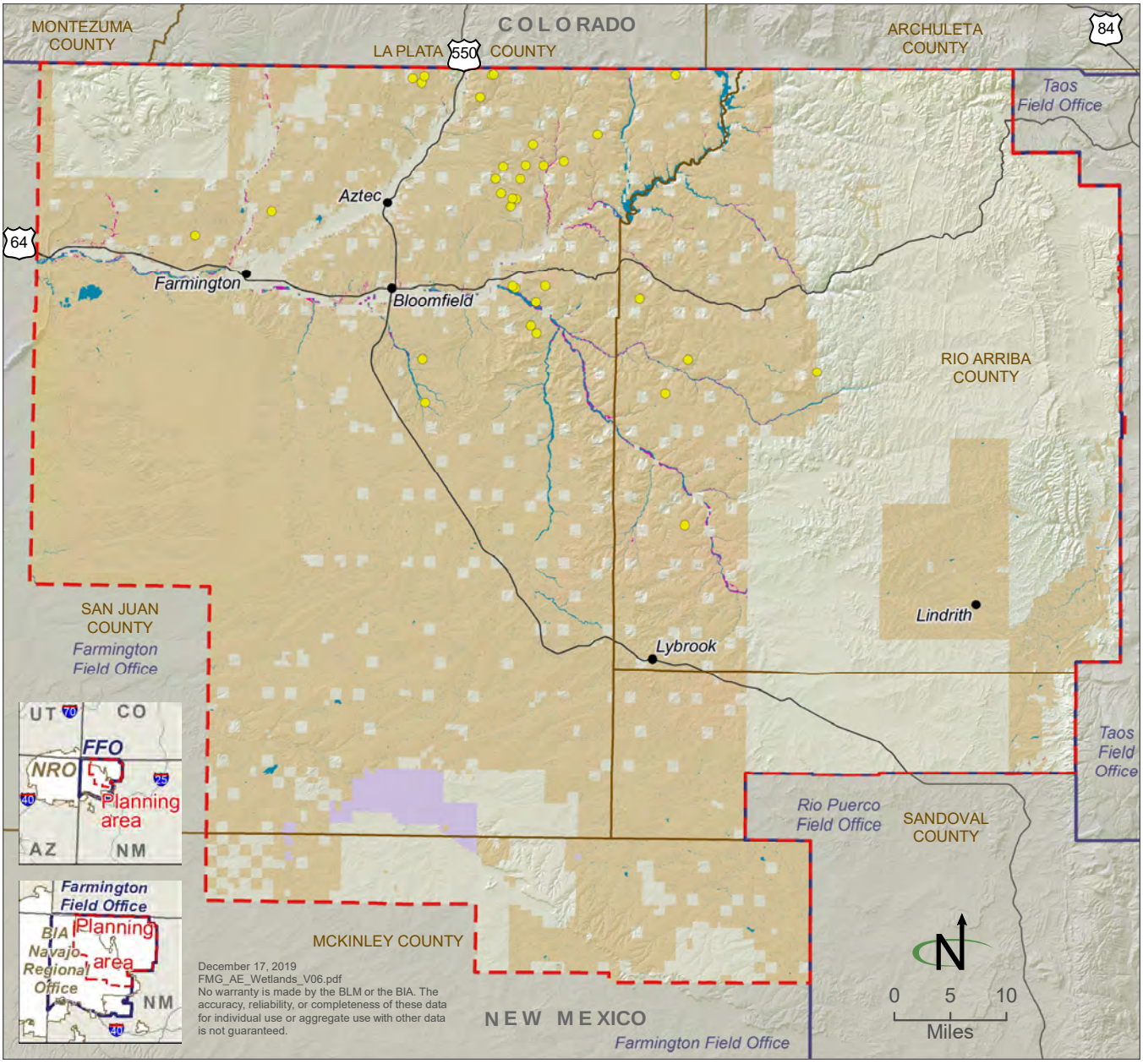
There is an active channel and 100-year floodplain component to riparian systems. Species assemblages in the active floodplain are variable. They are based more on the seasonality of water and elevation than soil type, but they generally include a cottonwood/willow-dominated community. Species assemblages in the 100-year floodplain are generally more associated with Blancot or Notal soil types. They support a more grass-dominated community but can include shrubs and trees. Species are those that are tolerant of drier conditions yet have a root structure capable of withstanding infrequent high-water flows. See **Appendix G** for further information on vegetation species. Generally, a riparian/wetland area in a non-functional condition does not provide quality habitat. A riparian/wetland area that has recovered to a proper functioning condition (PFC) or is recovering and is at a Functioning-at-Risk (FAR) with an upward trend condition could provide quality habitat, if recovery were allowed to continue. Riparian Wetland habitat that is Functioning-at-Risk with either a stable or downward trend would likely become non-functioning if a 25 to 50-year flood event occurred. PFC is discussed in more detail in **Appendix G.**

Upland plants, such as rabbitbrush, have moved into some of the riparian areas; however, native vegetation is evident and increasing in some areas, due to the exclusion of livestock or limitations on grazing during the plant growing season, from May 1 to September 30. Vegetation in these areas typically grows in zones from wetter to drier, starting with sedges and rushes common in the wettest zone and willows, grasses, salt cedar, rabbitbrush, and salt grass growing in progressively drier areas. A few scattered remnant cottonwoods are present (BLM 2000a).

The BLM first conducted PFC surveys in the planning area in 1994. Since 1998, it has conducted these surveys annually, assessing a portion of the reaches each year. During the latest PFC surveys, from 2010 to 2012, 23 of the river tracts were rated as PFC, 2 were rated as FAR with an upward trend, 4 were rated

Figure AE-9
Current Inventory Wetlands, Riparian Areas, and Springs

Wetlands are areas that lie transitionally between terrestrial and aquatic ecosystems, typically where the water table is at or near the surface, or where land is covered by shallow water. Riparian areas are plant communities that are affected by surface and sub-surface hydrologic features, e.g., rivers, streams, lakes, or drainage ways. Springs are concentrated discharges of water flowing from an aquifer to the Earth's surface.



Source: BLM GIS 2020

- Wetland
- Riparian area
- Spring
- BLM and BIA decision area
- Planning area
- National Park Service
- Field office boundary

as FAR with no apparent trend, and 1 was rated as FAR with a downward trend. Of the intermittent and ephemeral systems, 8 were rated as PFC, 31 were rated as FAR with an upward trend, 10 were rated as FAR with no apparent trend, 1 was rated as FAR with a downward trend, and 1 was rated as nonfunctioning. Both wetlands were rated as PFC. No surveys were conducted in 2013, due to an unavailability of resources (BLM 2014a).

The BIA currently has no PFC surveys or designated riparian areas in the planning area.

Trends

In some riparian areas, woody nonnative invaders, such as salt cedar and Russian olive, have encroached on native species, such as cottonwoods and willows. These nonnatives have been removed from nearly 7,000 acres of riparian habitat; because of this, routine maintenance will be required. Initial treatments involve either hand (chainsaw) or mechanical (heavy equipment) removal, immediately followed by an herbicide application to the stump. Most current Russian olive and tamarisk removal projects also incorporate a reseeding/replanting component as part of an integrated pest management system. Typical species used are willows, sedges/rushes, and cottonwoods.

Several factors have led to the invasion of other noxious weeds, such as Canada thistle and Russian knapweed, including unauthorized livestock grazing, wildlife, recreation, unauthorized off-highway vehicle (OHV) use, encroachment from uplands, wild and feral horses, and seed transport via humans, wind, and water.

Other sources of riparian degradation are unauthorized livestock grazing during the BLM deferment period, irrigation diversions, flow regulations in the San Juan River, and fluctuations in subsurface hydrology, likely due to drought (BLM 2000b).

Field data from BLM PFC studies compiled throughout the planning area since 1998 indicate that overall trends in riparian and wetland habitats have been improving. This is likely due to the implementation of the BLM Riparian and Aquatic Habitat Management Plan since 2000.

AE.2.5 Upland Vegetation and Soils

Current Conditions

The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) has done soil surveys for the planning area and has classified the soils into map units. There are over 700 different map units that have been identified in the planning area, consisting of associations of different major soil series found in the NRCS soil survey data. Additionally, there are miscellaneous areas that have little or no soil material, such as rock outcrops, and thus support scant or no vegetation. Soil information and classification data cover approximately 88 percent of the decision area. The FFO has also created a fragile soil and weeds dataset; data on microbiotic soil crust for a portion of the planning area were obtained from the Colorado Plateau Rapid Ecoregional Assessment. The characteristics and distribution of soil types in the planning area affect the use and management of the land and the quality of the surface water, air, forage, and vegetation growth.

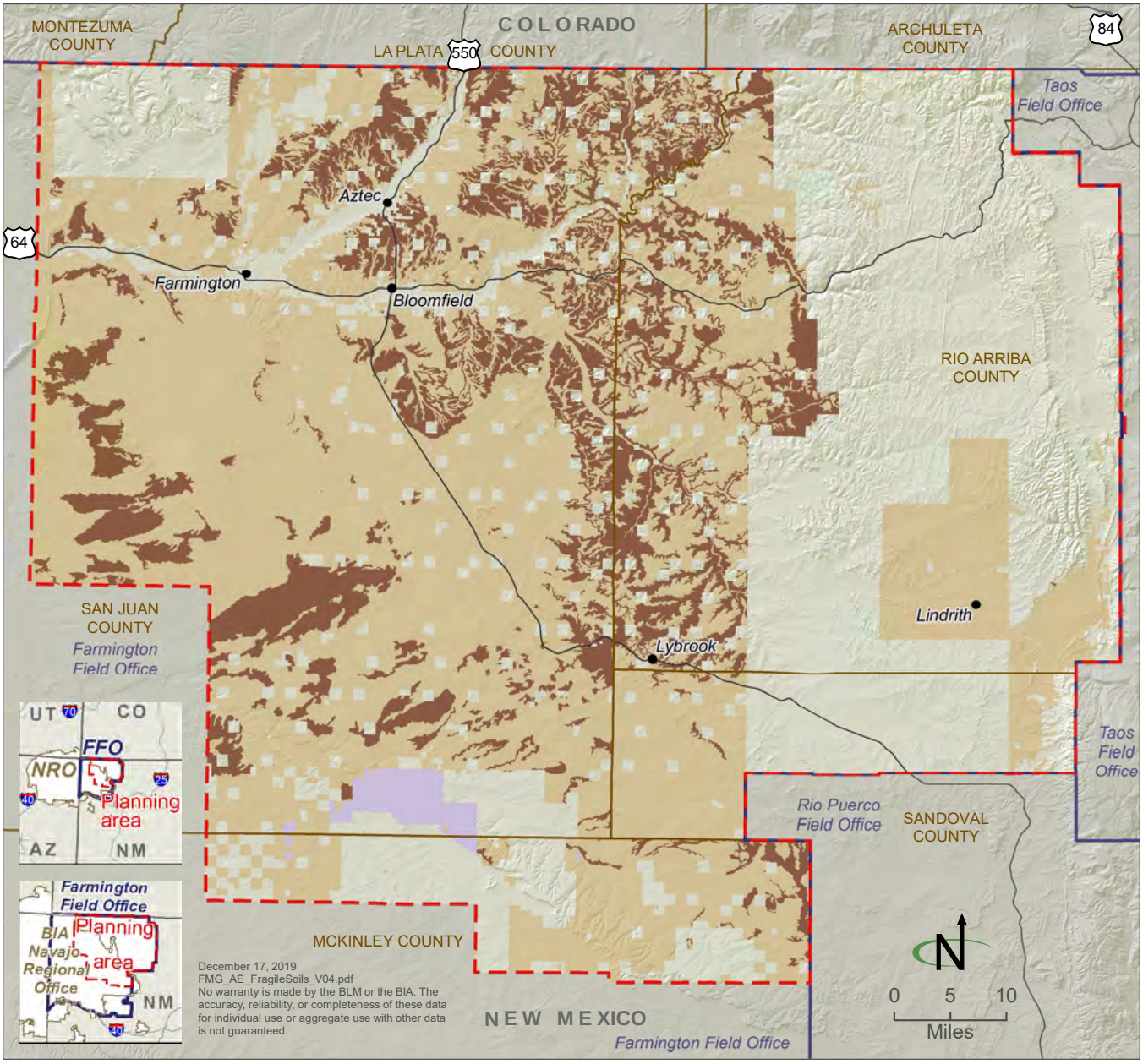
Fragile Soils

There are 561,700 acres of fragile soils in the decision area (**Figure AE-10**). When the BLM FFO identifies potentially fragile soils under its jurisdiction, it may recommend maintaining soil integrity.

Fragile soils may have the following characteristics:

- Susceptibility to wind or water erosion
- On steep slopes, making them more susceptible to erosion

Figure AE-10
Fragile Soils



Source: BLM GIS 2020

Fragile soils

BLM and BIA decision area

Planning area

National Park Service

Field office boundary

- Existing microbial crusts
- Susceptibility to weed invasion

Factors that influence soil erosion are soil texture, soil structure, length and percent of slope, vegetation cover, and rainfall or wind intensity. Soils most susceptible to erosion by wind or water are typified by bare or sparse vegetation 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.

Soils are prone to natural degradation when surface litter and horizons are removed by erosion in excess of the potential for soil to be rebuilt through deposition. Wind erosion is particularly a hazard when surface disturbance, biological crusts, and vegetation are removed.

Uplands in the decision area tend to have steep slopes, drainage densities, relief, and ruggedness, which may increase erosion rates. When coupled with the climate patterns in the planning area, which include intense rainfall, these characteristics can lead to high sediment loads and runoff rates during storms. Acres of soils by slope gradient in the decision area are listed in **Table AE-13**, below.

Table AE-13
Acres of Soils by Slope Gradient in the Decision Area

Percent Slope	Acres
1–10	1,519,700
11–20	607,900
21–30	64,300
31–40	26,800
41–50	371,000
50+	4,200

Sources: BLM GIS 2017; NRCS GIS 2014

Some soils are covered with microbiotic soil crusts, which are also important indicators of rangeland conditions (Belnap et al. 2001; Butler et al. 2003; Johansen et al. 1984). This is because they appear to be more sensitive than vascular plants to disturbance from wildfire, livestock grazing, and OHV activity.

Microbiotic soil crusts are made up of tiny living plants and bacteria that grow together on the surface. They help keep the soil from washing or blowing away, fix nitrogen from the atmosphere into the soil, help resist weed invasion, and promote the resiliency of plant communities. In areas where microbiotic soil crusts have been lost, there is a greater risk of annual grass or other invasive plants becoming established, which can alter erosion patterns.

LANDFIRE Vegetation Condition Classes

There are three LANDFIRE vegetation condition classes (VCCs) in the planning area. These classes are based on low (VCC I), moderate (VCC II), and high (VCC III) departure from the central tendency of the historical regime. They indicate the general level to which current vegetation is different from the simulated historical vegetation reference conditions. Low departure is within the historical range of variability, while moderate and high departures are outside of it. This departure results in changes to one (or more) of the following ecological components: vegetation characteristics (e.g., species composition, structural stages, canopy closure, and fuel loading); fuel composition; fire frequency, severity, and pattern; and other associated disturbance (e.g., grazing and drought). The LANDFIRE VCC data are dynamic and are periodically updated.

Plant Communities

Public lands in San Juan, McKinley, Rio Arriba, and Sandoval Counties support a diversity of upland and riparian plant communities. These plant communities or vegetation types are controlled in large part by site-specific topography, soil type, and climatic conditions.

The BLM and BIA surface decision areas contain nine FFO-defined broad-scale plant community types (**Table AE-14**, Acres of Plant Community Types in the Decision Area, and **Figure AE-11**, Vegetation Communities). The BLM derived the nine vegetation communities from the combination of Southwest Regional Gap Analysis Project (SWReGAP) data and NRCS ecological site descriptions (ESDs). These vegetation communities are pinyon-juniper, sagebrush grassland, grassland, badlands, saltbush/shadscale/winterfat, greasewood, riparian, oak woodlands, and ponderosa pine-mixed conifer. Six of these key vegetation communities are described in detail. (Oak woodlands and ponderosa pine-mixed conifer communities are not described in more intensive detail through ESD evaluation; this is because they comprise a small percentage of the vegetation communities.) Vegetation communities are further described in **Appendix G**, Farmington Field Office Vegetation Communities Descriptions and Determination of Farmington Field Office Vegetation Condition Classes. Each community description includes the ESDs and soils, indicators and importance of this community, and threats to this community. The riparian community is described in detail in **Section AE.2.4**, Riparian Areas and Wetlands.

Table AE-14
Acres of Plant Community Types in the Decision Area

Vegetation Community[1]	Acres	Percent of Decision Area
Pinyon-juniper	774,100	39
Sagebrush grassland	604,700	30
Grassland	246,600	12
Badlands	176,700	9
Ponderosa pine-mixed conifer	21,500	1
Greasewood	99,800	5
Saltbush/shadscale/winterfat	11,600	<1
Riparian-wetland	7,400	<1
Oak woodlands	3,300	<1

Sources: BLM GIS 2018; SWReGAP GIS 2016

[1] The broad-scale vegetation communities do not include agricultural areas, water, or developed areas.

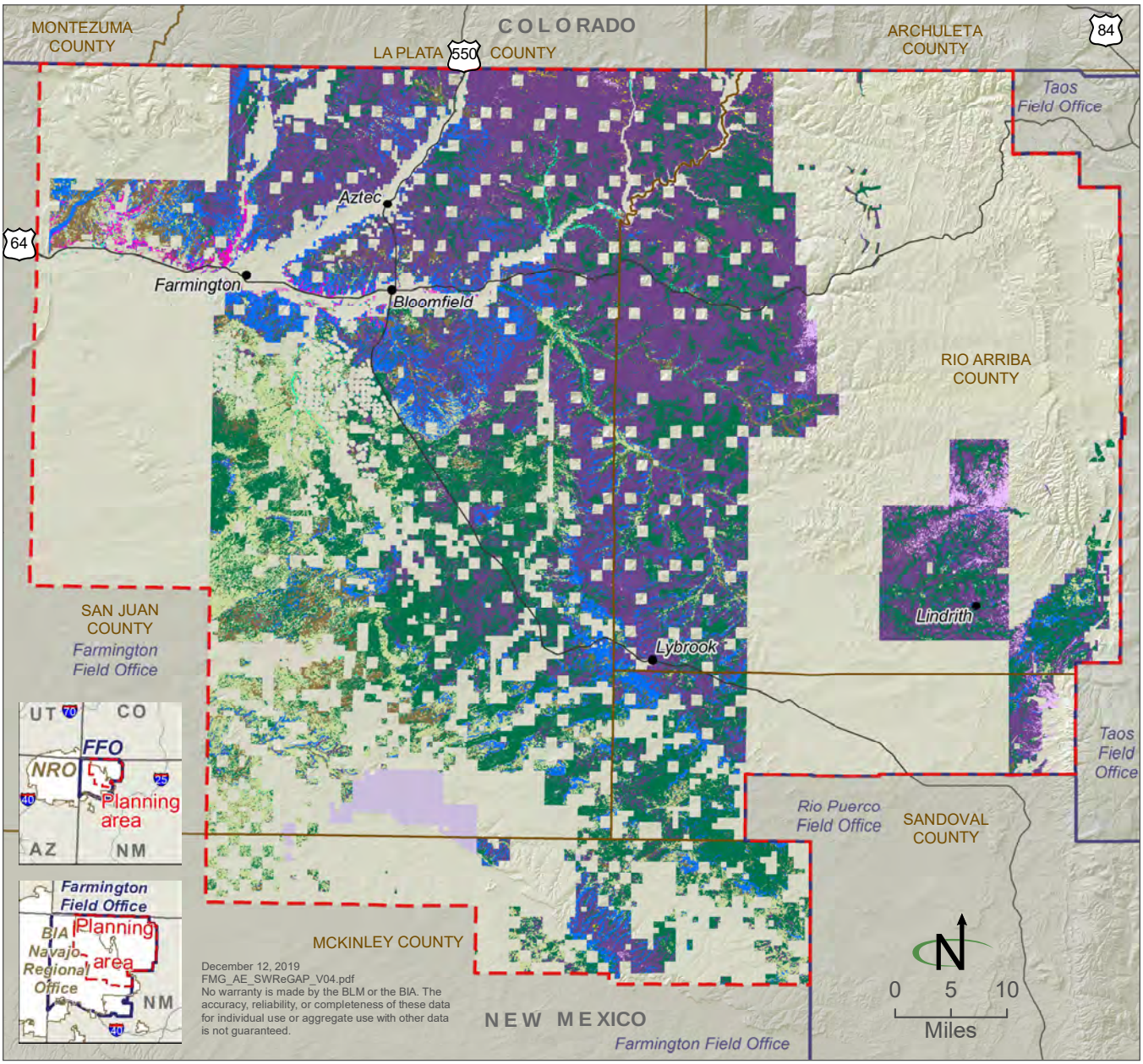
Pinyon-Juniper

The pinyon-juniper community is approximately 774,100 acres (39 percent) of the surface decision area. For all land jurisdictions in the area, pinyon (*Pinus edulis*) trees dominate at higher elevations and tend to form more closed canopy stands. Such stands exhibit forest-like dynamics and species composition, commonly including a significant shrub component of oaks (*Quercus* spp.), alder leaf mountain mahogany (*Cercocarpus ledifolius*), and limited grasses. Juniper (*Juniperus* spp.) tends to grow at lower elevations and in more arid areas; this is because its scaled foliage allows it to conserve water more effectively than pinyon pine.

Most of the pinyon-juniper community in the surface decision area is nearly evenly split between LANDFIRE VCC I (43 percent) and VCC II (46 percent). Most of the remaining pinyon-juniper community is in VCC III (9 percent), as shown in **Table AE-15**, below.

Figure AE-11
Vegetation Communities

The planning area contains nine plant community types. The BLM derived the vegetation communities from the combination of Southwest Regional Gap Analysis Project (SWReGAP) data and ecological site descriptions (ESDs). Vegetation communities are displayed on the BLM decision area.



Source: BLM GIS 2020

- Pinyon-juniper
- Sagebrush grassland
- Grassland
- Badlands
- Greasewood
- Ponderosa pine-mixed conifer
- Saltbush shadscale/ winterfat
- Riparian-wetland
- Oak woodland
- Planning area
- National Park Service
- Field office boundary

Table AE-15
LANDFIRE Vegetation Condition Classes in the Pinyon-Juniper Community in the Decision Area

Vegetation Condition Class	Acres	Percent of Community
VCC I	336,200	43
VCC II	354,300	46
VCC III	67,900	9
Agricultural	3,600	<1
Barren	1,400	<1
Sparsely vegetated	6,400	<1
Urban	4,000	<1
Water	300	<1

Sources: BLM GIS 2017; SWReGAP GIS 2016; LANDFIRE GIS 2017

Sagebrush Grassland

The sagebrush grassland vegetation community is approximately 604,700 acres, or 30 percent of the surface decision area. The sagebrush grassland community is comprised primarily of Wyoming big sage (*Artemisia tridentata wyomingensis*), with lesser amounts of basin big sage (*A. t. tridentata*) and minor areas of black sage (*A. nova*). This plant community occupies vast areas of relatively open rolling hills to the south of Farmington and numerous mesas and canyon bottoms to the east and north.

The sagebrush grassland community in the surface decision area falls mainly within LANDFIRE VCC II (75 percent), with 15 percent of the community in VCC I, and 7 percent in VCC III, as summarized in **Table AE-16**, below.

Table AE-16
LANDFIRE Vegetation Condition Classes in the Sagebrush Grassland Community in the Decision Area

Vegetation Condition Class	Acres	Percent of Community
VCC I	92,400	15
VCC II	452,300	75
VCC III	40,600	7
Agricultural	4,800	1
Barren	1,500	<1
Sparsely vegetated	8,700	1
Urban	4,200	<1
Water	200	<1

Sources: BLM GIS 2017; SWReGAP GIS 2016; LANDFIRE GIS 2017

Grassland

The grassland community is approximately 246,600 acres (12 percent) of the surface decision area. The community is dominated by perennial grasses, with a lesser shrub component, primarily dominated by saltbushes. This plant community occupies areas of relatively open landscape to the south of Farmington and occurs primarily in the BIA Eastern Navajo Agency, or "checkerboard" area, of mixed land jurisdiction.

Common shrub species are fourwing saltbush (*Atriplex canescens*), mound saltbush, jointfir (*Ephedra* spp.), broom snakeweed (*Gutierrezia sarothrae*), rabbitbrush, and black greasewood (*Sarcobatus vermiculatus*). Winterfat (*Krascheninnikovia lanata*) and shadscale (*Atriplex confertifolia*) can also occur. Common grass species are alkali sacaton, Indian ricegrass, galleta, blue grama, sand dropseed, and bottlebrush squirreltail (*Elymus elymoides*). Muhly spp. can also be found in sandier sites.

The grassland community in the surface decision area falls mainly in LANDFIRE VCC II (69 percent). Approximately 14 percent of this community is in VCC I, and 4 percent is in VCC III, as summarized in **Table AE-17**, below.

Table AE-17
LANDFIRE Vegetation Condition Classes in the Grassland Community in the Decision Area

Vegetation Condition Class	Acres	Percent of Community
VCC I	40,100	16
VCC II	168,500	68
VCC III	14,800	6
Agricultural	2,300	1
Barren	2,800	1
Sparsely vegetated	15,300	6
Urban	2,800	1
Water	100	<1

Sources: BLM GIS 2017; SWReGAP GIS 2016; LANDFIRE GIS 2017

Badlands

The badlands community is approximately 176,700 acres (9 percent) of the surface decision area. This community generally occurs at elevations ranging from approximately 4,800 to 7,000 feet. The general description for this site is that of rough, broken badlands, sparsely vegetated, rock/wash areas, and highly dissected. It is eroded into a series of low badland hills and gullies, interspersed with somewhat sandy alluvial deposits. More of the surface area is bare ground and rock than vegetated. Large bare areas with only biological crusts are not uncommon. In the surface decision area, the badlands community is typically associated with the shadscale saltbush community.

Plant communities of the badlands complex are typically sparsely vegetated, often with less than 10 percent vegetation cover, but occasionally with up to 30 percent. Cryptobiotic soil crust is an important component of this habitat. Shrubs and half shrubs are apparent and rather unevenly distributed.

The potential plant community varies somewhat with depth of soil, exposure, and slope. Despite the limited cover, these areas often support many species of plant that are endemic to northwest New Mexico. These species are restricted to soils derived from a specific geologic formation, and most occur in areas of exposed parent materials. Species composition is highly variable but may include Utah juniper (*Juniperus osteosperma*), Colorado pinyon, fourwing saltbush, Indian ricegrass, galleta, winterfat, Mormon tea, alkali sacaton, globemallow, and broom snakeweed.

The badlands community in the surface decision area falls mainly in LANDFIRE VCC II (50 percent). Approximately 24 percent of this community is in VCC I, and 7 percent is in VCC III, as summarized in **Table AE-18**, below.

Saltbush/Shadscale/Winterfat

The saltbush/shadscale/winterfat communities are approximately 11,600 acres (1 percent) of the surface decision area. This community also contains, to a lesser degree, several other shrub species, such as fourwing saltbush, Mormon tea, and big sagebrush. Variability is evident in this cover type, so site-specific criteria need to be developed for treatment areas and planned project work.

The saltbush/shadscale/winterfat community in the surface decision area falls mainly in LANDFIRE VCC II (79 percent). Approximately 4 percent of this community is in VCC 1, and 1 percent is in VCC III, as summarized in **Table AE-19**, below.

Table AE-18
LANDFIRE Vegetation Condition Classes in the Badlands Community in the Decision Area

Vegetation Condition Class	Acres	Percent of Community
VCC I	42,300	24
VCC II	88,500	50
VCC III	13,100	7
Agricultural	1,500	1
Barren	9,600	5
Sparsely vegetated	20,400	12
Urban	1,200	1
Water	200	<1

Sources: BLM GIS 2017; SWReGAP GIS 2016; LANDFIRE GIS 2017

Table AE-19
LANDFIRE Vegetation Condition Classes in the Saltbush/Shadscale/Winterfat Community in the Surface Decision Area

Vegetation Condition Class	Acres	Percent of Community
VCC I	500	4
VCC II	9,200	79
VCC III	100	1
Agricultural	600	5
Barren	400	3
Sparsely vegetated	200	2
Urban	400	3
Water	100	1

Sources: BLM GIS 2017; SWReGAP GIS 2016; LANDFIRE GIS 2017

Greasewood

The greasewood vegetation community is approximately 99,800 acres (5 percent) of the surface decision area. This community contains greasewood, and to a lesser extent, several other shrub species, such as fourwing saltbush, Mormon tea, Douglas rabbitbrush, and big sagebrush. This vegetation community is predominantly found in valley bottoms, but it can also be on fans with slopes of less than 8 percent and on plateaus and mesas.

The greasewood community in the surface decision area falls mainly in VCC II (60 percent). Approximately 16 percent of this community is in VCC I, and 5 percent is in VCC III, as summarized in **Table AE-20**, below.

Riparian-Wetland

The riparian-wetland community is discussed in detail in **Section AE.2.4**, above.

Oak Woodlands

The oak woodlands community is approximately 3,300 acres (less than 1 percent) of the surface decision area. Gambel's oak (*Quercus gambelii*) is found in small dispersed clumps, typically on moist sites, with deeper soils. They usually are clones of shrubs, in dense patches on northeast slopes. Gambel's oak stands occur at elevations of 6,500 feet and greater, mostly along the New Mexico/Colorado state line and in the extreme northeast section of the surface decision area.

Table AE-20
LANDFIRE Vegetation Condition Classes (VCC) in the Greasewood Community in the Surface Decision Area

Vegetation Condition Class	Acres	Percent of Community
VCC I	15,500	16
VCC II	60,100	60
VCC III	4,500	5
Agricultural	1,200	1
Barren	3,000	3
Sparsely vegetated	14,000	14
Urban	1,400	1
Water	200	1

Sources: BLM GIS 2017; SWReGAP GIS 2016; LANDFIRE GIS 2017

The oak woodlands community in the surface decision area falls mainly within VCC I (70 percent). Approximately 21 percent of this community is in VCC II, and 6 percent is in VCC III, as summarized in **Table AE-21**, below.

Table AE-21
LANDFIRE Vegetation Condition Classes in the Oak Woodlands Community in the Surface Decision Area

Vegetation Condition Class	Acres	Percent of Community
VCC I	2,300	70
VCC II	700	21
VCC III	200	6
Agricultural	100	<1
Barren	0	0
Sparsely vegetated	0	0
Urban	0	0
Water	0	0

Sources: BLM GIS 2017; SWReGAP GIS 2016; LANDFIRE GIS 2017

Ponderosa Pine-Mixed Conifer

The ponderosa pine-mixed conifer forest vegetation community generally occurs at elevations ranging from approximately 5,000 to 9,000 feet. This vegetation community occupies approximately 21,500 acres (1 percent) of the surface decision area. It is dominated by ponderosa pine and commonly includes other species, such as oak, juniper, and pinyon. This vegetation community typically occurs with an understory of grasses and forbs, although it sometimes includes shrubs.

The ponderosa pine-mixed conifer community in the surface decision area falls mainly in VCC I (37 percent). Approximately 44 percent of this community is in VCC II, and 18 percent is in VCC III, as summarized in **Table AE-22**, below.

At the broad-scale level, the SWReGAP land cover grouped vegetation types of Rocky Mountain ponderosa pine woodland, Rocky Mountain montane mesic mixed conifer forest and woodland, and Rocky Mountain montane dry-mesic mixed conifer forest and woodland. They comprise the ponderosa pine community. A detailed description of the ponderosa pine community in the surface decision area can be found in Farmington Field Office Vegetation Communities and Determination of Condition Class for the Affected Environment (BLM 2016a). It includes a description of the ESDs and soils, indicators and importance of this community, and threats to this community.

Table AE-22
LANDFIRE Vegetation Condition Classes in the Ponderosa Pine-Mixed Conifer Community in the Surface Decision Area

Vegetation Community Type	Acres	Percent of Community
VCC I	8,000	37
VCC II	9,400	44
VCC III	3,900	18
Agricultural	100	<1
Barren	0	0
Sparsely vegetated	0	0
Urban	0	0
Water	0	0

Sources: BLM GIS 2017; SWReGAP GIS 2016; LANDFIRE GIS 2017

Game Management Units

The New Mexico Department of Game and Fish (NMDGF) has established six game management units (GMUs) to manage big game hunting in the planning area. These GMUs vary in their priority for the management of general or trophy big game hunting. The BLM FFO is using these GMUs to assist in prioritizing wildlife habitat improvement treatments. These GMUs, and how they would be managed under each action alternative in terms of vegetation treatments, are shown in **Figures 2-1** to **2-4**, **Appendix A**.

Traditional Plant Uses

Executive Order (EO) 13007, Indian Sacred Sites (May 24, 1996) directs federal agencies to manage federal lands in a manner that accommodates Indian religious practitioners' access to and ceremonial use of sacred sites. The agencies also must avoid adversely affecting the physical integrity of such sacred sites, to the extent practicable, as permitted by law, and not clearly inconsistent with essential agency functions. The EO "is intended only to improve the internal management of the executive branch and is not intended to, nor does it, create any right, benefit, or trust responsibility, substantive or procedural, enforceable at law or equity by any party against the United States, its agencies, officers, or any person" (Section 4). Plant gathering (typically by hand and in small amounts) of grasses, shrubs, and forbs for medicinal, ceremonial, and other uses is allowed, as described in **Section AE.2.9**, Cultural Resources.

Trends

Vegetation communities in the surface decision area have been affected over the past 60 years by oil and gas development and its associated roads and other rights-of-way (ROWs); introduction of noxious weeds, such as cheatgrass, Russian knapweed, and halogeton; conversion from urbanization and rural home development; intensive agriculture; expanding OHV use; grazing; and vegetation treatments.

Fragmentation occurs to varying levels across the surface decision area, but much of the surface decision areas are extremely fragmented, nearer to urban areas due to increased development. This extreme fragmentation should continue to prevent larger fires from becoming common. Development of fluid and non-fluid mineral resources places a major demand placed on soils in the decision area. Extracting minerals generally disturbs the surface and impacts on soil and vegetation resources can be long term. Disturbance is associated with such activities as pipeline installation, power line construction, seismic exploration, exploratory drilling and mining. For BLM-authorized actions, disturbed areas require reclamation and soil stability recommendations are implemented in areas with identified fragile soils, or where needed.

Soils can be affected by changes in vegetation. Heavy grazing in the nineteenth and early twentieth centuries, coupled with the suppression of natural fires, has facilitated conditions that favor shrub dominance in the sagebrush grasslands.

If shrubs become too dominant and outcompete native perennial grasses, the amount of bare ground increases. Also, if perennial grass cover is compromised, noxious and invasive plants such as cheatgrass are more likely to invade and continue to outcompete native species. Vegetation management and restoration have included a variety of treatment types, such as tebuthiuron application treatments to selectively thin sagebrush and reseed desirable species. These treatments are most commonly implemented to promote native perennial grasses and cover, thereby stabilizing soils, reducing erosion, and increasing watershed function.

When identified, invasive plants are treated most commonly by approved herbicides. When native plant cover is not adequate, undesirable annual species and noxious and invasive weeds may become established. These areas are targeted for treatment and restoration, subject to available funding.

Potential changes in climatic conditions could affect the seasonality and intensity of precipitation. For example, the rapid ecoregional assessment (REA) climate model has predicted a trend toward wetter winters and springs. This type of potential change could result in vegetation cover changes, such as contracted shrublands, expanded grasslands, and changes in invasive plants.

The State Surface Water Quality Bureau has identified nonpoint source pollution as a problem in the decision area that is directly affecting soil stability. Efforts to reduce nonpoint source pollution by implementing erosion controls and management practices are an important part of the BLM's land management. Some of these management practices are implemented through conditions of approval (COA) that are attached to the application for permit to drill (APD) for oil and gas. Others are incorporated into management prescriptions applied in OHV management units or SDAs. The Navajo Nation addresses nonpoint source pollution through its water quality and National Pollutant Discharge and Elimination System program.

AE.2.6 Noxious Weeds and Invasive Plants

Current Conditions

Invasive plants are either not native to the area where they are growing or, if native, are a minor component of the original plant community or communities. Invasive plants also include noxious weeds. These species have the potential to become a dominant or co-dominant species on the site if their future establishment and growth is not controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants (BLM Handbook H-1740-2, Integrated Vegetation Management).

Invasive plants are widespread and can damage crops, affect entire industries, and harm the environment and public health. Organisms that have been moved from their native habitat to a new location, especially from a different country, are typically referred to as nonnative. Loss of native vegetation generally is not only a result of direct biotic competition between native and non-native plants. Land use practices, hydrologic modifications, and other habitat alterations can also displace native plants, and often create more favorable conditions for non-native plants.

Noxious weeds are native or nonnative plant species designated by a federal or state law as generally possessing one or more of the following characteristics (BLM Handbook H-1740-2, Integrated Vegetation Management):

- Aggressive and difficult to manage
- Parasitic
- Carriers or hosts of serious insects or disease
- Nonnative, new, or not common in the United States

Noxious weeds and invasive plants are found in the San Juan Basin, particularly in areas disturbed by surface activities. These plants displace native plant communities and degrade wildlife habitat. **Table AE-23**, New Mexico and Navajo Nation Noxious Weeds, lists each New Mexico and Navajo Nation designated noxious weed species, the current management classes for each species, and their occurrence in the planning area. The New Mexico Noxious Weed List (NMDA 2016) is the baseline document that the BLM and Navajo Nation use to establish primary noxious weed species of concern.

Table AE-23
New Mexico and Navajo Nation Noxious Weeds

Common Name	Scientific Name	Class	Occurrence[1]
African rue	*Peganum harmala*	B	X
Alfombrilla	*Drymaria arenarioides*	A	
Bald brome	*Bromus racemosus*	C[3]	X
Black henbane	*Hyoscyamus niger*	A	X
Blue mustard	*Chorispora tenella*	A[3]	X
Brazillian egeria	*Egeria densa*	A	
Bull thistle	*Cirsium vulgare*	B	X
Camelthorn	*Alhagi pseudalhagi*	A	X
Canada thistle	*Cirsium arvense*	A	X
Cheatgrass	*Bromus tectorum*	C	X
Chicory	*Cichorium intybus*	B	X
Common Mediterranean grass	*Schismus barbatus*	A[3]	
Crimson fountaingrass	*Pennisetum setaceum*	WL[2]	
Curlyleaf pondweed	*Potamogeton crispus*	C	
Dalmatian toadflax	*Linaria dalmatica*	A	
Diffuse knapweed	*Centaurea diffusa*	A	X
Dyer's woad	*Isatis tinctoria*	A	
Eurasian watermilfoil	*Myriophyllum spicatum*	C	
Field bindweed	*Convolculus arvensis*	C[3]	X
Field brome	*Bromus arvensis*	C[3]	X
Giant cane	*Arundo donax*	C	
Giant salvinia	*Salvinia molesta*	A	
Halogeton	*Halogeton glomeratus*	B	X
Hoary cress	*Cardaria* spp.	A	X
Horehound	*Marrubium polymorpha*	C[3]	X
Hydrilla	*Hydrilla verticillata*	C	
Johnsongrass	*Sorghum halepense*	B[3]	X
Jointed goatgrass	*Aegilops cylindrica*	C	X
Kochia	*Bassia scoparia*	C[3]	X
Leafy spurge	*Euphorbia esula*	A	X
Malta starthistle	*Centaurea melitensis*	B	
Meadow knapweed	*C. pratensis*	WL	
Musk thistle	*Carduus nutans*	C	X
Myrtle spurge	*Euphorbia myrsinites*	WL	
Oxeye daisy	*Leucanthemum vulgare*	A	
Pampas grass	*Cortaderia sellonana*	WL	
Parrotfeather	*Myriophyllum aquaticum*	C	
Perennial pepperweed	*Lepidium latifolium*	B	X
Poison hemlock	*Conium maculatum*	B	
Punctureveine	*Tribulus terrestris*	C[3]	X
Purple loosestrife	*Lythrum salicaria*	A	
Purple starthistle	*Centaurea calcitrapa*	A	

Common Name	Scientific Name	Class	Occurrence[1]
Quackgrass	*Elytrigia repens*	B	
Ravenna grass	*Saccharum ravennae*	A	
Red brome	*Bromus rubens*	C[3]	X
Rescuegrass	*B. catharticus*	C[3]	
Ripgut brome	*B. diandrus*	C[3]	X
Russian knapweed	*Acroptilon repens*	B	X
Russian olive	*Elaeagnus angustifolia*	C	X
Russian thistle	*Salsola kali*	C[3]	X
Sahara mustard	*Brassica tournefortii*	WL	
Salt cedar	*Tamarix* spp.	C	X
Scentless chamomile	*Matricaria perforata*	A	
Scotch thistle	*Onopordum acanthium*	A	X
Siberian elm	*Ulmus pumila*	C	X
Smooth brome	*Bromus inermis*	C[3]	X
Spiny cocklebur	*Xanthium spinosum*	B	
Spotted knapweed	*Centaurea biebersteinii*	A	X
Spreading wallflower	*Erysimum repandum*	C[3]	X
Squarrose knapweed	*Centaurea virgate*	A[3]	
Syrian beancaper	*Zygophyllum fabago*	WL	
Teasel	*Dipsacus fullonum*	B	
Tree of heaven	*Ailanthus altissima*	C	X
Wall rocket	*Diplotaxis tenuifolia*	WL	
Yellow nutsedge	*Cyperus esculentus*	A[3]	
Yellow starthistle	*Centaurea solstitialis*	A	X
Yellow toadflax	*Linaria vulgaris*	A	

Sources : BLM 2014b[2]; NMDA 2009 ; Navajo Nation 2017a

[1]Includes species that occur or have occurred in the planning area

[2]Watch list species

[3]Navajo Nation noxious weed species only.

The New Mexico Department of Agriculture places designated noxious weeds into four categories, as follows:

- Class A—Currently not present in New Mexico or limited distribution
- Class B—Limited to portions of the state; in areas with severe infestations, management should be designed to contain the infestation and stop any further spread
- Class C—Widespread; management decisions for these species should be determined at the local level, based on feasibility of control and level of infestation
- Watch List—Species of concern with the potential to become problematic; more data are needed to determine if these species should be listed

A tool used by the BLM to control noxious weeds and invasive plant species on the lands it manages is cooperative agreements with organizations like the San Juan Soil and Water Conservation District. In addition to conservation districts, the BLM works with other federal and state agencies, management groups, private landowners, and industry to control and prevent noxious weeds and invasive plant species. The BLM also addresses invasive plant management by incorporating prevention and control measures in realty, wildlife, range, recreation, oil and gas, and other mineral-related actions.

[2]Tracking document of weeds occurring in Farmington Field Office provided via personal communication by Stan Dykes, Farmington Field Office Vegetation Specialist. Farmington, New Mexico. January 2018.

The BIA controls noxious weeds and invasive plant species in cooperation with the Navajo Nation and other Tribal, federal, and state agencies; management groups; private landowners; and industry. The BIA controls approximately 50,000 acres of weeds annually across the Navajo Nation using a variety of methods.

Trends

Observations indicate some noxious weeds and invasive plants are spreading or increasing in density in parts of the planning area, especially in oil and gas fields, along roadways, and in some watersheds. Typically, as ground disturbance increases in areas of known populations, the distribution of noxious and invasive plants also increases.

Focused efforts have limited the spread and reduced the size of noxious weeds and invasive plant populations in areas. Examples of such efforts are as follows:

- Spot treating populations of noxious weeds and invasive plants
- Applying herbicide before seeding (targeting cheatgrass)
- Mowing or Dixie harrowing and seeding
- Using prescribed fire
- Seeding with native species after treating noxious weeds
- Routine inventory and monitoring of noxious weeds

Although federal, tribal, state, county, and private entities are working to control many noxious weeds and invasive plant species, control objectives are not being fully met. This is because of the large scale of infestations and lack of resources needed to treat these species.

AE.2.7 Wildlife

Current Conditions

Wildlife

The BLM FFO currently manages 9 wildlife SDAs including: Cereza Canyon, Crow Mesa, East La Plata, Ensenada Mesa, Gonzales Mesa, Laguna Seca Mesa, Middle Mesa, Rattlesnake Canyon, Rosa Mesa, Thomas Canyon ERMA/Wildlife Area (Table AE-12) and encompassing 392,192 acres.

There are portions of two Navajo Nation Big Game Hunting Units in the planning area; Units 13 and 14. These units are roughly bounded by US-491 on the west, the San Juan River valley to the north, US-550 on the east, and Interstate 40 to the south (NNDFW 2019). Currently, Navajo Nation Department of Fish and Wildlife (NNDFW) permits mule deer and elk hunts in these units (NNDFW 2018).

Common game species in the planning area are mule deer (*Odocoileus hemionus*) and elk (*Cervus elaphus)*. Mountain lion (*Felis concolor*) pronghorn antelope (*Antilocapra americana*), and black bear (*Ursus americanus*) also inhabit portions of the planning area.

The pinyon-juniper and Great Basin desert scrub plant communities in the northeastern part of the planning area provide habitat for wintering and resident populations of mule deer and elk. Mule deer and elk are found throughout the planning area, but the highest densities generally are found north of US Highway 550.

Deer and elk population density varies by location and time of year, because of migrations of mule deer and elk. A few small populations of pronghorn antelope reside in the area north and east of US Highway 550, near Angel Peak and Ensenada Mesa. There is also a remnant population of antelope in the Twin Mounds area, and they face declining habitat quality, predation, and poaching. Legal antelope hunting is also permitted in GMU 2 in the planning area.

Mountain lion and black bear are also legally hunted in the planning area. The mountain lion population in the planning area is stable to increasing. Since the 2003 FFO Resource Management Plan (RMP) (the 2003 RMP), mountain lion harvest objectives in the planning area have increased in GMUs 2 and 7, from 11 lions to 42, no more than 13 of which may be female. Also, since the 2003 RMP, black bear hunting, which was also closed in GMU 2, is now open, with an allowable harvest of 15 bears, no more than 6 of which may be female.

Much of the deer habitat on BLM-managed lands is considered critical winter range. This is protected in nine SDAs, which the BLM established in the 2003 RMP to protect wildlife habitat in the planning area (**Figure AE-12**, Wildlife SDAs). In these areas, surface-disturbing activities are restricted seasonally to protect wildlife. These restrictions also indirectly protect nontarget species in the SDAs.

The Rattlesnake Wildlife Area in the north provides habitat for big game and also hosts pinyon jay (*Gymnorhinus cyanocephalus*) nesting colonies (Johnson et al. 2015). It contains mixed pinyon-juniper woodlands; sagebrush in this area has been treated by prescribed fire and mechanical means to allow for more livestock and wildlife forage. Crow Mesa in the south is an SDA, but it has also been leased for oil and gas development. Wells and associated development are situated across the lowlands and mesa. The remaining wildlife habitat in this SDA is at risk from future planned oil and gas well development on existing leases.

According to New Mexico Department of Fish and Game harvest reports, deer, elk, and pronghorn antelope populations have remained stable over the past three years (New Mexico Department of Fish and Game 2018). A well-established deer migration corridor extends from Rosa Mesa and Thomas Canyon ERMA/Wildlife Area to summer range habitat in Colorado, providing an important route for deer in the planning area. Migration corridors also extend from East La Plata, Rattlesnake, and Middle Mesa Wildlife Areas into Colorado; however, development along the Highway 160 corridor, primarily around Durango, Colorado, has greatly reduced the number of animals (primarily mule deer) migrating into these areas.

Bat surveys in the planning area have detected 14 species, the most common of which are the California myotis (*Myotis californicus*), long-legged myotis (*M. volans*), long-eared myotis (*M. evotis*), and big brown bat (*Eptesicus fuscus*; Gannon 1998).

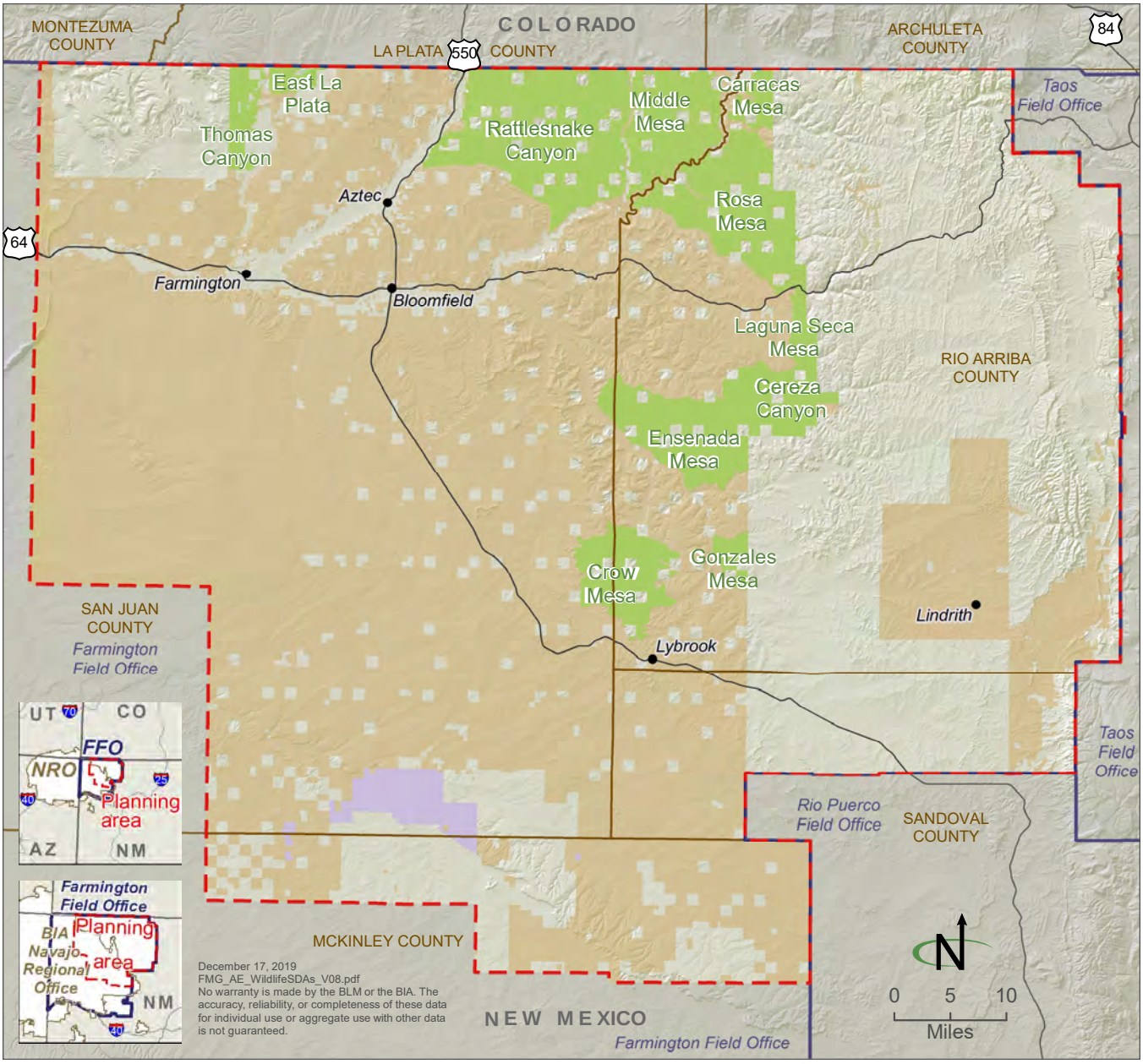
There are portions of two Navajo Nation Big Game Hunting Units in the planning area; Units 13 and 14. These units are roughly bounded by US-491 on the west, the San Juan River valley to the north, US-550 on the east, and Interstate 40 to the south (NNDFW 2019). Currently, NNDFW permits mule deer and elk hunts in these units (NNDFW 2018).

More information regarding special status species and associated wildlife areas managed by the Navajo Nation is located under the Special Status Species, Section AE.2.8.

Migratory Birds

A variety of migratory songbird species use habitats in the planning area for breeding, nesting, and foraging. The New Mexico Partners in Flight (NMPIF) Bird Conservation Plan identifies a number of bird species in the Colorado Plateau physiographic region as priority species. Some of the highest priority species have been detected in the planning area, including sage sparrow (*Artemisiospiza nevadensis*), mountain bluebird (*Sialia currucoides*), loggerhead shrike (*Lanius ludovicianus*), and gray vireo (*Vireo vicinior*). The NMPIF has identified the pinyon jay and western bluebird (*Sialia mexicana*) as having a high percentage (over 10 percent) of their US population in the FFO (Johnson et al. 2015).

Figure AE-12
Wildlife SDAs



Source: BLM GIS 2020

Wildlife area SDA
BLM and BIA decision area
Planning area
National Park Service
Field office boundary

In 2001, EO 13186 was issued directing federal agencies that take actions that either directly or indirectly affect migratory birds to develop a memorandum of understanding (MOU), and to work with USFWS and other federal agencies to promote the conservation of migratory bird populations. In 2010, the BLM and USFWS signed an MOU to promote the conservation of migratory birds. The MOU identifies strategies that promote conservation and avoid or minimize adverse impacts on migratory birds through enhanced collaboration between the BLM and USFWS, in coordination with state, Tribal, and local governments. For additional information on FFO special status migratory birds in the planning area, see **Section AE.2.8**, Special Status Species.

Waterfowl and upland game birds are also found in the planning area. Raptor abundance and nesting success has fluctuated, probably due to cyclic prey abundance. Populations of ferruginous hawks (*Buteo regalis*) have historically had few nests on BLM-managed lands. On Navajo lands, ferruginous hawk nests are relatively more common. Across the planning area, populations of golden eagles (*Aquila chrysaetos*) have remained relatively stable since 2003[3]. Wintering populations of bald eagles have remained stable since 2003. One bald eagle nest identified in 2015 produced fledglings in both 2016 and 2017[4].

In 1999, the BLM initiated a monitoring program to assess the status of avian species, using the key habitat types common in the planning area. The results of these surveys are generally consistent with the trends reported in the breeding bird surveys conducted by the USFWS and with the information presented in the NMPIF Draft Landbird Conservation Plan for the State of New Mexico (Rich et al. 2004). Survey results indicated declines in sagebrush-obligate bird species, due to herbicide treatment eliminating the sagebrush (Northwest Power and Conservation Council 2004).

Twenty-five bird species were detected during the surveys, seven of which are NMPIF priority species (Rich et al. 2004): black-chinned hummingbird (*Archilochus alexandri*), sage sparrow, Brewer's sparrow (*Spizella breweri*), mountain bluebird, pinyon jay, loggerhead shrike, and sage thrasher (*Oreoscoptes montanus*).

Trends

Wildlife

In general, elk and pronghorn antelope populations are doing well and increasing in numbers throughout the planning area. Mule deer have been stable in various regions in the planning area. In GMU 2A, surveys of deer populations between 2000 and 2010 estimated a fawn-to-doe ratio of 61:100. In the Rosa Mesa Wildlife Area, where there is oil and gas development, the fawn-to-doe ratio is estimated at 59.1:100. This is fairly high, considering the human activity in that area; however, in other parts of the planning area, mule deer populations have been declining.

Other wildlife, including black bear, mountain lion, and turkey (*Meleagris gallopavo*), are increasing in numbers. Current and proposed oil and gas development continues to increase habitat loss and fragmentation for wildlife species. Future increased development and climate change could disrupt travel corridors and secure areas for fawning and calving, reduce the amount of forage, and cause habitat avoidance, thereby shrinking the acreage of effective habitat available to wildlife.

[3] John Kendall, BLM FFO Wildlife Biologist, personal communication with Dan Morta, EMPSi Biological Specialist. February 2018.

[4] John Kendall, BLM FFO Wildlife Biologist, personal communication with Dan Morta, EMPSi Biological Specialist. February 2018.

Migratory Birds

Across North America and in the Western Hemisphere, bird populations have declined, particularly neotropical migratory birds (Parrish et al. 2002). These declines are largely attributed to the loss of habitat, due to fragmentation and other landscape modifications, including urbanization. Most human-induced changes in bird populations and distributions have occurred in the recent past. Other primary factors are natural disasters, loss or alteration of habitat in nonbreeding areas and along migratory routes, and brood parasitism[5] (Parrish et al. 2002).

The FFO has been collecting long-term population data for sagebrush-obligate bird species. Since 2003, sage sparrow populations in the planning area have been stable to slightly increasing and Brewer's sparrow numbers have been increasing. Sage thrasher populations have been declining, and herbicide treatments may play a role (Northwest Power and Conservation Council 2004). A number of federal programs have been initiated to reverse the decline in bird populations. Migratory bird populations will continue to be impacted by habitat fragmentation and climate change, reducing effective habitat available for nesting, migratory stopovers, and winter habitat for many bird species.

AE.2.8 Special Status Species

Current Conditions

Species Listed Under the Endangered Species Act

The FFO manages habitats for species listed by the USFWS as candidate species, endangered, threatened, or proposed for listing under the authority of the Endangered Species Act (ESA). Currently, there are ten endangered and five threatened species that occur or have the potential to occur in the counties comprising the planning area (**Table AE-24**).

The USFWS has designated portions of BLM-managed lands in the planning area as critical habitat for the yellow-billed cuckoo, Mexican spotted owl, the Rio Grande silvery minnow, the razorback sucker, and the Colorado pikeminnow. No habitat for Mexican spotted owl has been identified on Navajo Nation-managed lands in the planning area. Critical habitat locations will be described in the biological assessment associated with the FMG RMPA/EIS.

Tribally Listed Species

Species classified as Endangered by the Navajo Nation are protected under the Resources Committee of the Navajo Nation Council, through the Division of Natural Resources' Department of Fish and Wildlife (NNDFW). The primary guidance documents in place to assist in protection of the Navajo Nation's endangered species include: Biological Resource Land Use Clearance Policies and Procedures (RCP) and Navajo Endangered Species List (NESL). The RCP identifies six wildlife areas (**Figure AE-13**, Navajo Nation Wildlife Areas) within the boundaries of the reservation that help guide development to limit or avoid impacts on the listed species (Navajo Nation 2008a). The NNDFW maintains the RCP document to ensure protection of endangered, rare, and game species found on the reservation (Navajo Nation 2008a). In accordance with the Indian Self-Determination Act of 1975 (PL 93-638), the NNDFW is a 638 contractor for the BIA for special status species and is authorized to make recommendations for appropriate treatment of biological resources, with final determinations from the Regional Director of the BIA.

[5] When a host raises the young of a parasite instead of the host's own young.

Table AE-24
Federally Listed Species and Critical Habitat that Occur or Potentially Occur in McKinley, Rio Arriba, San Juan, and Sandoval Counties

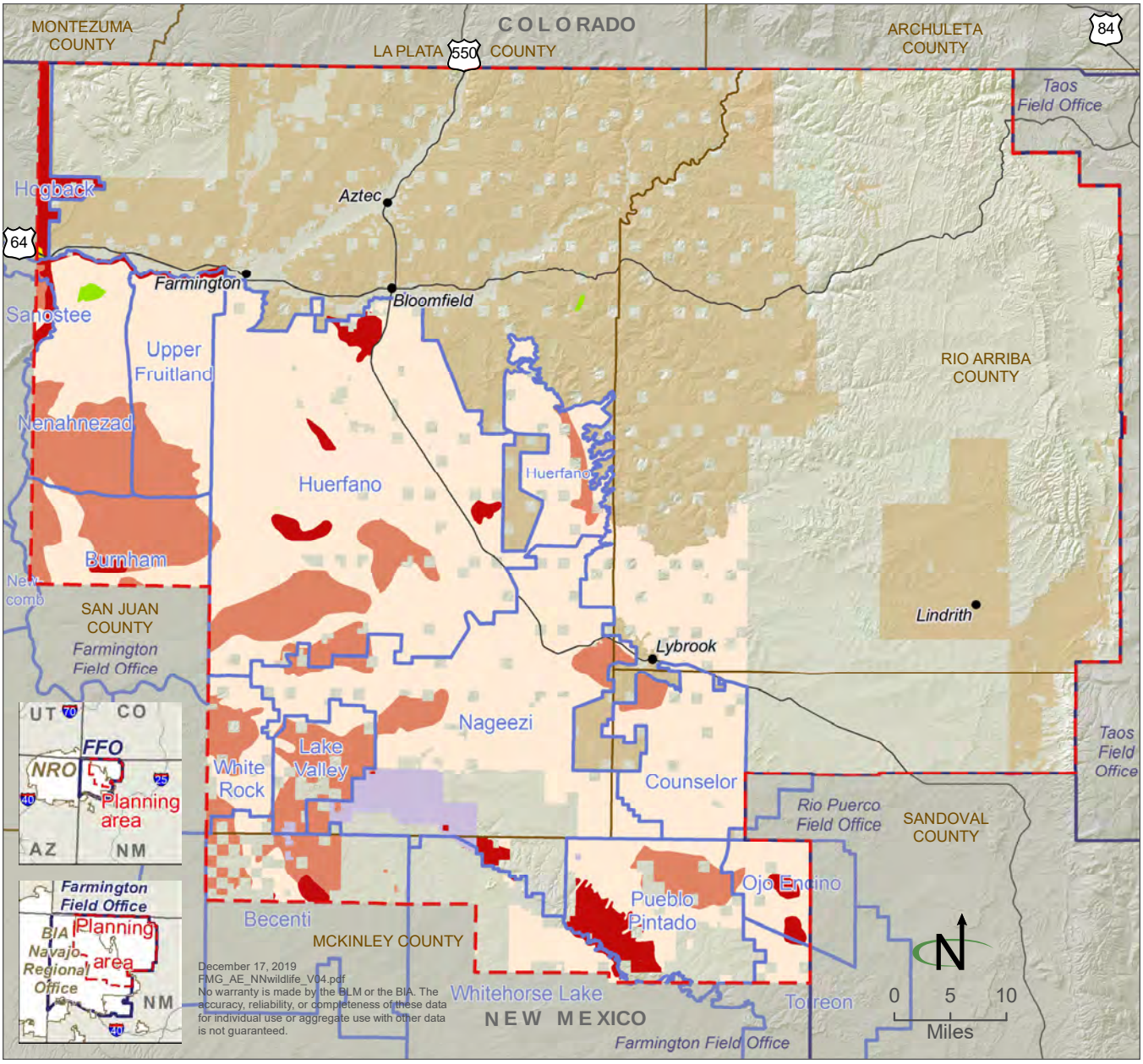
Species	Status[1]	Comments
Knowlton's cactus *Pediocactus knowltonii*	E	Endemic to New Mexico on rolling gravel hills in the pinyon-juniper/sagebrush plant community. Entire known wild population is fenced and protected from disturbances.
Mancos milkvetch *Astragalus humillimus*	E	Found in pinyon-juniper woodlands and desert shrublands on sandstone rimrock ledges and mesa tops in San Juan County and adjacent Colorado. All known populations in the planning area are found in areas of critical environmental cocnern (ACECs).
Mesa Verde cactus *Sclerocactus mesae-verdae*	T	Found in soils derived from Mancos, Fruitland, and Lewis shale. Largest population is found on Ute and Navajo Tribal lands. Other populations exist in Colorado. All known populations in the planning area are in ACECs.
Zuni fleabane *Erigeron rhizomatus*	T	Found in pinyon-juniper woodlands on steep, easily eroded sandstone slopes and clay banks, usually in close association with the Chinle and Baca Formations.
Colorado pikeminnow *Ptychocheilus lucius*	E	Inhabits sections of the San Juan River and other rivers in the Upper Colorado River Basin. No known occurrences in the planning area.
Colorado pikeminnow critical habitat	—	Colorado pikeminnow designated critical habitat consists of portions of the San Juan River, beginning at the New Mexico Highway 371 bridge in Farmington and continuing downstream to Lake Powell.
Razorback sucker *Xyrauchen texanus*	E	Inhabits off-channel backwaters and shallow flooded areas of the San Juan River and other rivers in the Upper Colorado River Basin. No known occurrences in the planning area.
Razorback sucker critical habitat	—	Critical habitat for this species in New Mexico is in 39 miles of the lower San Juan River, where the wild population has been extirpated and is being reestablished through stocking.
Rio Grande silvery minnow *Hybognathus amarus*	E	Found in pools and backwaters of creeks and rivers in the Rio Grande and Pecos River drainages in Rio Arriba and Sandoval Counties. Extirpated from most historic habitat.
Rio Grande silvery minnow critical habitat	—	Critical habitat for the silvery minnow extends from Cochiti Dam on the Rio Grande in Sandoval County, downstream 157 miles to the middle Rio Grande.
Zuni bluehead sucker *Catostomus discobolus yarrow*	E	Sedentary sucker found in shady pools in low velocity runs of rivers and creeks of the Rio Nutria drainage of the Little Colorado River in McKinley County.
Jemez Mountains salamander *Plethodon neomexicanus*	E	Restricted to the Jemez Mountains in Sandoval and Rio Arriba Counties, it is found in mixed coniferous forests with rotted logs and rocks for cover.
Least tern, interior population *Sterna antillarum athalassos*	E	Breeds locally along the Colorado River and other southern river systems. No known occurrences in planning area.
Mexican spotted owl *Strix occidentalis lucida*	T	Found in the southwestern United States, principally in New Mexico and Arizona. After extensive surveys, no nesting has been confirmed in the planning area.
Mexican spotted owl critical habitat	—	Critical habitat present in the Mexican spotted owl ACEC.
Yellow-billed cuckoo *Coccyzus americanus*	T	Breeding territory for western subspecies includes western New Mexico. Nests in cottonwood/willow riparian habitat along rivers; rare in the San Juan River valley.
Yellow-billed cuckoo critical habitat	—	Critical habitat is present and mapped along San Juan River.

Species	Status[1]	Comments
Southwestern willow flycatcher *Empidonax trailii extimus*	E	This species is known or believed to occur in San Juan, McKinley, and Rio Arriba Counties.
Southwestern willow flycatcher critical habitat	—	Critical habitat for this species is in riparian corridors along the San Juan River in San Juan County (outside of the analysis area).
Canada lynx *Lynx canadensis*	T	Medium-sized cat found in boreal and montane forests; feeds primarily on snowshoe hare and other small mammals and birds. Distributed through western and northern United States, into the southern Rocky Mountains; it has been observed in the planning area, along the San Juan River corridor.
New Mexico meadow jumping mouse *Zapus hudsonius luteus*	E	Found in wet meadows and willow zones along streams in the Jemez Mountains and, in the Rio Grande watershed in Rio Arriba and Sandoval Counties.

Sources: BLM 2003; NatureServe 2014; USFWS 2016

[1]E = endangered, T = threatened

Figure AE-13
Navajo Nation Wildlife Areas



Source: BLM GIS 2020

- High Sensitivity
- Moderate Sensitivity
- Low Sensitivity
- Community Development
- Recreational Area
- BLM and BIA decision area
- Planning area
- National Park Service
- Field office boundary
- Navajo Nation Chapter

The RCP wildlife areas are as follows:

- Highly Sensitive Area—recommended no development with few exceptions.
- Moderately Sensitive Area—moderate restrictions on development to avoid sensitive species/habitats.
- Less Sensitive Area—fewest restrictions on development.
- Community Development Area—areas in and around towns with few or no restrictions on development.
- Biological Preserve—no development unless compatible with the purpose of this area.
- Recreation Area—no development unless compatible with the purpose of this area.

Other Special Status Species
Other special status species are as follows

- Those listed by the State of New Mexico
- BLM sensitive species
- Bald and golden eagles that are protected by other laws
- Migratory birds

Other special status species are those that may warrant protection, such as rare plants, important pollinators, and species that may be important as hosts or prey for other species, such as prairie dogs.

Federal land management agencies are mandated to manage special status species so that they should not need to be listed under the ESA in the future. It is thus BLM policy to initiate proactive conservation measures that reduce or eliminate threats to BLM sensitive species and to conserve and recover ESA-listed species and the ecosystems on which they depend so that ESA protections are no longer needed for these species.

The BLM must ensure that actions authorized, funded, or carried out do not contribute to the need to list any of these species as threatened or endangered. It also must ensure that its actions would not adversely affect the likelihood of any threatened or endangered species to recovery. Protecting and managing all special status species will continue to be a priority for the BLM. It will coordinate with other programs and activities as needed to meet management objectives.

The Navajo Nation requires preparation of a biological evaluation (BE) if proposed development is in the wildlife areas, excluding Area 4. Other exceptions to the BE requirement are found on pages 2 and 3 of the NNDFW RCP.

The Navajo Nation Natural Heritage Program's (NNHP's) Division of Natural Resources maintains the NESL Species Accounts (Mikesic and Roth 2008). The species in the NESL are organized into four groups, as follows:

- Group 1—Species that no longer occur on the Navajo Nation
- Group 2 (G2) —Species or subspecies whose prospects of survival or recruitment are in jeopardy
- Group 3 (G3)—Species or subspecies whose prospects of survival or recruitment are likely to be in jeopardy in the foreseeable future
- Group 4 (G4)—Species or subspecies for which the NNDFW does not currently have sufficient information to support their being listed in G2 or G3 but has reason to consider them

In 2017, the BIA consulted with the NNHP regarding the FMG RMPA/EIS. The agency received a response to this request on October 6, 2017. The species listed in **Table AE-25** were identified through this consultation with NNDFW. The list includes 21 species known to occur in the planning area and 30 additional species as having the potential to occur there.

Table AE-25
Navajo Nation Endangered Species Known to Occur or Potential to Occur in the Decision Area

Common Name, *Scientific Name*	**Navajo Status**	**Species Alpha Code**
Known Species		
Pronghorn, *Antilocapra americana*	G3	ANAM
Golden eagle, *Aquila chrysaetos*	G3	AQCH
Mancos milkvetch, *Astragalus humillimus*	G2	ASHU
Naturita milkvetch, *A. naturitensis*	G3	ASNA
Ferruginous hawk, *Buteo regalis*	G3	BURE
Mountain plover, *Charadrius montanus*	G4	CHMO
Southwestern willow flycatcher, *Empidonax traillii extimus*	G2	EMTREX
Peregrine falcon, *Falco peregrinus*	G4	FAPE
Bald eagle, *Haliaeetus leucocephalus*	G2	HALE
Northern leopard frog, *Lithobates pipiens*	G2	LIPI
Black-footed ferret, *Mustela nigripes*	G2	MUNI
Mesa Verde cactus *Sclerocactus mesae-verdae*	G2	SCMEVE
Potential Species		
Pronghorn, *Antilocapra americana*	G3	ANAM
Golden eagle, *Aquila chrysaetos*	G3	AQCH
Mancos milkvetch, *Astragalus humillimus*	G2	ASHU
Naturita milkvetch *A. naturitensis*	G3	ASNA
Yellow-billed cuckoo, *Coccyzus americanus*	G2	COAM
Southwestern willow flycatcher, *Empidonax traillii extimus*	G2	EMTREX
Roundtail chub, *Gila robusta*	G2	GIRO
Bald eagle, *Haliaeetus leucocephalus*	G2	HALE
Northern leopard frog, *Lithobates pipiens*	G2	LIPI
Black-footed ferret, *Mustela nigripes*	G2	MUNI
Colorado pikeminnow, *Ptchocheilus lucius*	G2	PTLU
Mesa Verde cactus, *Sclerocactus mesae-verdae*	G2	SCMEVE
Mexican spotted owl, *Strix occidentalis lucida*	G3	STOCLU
Razorback sucker, *Xyrauchen texanus*	G2	XYTE

Group 1—Species that no longer occur on the Navajo Nation; Group 2 (G2) and Group 3 (G3)—Species or subspecies whose prospects of survival or recruitment in the Navajo Nation are in jeopardy or are likely in the foreseeable future to become so; and Group 4 (G4)—Species or subspecies for which the NNDFW does not have sufficient information to support their being listed in G2 or G3 but has reason to consider them.

Conditional criteria notes are included on page 13 of the consultation letter. These criteria provide additional guidance for RCP, raptors, surveys, oil and gas lease sales, power line projects, guy wires, San Juan River, Little Colorado River, wetlands, life length of data request, and ground water pumping.

The State of New Mexico, through the New Mexico Department of Game and Fish, maintains a list of threatened and endangered species of New Mexico. It also maintains a list of species of greatest conservation concern, which is a part of the state wildlife action plan (New Mexico Department of Fish and Game 2016a, 2016b). The New Mexico Energy, Minerals, and Natural Resources Department (EMNRD) Forestry Division has statutory responsibility for maintaining and updating the list of state endangered plant species (EMNRD 2017). A current and up-to-date list of all (235) rare and endangered

plants is provided by the New Mexico Rare Plant Conservation Strategy (Strategy) (EMNRD 2017). The Strategy list is maintained and updated by the Rare Plant Conservation Strategy Partnership, which includes the BLM (EMNRD 2017). The BLM uses the Strategy Scorecard to determine the conservation status of a species. In addition, the Strategy provides a map of Important Plant Areas (IPAs) in New Mexico, including IPAs within the BLM Farmington Resource Management Area. These are areas of high significance for plant conservation and may be considered for Conservation Opportunity Areas. Details of the process and the Strategy Scorecard can be found online at: http://www.emnrd.state.nm.us/SFD/ForestMgt/NewMexicoRarePlantConservationStategy.html.

Protecting state-listed species is not applicable on Navajo Nation Tribal trust land.

The BLM, Navajo Nation, and State of New Mexico special status species known to occur or with the potential to occur in the planning area are listed in **Table AE-26**.

The FFO monitors nesting of special status raptors. The FFO special management species policy provides for appropriate species-specific nesting protection buffers from facility construction, well drilling, and completion activities for active or historical nests during the breeding season. Restrictions and buffers are typically enforced between February 1 through August 1 annually.

Table AE-26
BLM Sensitive, FFO Special Management Status, State of New Mexico, and Navajo Nation Species that May Occur in the Planning Area

Species	Status[1]			Comments
	BLM	State	Navajo	
Plants				
Aztec gilia *Aliciella formosa*	Sensitive, SMS	E	G4	Grows in salt desert shrublands on soil from the Nacimiento Formation. Known from San Juan County in New Mexico in the planning area in the tri-cities area.
Clover's cactus (previously known as Brack's hardwall cactus) *Sclerocactus cloverae* var. *brackii*	Sensitive, SMS	E	G4	Occurs on sandy clay hills of the Nacimiento Formation in desert scrub habitat.
Sivinski's Blazingstar *Mentzelia sivinskii*	Sensitive	SOC	None	Grows in volcanic pumice and unconsolidated pyroclastic ash in pinyon-juniper woodland and lower montane coniferous forest around 7,000 to 8,000 feet.
Mancos saltbush *Proatriplex pleiantha*	Sensitive	SOC	None	Desert badlands in saline clay soils of the Mancos and Fruitland shale formations. Found in clay slopes of mesas and barren clay flats.
Clover's Cactus *Sclerocactus cloverae*	Sensitive	None	None	Grows in sandy clay strata of the Nacimiento Formation in sparse shadscale scrub at 5,000 to 6,400 feet.
San Juan milkweed *Asclepias sanjuanensis*	Sensitive	SOC	G4	Found in sandy loam soils, usually in disturbed sites, in juniper savanna and Great Basin desert scrub, at 5,000 to 5,500 feet.

Species	Status[1]			Comments
	BLM	State	Navajo	
Amphibians				
Northern Leopard Frog *Lithobates (Rana) pipiens*	Sensitive	SGCN	G2	Breeds in a variety of aquatic habitats that include slow-moving or still water along streams and rivers, wetlands, permanent or temporary pools, beaver ponds, and human-constructed habitats such as earthen stock tanks and borrow pits; feeds along the borders of larger, more permanent bodies of water, and moves up and down drainages and across land in an effort to locate new breeding areas.
Invertebrates				
Monarch Butterfly *Danaus plexippus plexippus*	Sensitive	SGCN	None	Dependent on milkweed for breeding.
Birds				
Bendire's thrasher *Toxostoma bendirei*	Sensitive	None	None	Found in sparse desert habitats, from sea level to 5,900 feet. For breeding it favor relatively open grassland, shrubland, or woodland with scattered shrubs or trees; it is not found in dense vegetation.
Pinyon jay *Gymnorhinus cyanocephalus*	Sensitive	None	None	Pinyon-juniper woodland, less frequently pine; in nonbreeding season, also occurs in scrub oak and sagebrush.
Western burrowing owl *Athene cunicularia*	Sensitive, SMS	None	G4	Breeds in much of the western United States and Canada. Populations in New Mexico consist of breeding and wintering birds. Nests in grasslands and desert scrub habitats in association with prairie dogs or other burrowing rodents. Present in the planning area.
Virginia's Warbler *Vermivora virginiae*	Sensitive	SGCN	None	Breeds in open pinyon-juniper and oak woodlands often on steep slopes with shrubby ravines throughout most of their range and tends to gravitate toward pine forests and scrubby or wooded areas adjacent to creeks.
Mammals				
Gunnison's prairie dog *Cynomys gunnisoni*	Sensitive	None	None	High mountain valleys and plateaus at elevations of 6,000 to 12,000 feet; open or slightly brushy country, scattered junipers, and pines. Burrows usually on slopes or in hummocks. Found in the planning area.
Spotted bat *Euderma maculatum*	Sensitive	T	None	Occurs in the western United States, with historical records from all counties in the planning area. Found mostly in forested habitat and lower elevation sites. Detected once in the planning area and once on the Jicarilla Ranger District.
Townsend's big-eared bat *Plecotus townsendii pallescens*	Sensitive	None	None	Occurs in the western United States, including the western half of New Mexico. Commonly found in caves and mines. Captured at two locations in the planning area.

Sources: BLM 2003, 2008; USFWS 2016

[1]E= endangered, T= threatened, SMS = BLM Special Management Species

Trends

Special status species diversity and abundance is directly related to maintaining habitat availability, diversity, and quality. The species listed above all have specialized habitat requirements. Many of these habitat types have been drastically altered or reduced from their historical native ranges.

Continuing threats to native ecosystems and species diversity in the planning area include fragmentation and loss of critical or important habitat due to human activities. The cumulative impact from all disturbances poses a risk to these species. Additionally, invasive species may continue to displace native vegetation, which indirectly affects the distribution and populations of wildlife species. Displacement of native vegetation may also contribute to loss of pollinators and supporting habitat for plants.

Special Status Species Management

Several areas in the planning area have management prescriptions for special status wildlife species. The bald eagle ACEC is designated to prevent disturbance and has timing limitations on mineral development to protect bald eagle use areas during the winter, with buffers to prevent disturbance.

There are a variety of threats associated with the decline of rare plants in the planning area, for example, drought, oil and gas development and associated infrastructure, disease and predation, nonnative noxious and invasive species, off-road vehicles, livestock grazing, and fragile soils. New oil and gas development is expected in the special status species habitat (Muldavin et al. 2016). This could negatively affect rare plants in these areas.

AE.2.9 Cultural Resources

The term cultural resources broadly refers to the physical remains left behind by prehistoric and historic peoples, as well as places important to Tribes or other groups; however, the term is not defined in NEPA, the National Historic Preservation Act of 1966 NHPA, or any other federal law. NEPA requires that agencies consider the impacts of their actions on aspects of the "human environment," the NHPA (54 USC 306108) and its enabling legislation (36 CFR, Part 800) require agencies to consider the impacts of an undertaking on historic properties, and other legislation uses different terms.

The BLM has its own definition of "cultural resources" that includes archaeological, historic, or architectural sites, structures, or places with important public and scientific uses (BLM Manual 8100). Some Tribes have more expansive definitions of cultural resources, which can include wildlife, water features, geologic features, and others. For the purposes of this document, the most common terms used are cultural resources, which is the broadest and most encompassing, and "historic properties" and "culturally important properties" (CIMPPs), which are defined below. National Historic Trails (NHTs) are also considered as historic properties in this document. NHTs are types of resources considered under the National Trails System Act of 1968 (NTSA [PL 90-543, as amended in 2009 by PL 111-11]), which provides for Congress designating NHTs to bring greater awareness and interpretation of the historic trails and routes that are important elements of our nation's past. BLM's guidance for the NHT inventorying, designation, administration, and monitoring is included in BLM Manuals 6250 and 6280.

A historic property is defined in the NHPA as "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on the [NRHP]." The term is used when discussing adverse impacts. The NRHP also notes that historic properties are "significant in American history, architecture, archaeology, engineering, and culture."

CIMPPs are defined for the FMG RMPA/EIS to include a variety of resource types, such as traditional cultural properties (TCPs), sacred sites, ceremonial grounds, and areas of traditional cultural practice. These CIMPPs are generally significant because of their importance to living communities, such as Tribes

or other groups, and are discussed in greater detail below and their relationship to Tribes is described in more detail in **Section AE.5.1**, Native American Tribal Interests and Uses.

The term CIMPP is intended to provide ease of use when referring to the various resources listed below, which may not fall within the definitions of a historic property per the NHPA but may be considered under other legislation as described in greater detail. This umbrella term removes the need to continuously refer to all the relevant definitions and regulations beyond the NHPA for these types of resources. Some of the CIMPPs are relevant to both the BLM and BIA on the lands they manage, while other CIMPP definitions are specifically related to BIA-managed Tribal trust lands and Navajo Nation regulations noted below.

CIMPPs include the following (although this list is not meant to exclude appropriate resources not listed below):

- TCPs, as defined in National Register Bulletin 38
- Sacred sites, as defined in EO 13007 or AIRFA
- TCPs, as identified in the Navajo Nation Policy to Protect TCPs
- Loci of traditional cultural practices, as defined in the Navajo Nation's Guidelines for the Treatment of Historic, Modern and Contemporary Abandoned Sites
- Jishchaa' (gravesites, human remains, or funerary items), as defined in the Navajo Nation Policy for the Protection of Jishchaa'.

The NPS' National Register Bulletin 38 describes TCPs as "districts, sites, buildings, structures, or objects that are "eligible for inclusion in the [NRHP] because of [their] association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community" (Parker and King 1998). In general, cultural resource categories are archaeological resources, cultural landscapes, structures, museum objects, and ethnographic resources.

The Archaeological Resources Protection Act (ARPA), the Native American Graves Protection and Repatriation Act (NAGPRA), the American Indian Religious Freedom Act (AIRFA), and EO 13007 also require the federal government to protect various cultural resources. As discussed further under **Section AE.5.1**, Native American Tribal Interests and Uses, AIRFA requires the federal government to consider the impacts of its actions on sites and practices that may not meet the definition of a historic property.

In a similar fashion, EO 13007 requires federal land managing agencies to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and to avoid affecting the physical integrity of such sacred sites. Sacred sites are defined as "any specific, discrete, narrowly delineated location on federal land that is identified by an Indian tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion" (EO 13007, Section 1 [b]iii). Agencies are also required to develop procedures for reasonable notification of proposed actions or land management policies that may affect or restrict access to or ceremonial use of sacred sites.

As with AIRFA, sacred sites may not meet the definition of a historic property under the NHPA; however, the Advisory Council on Historic Preservation (ACHP) notes that the requirements of Section 106 of the NHPA and the requirements of EO 13007 are similar enough in the obligations for federal agencies to consult with Indian Tribes regarding effects; therefore, the Section 106 process also can be used to fulfill the requirements of EO 13007 (ACHP 2013).

The Navajo Nation's Policy to Protect Traditional Cultural Properties and Guidelines for the Treatment of Historic, Modern, and Contemporary Abandoned Sites provide different definitions for TCPs than the NPS

(as further explained in the glossary). They include more recent loci of traditional cultural practices. Further, the policy and guidelines recognize that TCP is an imperfect term for many Tribes and Navajo traditionalists but acknowledge its use is a "practical necessity in certain contexts." Additionally, the Navajo Nation Policy for the Protection of Jishchaa' discusses the significance of gravesites, human remains, or funerary items for the Navajo people.

The BLM, BIA, and other federal agencies generally use the definitions for historic properties and NRHP eligibility (36 CFR, Parts 60 and 800) when considering cultural resources on the lands that they manage. While the BIA is the lead federal agency on most undertakings on Tribal trust lands in the BIA decision areas, these lands are in the Navajo Nation. The BIA also engages the Navajo Nation Heritage and Historic Preservation Department (NNHHPD) as a contractor for reviewing undertakings related to cultural resources and as part of an overall commitment to facilitating tribal self-determination.

The Navajo Nation has its own cultural resources regulations that apply on Tribal trust lands, including the aforementioned regulations, along with the Navajo Nation Cultural Resources Protection Act (NNCRPA [Navajo Nation Code, Title 19 Chapter 11–Sections 1001-1061]). The Navajo Nation Tribal Historic Preservation Officer (THPO) makes recommendations on undertakings and potential adverse effects in the Section 106 process. The BIA then considers these in making its final determinations for compliance with federal and Tribal historic preservation laws.

The BLM and BIA follow the guidance of the NHPA and evaluate cultural resources using the NRHP criteria, while complying with the other relevant authorities, as discussed in greater detail above. The agencies must consider the impacts of their actions, in accordance with the criteria of adverse effects, which are defined as "direct or indirect alteration of the characteristics that qualify a [historic] property for inclusion in the NRHP in a manner that diminishes integrity of location, design, setting, materials, workmanship, feeling, or association" (36 CFR 800.5[a][1]).

A historic property must be listed on, or eligible for listing on, the NRHP for evaluation under the following criteria (36 CFR 60; NPS 2002):

> The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and
>
> A. That are associated with events that have made a significant contribution to the broad patterns of our history or
> B. That are associated with the lives of significant persons in our past or
> C. That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction [such as a historic district] or
> D. That have yielded or may be likely to yield, information important in history or prehistory

Current Conditions

This section describes the condition of historic properties and CIMPPs in the planning area that may be affected by potential leasing and other management actions. The understanding of these historic properties and CIMPPs serves as the baseline for analysis, including determining the impacts of the various alternatives on resources. Resource descriptions are depicted in only as much detail as needed to analyze, in **Chapter 3** of the FMG RMPA/EIS, the effects of the proposed actions.

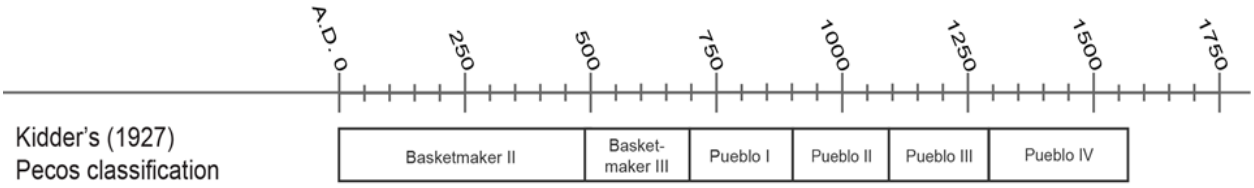
The cultural history of the Southwest, including the planning area in northwest New Mexico, can be divided into general cultural periods. The BLM uses the cultural/temporal affiliations from the Laboratory of Anthropology, including Paleoindian, Archaic, Anasazi, Navajo, Apache, Ute, Hispanic, and Anglo/Euro-American.

In the 2003 Proposed RMP and 2015 Assessment of the Management Situation, the prehistoric culture history was subdivided into Paleo-Indian, Archaic, and the Pecos Classification of Basketmaker II, Basketmaker III, Pueblo I, Pueblo II, Pueblo III, and Pueblo IV. The historic culture included the Navajo phases of Dinetah/Gobernador, Cabezon, and Reservation, along with the Spanish Colonial, Mexican, and Euro-American periods.[6]

Researchers have identified thousands of important cultural resources in the planning area. Prehistoric occupation in the San Juan Basin may date to more than 12,000 years ago, although evidence of the early Paleo-Indian occupations that focused on nomadic pursuit of large, migratory game is limited to isolated projectile points or to tools with a heavy patina. The Archaic period (5500 BC–AD 1) is better represented in northwest New Mexico and the planning area, with pre-ceramic occupations based mostly on hunting and gathering and evidence of limited agriculture appearing around 1800 BC (Fuller 2017).

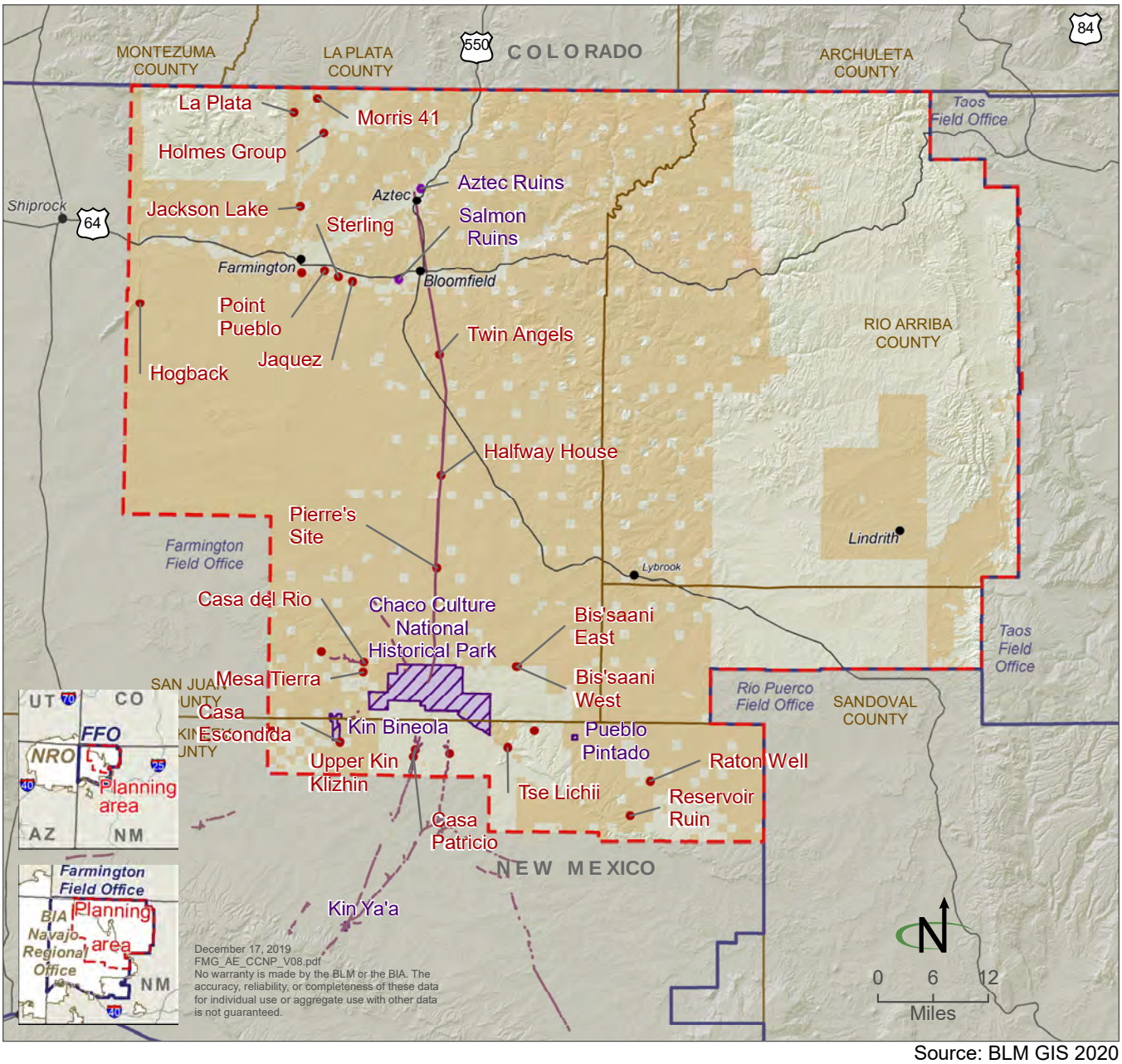
As the Archaic transitioned to Basketmaker and Anasazi periods (**Figure AE-14**, Pecos Classification for the Prehistoric Anasazi Periods), site architecture began to consist of shallow pit structures alongside circular surface structures with limited amounts of plain pottery during the Basketmaker II period. The Pueblo I period saw increasing reliance on maize agriculture and greater frequency of unit pueblos with contiguous surface rooms backing up to large, deep pit structures. This trend of more complex surface structures continued into the Pueblo II period and perhaps reached its height in the Pueblo III period, with the large public architecture of Chaco Canyon (**Figure AE-15**, NPS, UNESCO, and Select Chacoan Roads and Great Houses). Examples of this are the great houses, great kivas, road complexes, and trade networks.

Figure AE-14
Pecos Classification for the Prehistoric Anasazi Periods



[6] For more detailed information on the cultural history of the planning area, refer to the Farmington Proposed Resource Management Plan and Final Environmental Impact Statement (2003) or large research syntheses, such as A Class I Archaeological Inventory of the Navajo-Gallup Water Supply Project (2013) or Fruitland Coal Gas Gathering System Data Recovery Program, San Juan Basin, San Juan and Rio Arriba Counties, New Mexico (2014).

Figure AE-15
NPS, UNESCO, and Select Chacoan Roads and Great Houses



Source: BLM GIS 2020

- Chaco Culture National Historical Park
- Chacoan road
- Major Chacoan outliers
- BLM and BIA decision area
- Planning area
- National Park Service
- Field office boundary

While just outside the BIA and BLM decision areas, CCNHP hosts one of the most exceptional concentrations of archaeological sites in the American Southwest from the 10th to 12th century A.D. and is one of the most important pre-Columbian cultural and historical areas in the United States. Chacoan cultural sites are fragile; concerns of erosion caused by tourists have led to the closure of Fajada Butte to the public. The sites are considered sacred ancestral homelands by the Navajo and Pueblo people, whose oral accounts speak of their historical connections to Chaco and their spiritual relationship to the land.

By the latter part of the Pueblo III period, much of the population of the Chaco area had moved elsewhere, most likely due to a prolonged drought, with some of the population moving north in the planning area to the greater Three Rivers/middle San Juan area, near Aztec Ruins National Monument and modern-day Farmington. These trends were slightly different in other portions of the planning area such as the upper San Juan and Gallina regions.

There are also many prehistoric, protohistoric, and historic sites associated with the Navajo in the planning area. The earliest Navajo sites are located in the upper San Juan region, in an area known as Dinetah, where forked-stick hogans[7] (often with interior milling bins) and Dinetah gray pottery were common.

Gobernador phase (ca. AD 1630–1760) sites include Gobernador polychrome pottery and defensive masonry or rock shelter structures, known as pueblitos. Eventually, the Dinetah area was significantly depopulated due to conflict with Utes and the Spanish, and the Navajo population moved south and west during the Cabezon phase. This move culminated with the US Army occupation of the region in 1863 and the Long Walk, where the military force moved the majority of the Navajo to the internment camp at Bosque Redondo near Fort Sumner. In 1868, after the failure of Bosque Redondo, the Navajo reoccupied their former territory in the south and west portions of the planning area.

In addition to the trails used during the Long Walk, the planning area includes the Old Spanish NHT (OSNHT)—the only NHT in the planning area. The Armijo Route of the OSNHT represents Antonio Armijo's 1829 trade caravan route through New Mexico and thence to Los Angeles, California, while the Northern Route of the OSNHT follows the trail taken by subsequent traders between Santa Fe and Los Angeles. The NPS and BLM manage the OSNHT in the planning area, in coordination with the Ute Mountain Ute Tribe, Jicarilla Apache Nation, and Navajo Nation, and in accordance with the 2017 Comprehensive Administrative Strategy (BLM and NPS 2017).

Other sites important to the Jicarilla Apache Nation, the Navajo Nation, and other Tribes are habitations, hunting blinds, camps, homesteads, sweat lodges, hogans, and areas of intensive settlement and resource acquisition. Early Hispanic and Euro-American ranching, homesteading, mining, transportation, and trade are also represented in the documented archaeological and historic records of the planning area.

Many Tribes have deep historical connections to sites and CIMPPs in the planning area—some of this information may only be known by these Tribes. Often these strong relationships continue to the present day, with Tribal members continuing to visit cultural resources in the planning area for activities ranging from use of CIMPPs for ceremonial or sacred purposes to gathering plants for medicinal or other purposes. Traditional ceremonies, offerings, or pilgrimages at these CIMPPs can occur throughout the planning area and do not always occur on fixed dates or times.

The CCNHP and several Chaco outliers (**Figure AE-15**) are near the south edge of the planning area. The BLM has designated various ACECs on the lands they manage in the planning area, including 12 Chacoan outliers, the Chacoan North and Ah-shi-sle-pah Roads, five Anasazi sites or communities that do

[7] Traditional Navajo structures, often made of logs reinforced with mud.

not contain Chacoan structures, and an ACEC specifically designated for its early Anasazi petroglyphs. Some of these ACECs are also managed as Chaco Protection Sites and are United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage inscribed properties.

In addition, various groups had submitted an ACEC nomination (BLM 2014cg) to the BLM for a Greater Chaco Landscape, which suggested there were important Chaco sites in the proposed Greater Chaco Landscape boundary that merited protection as an ACEC. In 2014, however, the BLM (2014cg) denied that ACEC nomination, noting that "the nominated ACEC did not contain relevant and important values pursuant to BLM Manual 1613: Areas of Critical Concern" and also specifying that "there are no known Chacoan outlier within the [proposed] ACEC boundary and . . . . it seems unlikely that any previously unknown Chaco[an] outliers would be found in the [proposed] ACEC."

There are other ACECs on BLM-managed lands in the planning area, including 35 early Navajo pueblitos and habitation sites or districts, petroglyph and pictograph panels, locations identified in Navajo origin stories, and the locations of battles. Additional resources include 10 Hispanic and Euro-American homesteads, a livestock trail, a one-room school house, and an early trading post in locations such as Largo Canyon.

While there is considerable similarity in the cultural resources on the lands managed by the BLM and BIA in the planning area, there are differences in the methods used to track the related data; therefore, the information presented below is based on the relevant land managing agency.

Previous Research and Resources on Lands Managed by the BLM FFO

The results of undertakings on BLM-managed lands in the planning area that include cultural resource surveys and the documentation of cultural resources, including some ethnographic information, are kept on file at the FFO and shared with the New Mexico Cultural Resource Information System (NMCRIS). NMCRIS is an online, user-restricted system that includes narrative and spatial information on cultural resources in New Mexico. These undertakings included consultation with tribes under the Section 106 process, which may have resulted in the identification of CIMPPs by tribes during the consultation process. The following summaries are drawn from the records at the FFO, the New Mexico Cultural Resource Inventory System (NMCRIS), and other resources.

Due to steady increases in oil and gas development on the FFO, over 600,000 acres have been surveyed for cultural resources, reflecting approximately 15 percent of the planning area. During these inventories, over 32,000 cultural resources were recorded, including many important components of the Chacoan system currently under study by the NPS and others. Private contractors with BLM permits perform most cultural resource inventories associated with development obligations under Section 106 of the NHPA. The technical reports generated as part of the Section 106 process are used to determine if listed or potentially listed historic properties could be affected by the proposed action; however, this information has not been broadly synthesized into an overview report (Class I Cultural Resource Study) or a GIS modeling exercise.

As of November 2016, more than 23,000 archaeological inventories had been conducted in the planning area.[8] An average of almost 800 archaeological sites are recorded or updated each year for various undertakings, including oil and gas exploration and production. They are recorded in accordance with BLM and New Mexico Historic Preservation Division (HPD) standards. All archaeological sites are assessed for their eligibility to be listed on the NRHP.

[8] The data used for the EIS come from NMCRIS.

In addition to the archaeological inventories conducted under Section 106 of the NHPA, the BLM has conducted inventories of 558 acres since 2010 related to Section 110, which calls on federal agencies to establish programs to identify, evaluate, and protect historic properties. These Section 110 efforts included archaeological surveys of the Twin Angels ACEC, Upper Largo Canyon, Holmes Group, Chacoan roads associated with the Holmes Group, and stabilization of the Margarita Martinez homestead.

Of the 32,000 archaeological sites found, approximately 39 percent have been determined eligible under Criterion D for listing on the NRHP; 8 percent have been determined not eligible; and 6 percent are of undetermined eligibility. Forty-seven percent of the sites have an unknown determination of eligibility, as these data were not entered into the NMCRIS.

However, because the BLM must manage undetermined sites as potentially eligible, this can inhibit monitoring and protection of known historic properties due to a lack of time and funding. Monitoring effects on historic properties, resulting from any activity that is not subject to Section 106 compliance, such as trespassing or dispersed recreation, is also inhibited by recording practices that do not meet current standards. Vandalism and unauthorized collection at sites may be occurring, but many historic properties in the planning area have not been regularly monitored. Numerous BLM employees, volunteers, and law enforcement officers do take an active role in observing site condition when possible.

Private contractors with BLM permits perform most cultural resource inventories associated with development under Section 106 of the NHPA. The technical reports generated as part of the Section 106 process are used to determine if listed or potentially listed historic properties will be affected by the proposed action.

Previous Research and Resources on Lands Managed by the BIA or Navajo Nation

The results of undertakings related to cultural resources on BIA-managed lands in the Navajo Nation and planning area are kept on file at the NNHHPD. These include cultural resource surveys and the documentation of cultural resources, including CIMPPs identified during tribal consultation or consultation with Navajo Nation chapters and local residents. They are not shared with NMCRIS and are considered proprietary information by the Navajo Nation. Site and survey records at the NNHHPD are generally not digitized or entered into a database. Until around 2007, the resource locations were recorded on USGS 7.5-minute quadrangle maps.

Following consultation with Richard Begay, the Navajo Nation THPO, on the appropriate approach to data synthesis on BIA-managed lands on the Navajo Nation, the following summary is drawn from tallies of the sites and TCPs shown on the 66 USGS 1:24,000 and 6 1:100,000 quadrangle maps intersecting the planning area. It includes recent, large-scale research syntheses (Gilpin and Thompson 2013) that characterize the nature and frequency of the cultural resources on BIA-managed lands in the planning area.

The exact number of archaeological inventories conducted on the Navajo Nation in the planning area is unknown. There have been archaeological surveys conducted for oil and gas development on Navajo Nation trust lands. Akhtar Zaman, Manager of the Navajo Nation Department of Minerals, indicated that oil and gas development occurs at much lower frequencies on Tribal trust lands than on the FFO.[9]

Other typical undertakings on the Navajo Nation that have required archaeological surveys are highway expansions, transmission and water supply lines, new homesites for Tribal members, and the Navajo Agricultural Irrigation Project. Since fifteen percent of BLM lands in the planning area has been surveyed and development is thought to be higher on BLM lands, it is likely that less than 15 percent of BIA-

[9] Akhtar Zaman, Manager, Navajo Nation Department of Minerals, personal communication with William Penner, Environmental Planner, EMPSi. 2017.

managed lands in the planning area have been surveyed. Because of this, it is likely that archaeological surveys have been conducted on less than 15 percent of the BIA-managed lands in the planning area.

Based on the USGS 1:24,000 quadrangle maps on file at the NNHHPD, there are 5,383 sites and 7 known TCPs on the BIA-managed lands in the Navajo Nation and planning area. Additionally, the USGS 1:100,000 quadrangle maps at NNHHPD show there are 75 known TCPs whose locations have been previously published in the planning area on the Navajo Nation. As discussed previously, the NNHHPD does not maintain a comprehensive database that would allow for summary information about the distribution of cultural or temporal occupations for the documented sites on the Navajo Nation.

According to Richard Begay, the Navajo Nation THPO, the large-scale survey (Gillpin and Thompson 2013) provides a synthesis of the typical sites that are found on the Navajo Nation. These findings indicate that the temporal components are roughly 45 percent prehistoric, 26 percent historic, and 11 percent multicomponent; 18 percent have no defined temporal component. The cultural/temporal affiliations are mostly prehistoric or protohistoric, with less than 1 percent Paleo-Indian, 4 percent Archaic, 49 percent Formative, 33 percent Navajo, 2 percent Euro-American, and 12 percent undefined.

Trends

Based on the broad spectrum of conditions in the planning area, there are several trends to note. This is particularly the case for the rate of cultural resource discovery and related recording, along with potential changes in conditions. These changes could be the result of permitted undertakings, such as oil and gas development, or unpermitted actions, such as recreation.

Recording of cultural resources has steadily increased due to greater amounts of oil and gas development and other undertakings. As these activities have expanded in geographical scale and scope, many more resources are recorded, and previously recorded sites and other resources are re-recorded or updated.

Changes in resource conditions can be tracked during these opportunities for re-recording or updating information; however, recording quality varies, and no agency has done a thorough analysis of the actual rate of change. But just as evaluating the trends in resource conditions is difficult to determine from permitted activities, the trends related to unpermitted activities on historic properties are even more difficult to determine.

AE.2.10 Paleontological Resources

Paleontology is the scientific study of fossilized life forms and ecosystems. The term 'paleontological resource' means any fossilized remains, traces, or imprints of organisms, preserved in the Earth's crust, that are of paleontological interest and that provide information about the history of life on Earth (Paleontological Resources Protection Act (PRPA) Section 6301, 16 USC 470aaa-1). Paleontological resources constitute a fragile and nonrenewable scientific record. Late Cretaceous geologic units, such as the Mancos and Gallup Formations, are associated with the source rocks and natural reservoirs for oil and gas are also sensitive for paleontological resources. These paleontological resources may also be CIMPPs, which are discussed in greater detail in **Section 3.7.1**, Native American Interests and Uses.

The BLM manages fossils to promote their use in research, education, and recreation, in accordance with the PRPA; Subtitle D of the Omnibus Public Land Management Act of 2009 (16 USC, Sections 470aaa–470aaa-11), and the general guidance of the Federal Land Policy and Management Act of 1976 (FLPMA) and NEPA.

The PRPA does not apply to fossils on BIA-managed lands; however, the BLM does provide expertise to other federal agencies. BIA policy and guidance for managing paleontological resources is found in the Indian Affairs Manual: Part 59, Chapter 7—Paleontological Resources (Indian Affairs 2012) and the NEPA process.

The BLM has developed objectives for paleontological resources (Manual H-8270-1, General Procedural Guidance for Paleontological Resource Management [BLM 1998]) to protect the resources. New regulations for Department of Interior (DOI) agencies, excluding the BIA, are under review. It is the BLM's policy to manage paleontological resources using scientific principles and expertise and mitigate impacts on the resource.

The BLM has established guidelines and permitting processes for removing paleontological resources found on the lands they manage. Paleontological specimens are considered surface resources and are not available for location under the general mining laws. Paleontologists must have a valid paleontological resource use permit before collecting or disturbing fossil resources on BLM-administered lands. All fossils and associated notes that are collected under a paleontological resource use permit must be transferred to a publicly accessible curation facility.

The BIA has the responsibility to issue permits for recovery of "imbedded" fossils on the lands of Indian tribes or Indian individuals which are either held in trust or subject to restriction against alienation. There is an exception for any subsurface interests in lands not owned or controlled by an Indian tribe or Indian individual. Fossils are considered part of the surface estate. Imbedded fossils are those that cannot be moved from their location without the aid of a tool. Permits for collecting fossils on the Navajo Nation are issued by the Minerals Department and are issued only for scientific research or mitigation.

Both the BLM and BIA have established guidelines and permitting processes for removing paleontological resources found on their respective lands. Fossils on public lands are not locatable because they are not considered minerals under U.S. mining laws. Fossils embedded on tribal trust property are considered an interest in land. The Navajo Nation administers a permitting program and project review.

Current Conditions

Paleontological resource condition is assessed by field observations, paleontological reports, consultant site reports, and project review. Most vertebrate fossils are rare, whereas non-vertebrate fossils are typically more common. The BLM considers as scientifically important any vertebrate fossils or other noteworthy occurrences of invertebrate and plant fossils.

Indicators for the condition of paleontological resources are as follows:

- Type of fossil resource present (vertebrate, invertebrate, or plant)
- Prevalence of the fossil resource in the area
- Geologic formations in the planning area likely to contain fossils
- Physical condition of the fossil
- Scientific, educational, or recreational merit of the resource.

Geologic formations are the basic units of geology, indicating a discrete rock type and representing a certain depositional environment or method of development. Paleontological resources are closely tied to the geologic formations containing them; rocks of different ages contain fossils of different types that are characteristic to that specific geologic period.

A basic tenet in paleontology holds that if fossils are found in a formation elsewhere, they could also occur in the same formations in the planning area. The probability for finding paleontological resources can be broadly predicted from the geologic units at or near the surface; therefore, geologic mapping can be used for assessing the potential for paleontological resources.

The potential fossil yield classification (PFYC) is a system for categorizing the probability of geologic units to contain scientifically important paleontological resources or noteworthy fossil occurrences. This system is intended to provide a more uniform tool to assess potential occurrences of paleontological resources. It

is intended to be applied in a broad approach for planning and as an initial step in evaluating specific projects. Development of the PFYC is based in part on known fossil occurrences and geology. This system has been developed to estimate the potential for discovering fossils in specific geologic units.

The PFYC ranges from Class 1, which applies to geologic units that are not likely to contain scientifically important fossils, through Class 5, which applies to geologic formations that have a high potential to yield scientifically important fossils. Geologic formations that have not been classified are labeled U, for unknown. (BLM IM 2016-124). This classification system does not reflect rare or isolated occurrences of important fossils or individual localities; it refers only to the relative occurrence on a formation- or member-wide basis. Any rare occurrences may require additional assessment and mitigation if they fall in the area of anticipated impacts.

Each class is defined briefly, as follows:

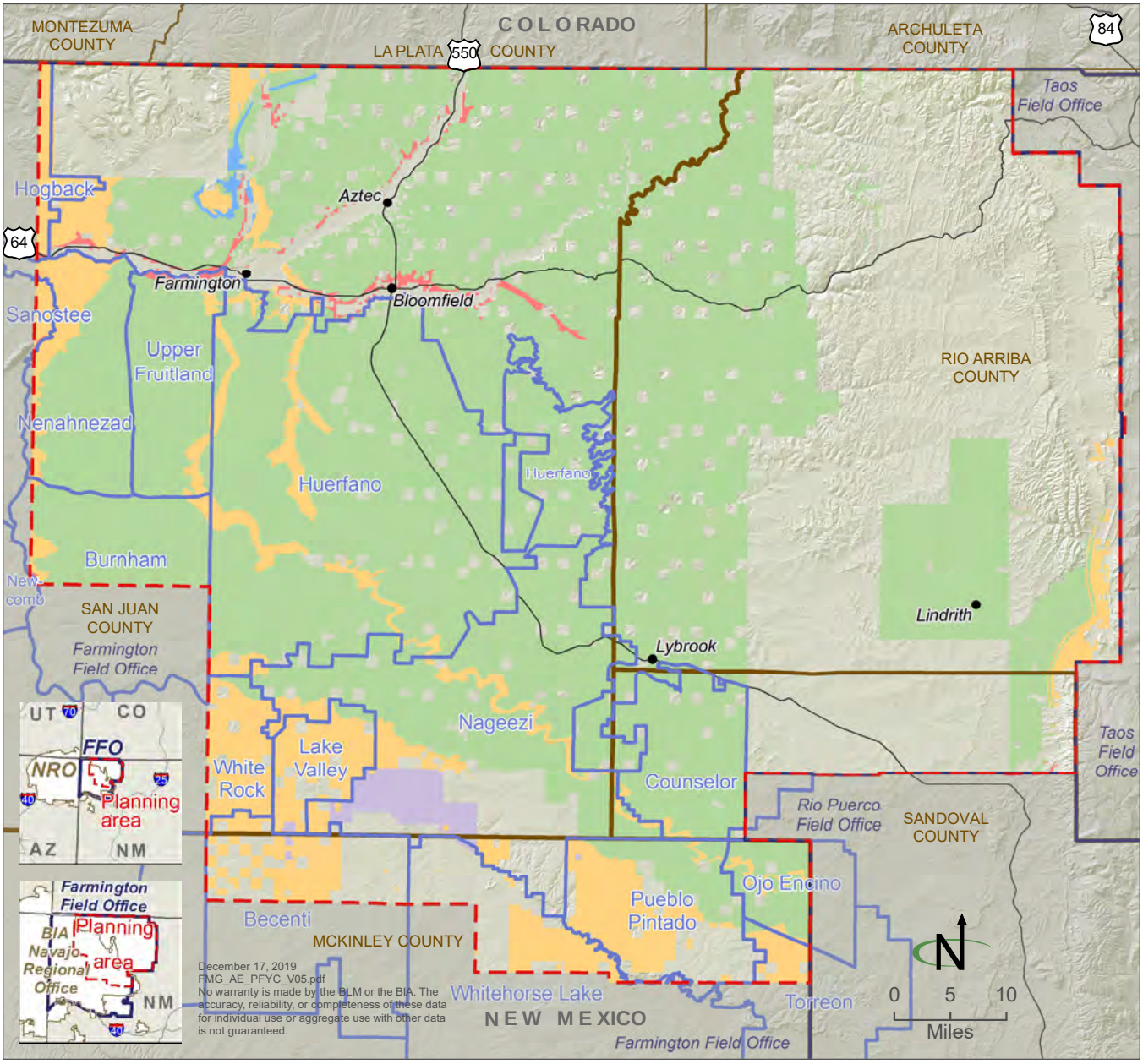
- U, unknown potential—Geologic units whose paleontological resource potential is unknown
- Class 1, very low potential—Geologic units that are not likely to contain recognizable paleontological resources
- Class 2, low potential—Geologic units that are not likely to contain paleontological resources
- Class 3, moderate potential—Sedimentary geologic units, where fossil content varies in significance, abundance, and predictable occurrence
- Class 4, high potential—Geologic units that are known to contain a high occurrence of paleontological resources
- Class 5, very high potential—Highly fossiliferous geologic units that consistently and predictably produce significant paleontological resources

Most fossils occur in sedimentary rock units, where they may be distributed extensively, both vertically and horizontally, throughout the geologic unit, or they may occur in discontinuous pockets. Few geologic units are uniformly rich in fossils throughout, and some are richer in fossils than others. Experienced paleontologists can predict which geologic units will contain fossils and, in general, what types of fossils will be found, based on the age of the formation and its depositional environment; however, predicting the exact location where fossils will be found without field surveys is not possible.

Most of the planning area lands are in the San Juan Basin. In the decision area, Potential Fossil Yield Classification (PFYC) Class 2 (low potential) makes up approximately 22,000 acres and Class 3 (moderate potential) geologic formations account for approximately 389,300 acres on federal mineral estate (see **Figure AE-16**, Potential Fossil Yield Classification). PFYC Class 4 (high potential) formations are found on only 7,400 acres of the decision area. There are 2,181,100 acres of PFYC Class 5 (very high potential) identified for the decision area (BLM GIS 2017).

Sensitive units for paleontological resources are Late Cretaceous and Early Paleocene formations in the planning area. These formations also contain the source rocks and natural reservoirs for oil and gas resulting from the slow decomposition of plant and animal material. Late Cretaceous rocks exposed in the San Juan Basin are the Mancos Shale, Gallup Sandstone, Mesaverde Group, Lewis Shale, Pictured Cliffs Formation, Fruitland Formation, and Kirtland Shale (**Figure AE-6**, Stratigraphic Cross Section of the San Juan Basin Highlighting Depositional Facies and Units in the Lewis Shale Total Petroleum System*, for a graphical representation of these formations). These units preserve two major transgressions, followed by regressions, with the Pictured Cliff Sandstone representing the final rock unit deposited in marine conditions in the San Juan Basin. Early Paleogene units are the Ojo Alamo Formation, Animas Formation, Nacimiento Formation, and San Jose Formation, deposited primarily in river environments. Abundant fossils are found in the San Juan Basin (Kues 2008; Lucas et al. 1981).

Figure AE-16
Potential Fossil Yield Classification



Source: BLM GIS 2020

- PFYC 5 — Very high fossil occurrence
- PFYC 4
- PFYC 3
- PFYC 2
- PFYC 1 — Very low potential for recognizable fossils

- Planning area
- National Park Service
- Field office boundary
- Navajo Nation Chapter

The Mancos Shale through Pictured Cliffs Formations are listed as PFYC 3. These rocks often represent marine depositional conditions and known occurrences of vertebrate fossils are sporadic. Known fossils are those of bivalves, ammonites, trace fossils, and rare fish and marine reptiles (Sealey and Lucas 1997; Lucas et al. 1988).

The Ojo Alamo Formation is also listed as PFYC 3. It is a non-marine unit containing intermittent fossils with low predictability, primarily containing petrified wood. Of note, a hadrosaurian femur was collected from the Ojo Alamo Formation. This has led to debate regarding the possibility of dinosaurs surviving the end-Cretaceous extinction event in the San Juan Basin (e.g., Fassett and Lucas 2000; Lucas et al. 2009).

The Fruitland Formation and Kirtland Shale are the final two rocks deposited in the San Juan Basin during the Cretaceous. Both are PFYC 5, due to high concentrations of vertebrate fossil localities known in the basin, especially in the Bisti/De-na-zin Wilderness Area and Ah-shi-sle-pah Wilderness Area.

Invertebrate fossils are those of insects, gastropods, bivalves, crustaceans, and bryozoans (Wolberg et al., 1988). Vertebrate fossils are diverse in these two formations. Examples are bony fish, sharks and rays, lizards, snakes, frogs, salamanders, turtles, crocodiles, dinosaurs, and mammals. Additionally, dinosaur skin impressions, coprolites,[10] and tracks are known from these rocks (Hall et al. 1988). Plant fossils are those of logs, stumps, leaves, and palm fronds (Hunt and Lucas, 1992).

The Animas Formation is primarily Paleocene, though the bottom is Late Cretaceous. In FFO-administered lands, the Animas Formation outcrops only along the La Plata River valley and at the base of Pinyon Mesa in the northwest part of the San Juan Basin. It grades laterally with the Nacimiento Formation. (Craigg 2001). While it is listed as PFYC 4, no fossil localities have been recorded from this formation in the San Juan Basin.

The early Paleogene Nacimiento and San Jose Formations are PFYC 5, due to high occurrences of vertebrate fossils, such as those of bony fish, rays, salamanders, frogs, lizards, snakes, turtles, crocodiles, champsosaurs,[11] birds, and abundant mammals (Lucas and Williamson 1992; Williamson and Lucas 1992; Williamson 1996). Vertebrates from the Nacimiento Formation in the San Juan Basin form the basis for the Puercan and Torrejonian North American land mammal ages (Archibald et al. 1987). Invertebrate fossils include gastropods, and many stumps, logs, and leaves are found in these rock units.

Key features in the San Juan Basin are extensive badlands and abundant canyon walls and cliff faces with widespread exposures of fossil-bearing late Cretaceous and Paleogene sandstones and mudrocks. Vertebrate fossils are most commonly preserved in mudrocks and are therefore particularly sensitive, especially where exposed in badlands topography. Mudrock beds are present in all of the vertebrate fossil-bearing units in the San Juan Basin and are closely tied to PFYC 4 and 5.

The BLM has identified several paleontological areas as being especially sensitive for paleontological resources (**Table AE-27**, BLM-Designated Paleontological Areas Identified for Management). The BIA or the Navajo Nation do not have any SDAs for paleontology.

In the FFO, the BLM manages nine fossil areas as SDAs to protect and provide scientific study and public interpretation of animal and plant fossils, palynomorphs,[12] petrified wood, and trace fossils in rocks spanning multiple geologic periods.

[10] Fossilized dung
[11] Reptile similar to a crocodile
[12] A microscopic fossil composed especially of pollen or spores.

Table AE-27
BLM-Designated Paleontological Areas Identified for Management

Locality Name	Size (Acres)	Environmental Education/Scientific Research	Surface Geology
Ah-shi-sle-pah	6,560	Wilderness Study Area	Kirtland, Fruitland Formations
Betonnie Tsosie	8,070	Fossil area	Nacimiento Formation
Bisti/De-na-zin Wilderness	39,960	Wilderness area	Kirtland, Fruitland Formations
Bohanon Canyon Complex	12,530	Fossil area	Nacimiento Formation
Carson Fossil Pocket	960	Fossil area	Nacimiento Formation
Fossil Forest	2,800	Research Natural Area	Kirtland, Fruitland Formations
Gobernador and Cereza	17,900	Fossil area	San Jose Formation
Kutz Canyon Paleontological Area	47,700	Fossil area	Nacimiento Formation
Lybrook Fossil Area	19,850	Fossil area	Nacimiento, San Jose Formations

Source: BLM 2008

Trends

Researchers and academics have visited and continue to visit the fossil-rich formations found in the planning area. There are currently permitted paleontological studies of fossils found from the Fruitland Formation and Kirtland Shale in the Ah-shi-sle-pah Wilderness Area and Bisti/De-na-zin Wilderness Area. Fossils in these areas and in the San Juan Basin record the end-Cretaceous extinction event.

Additionally, there has been significant recent activity toward the southern end of the San Juan Basin, related to exploration of the Mancos Shale for hydrocarbons. The Paleocene Nacimiento Formation is exposed at the surface in the areas where most of this work is occurring. The resulting paleontological surveys and monitoring have led to an increased knowledge of fossil distribution, particularly those beds in the formation that have an especially high concentration of fossils. Fossils are provided extra protection early in new project planning, as fossil-bearing beds are mapped along their trend and are avoided.

AE.2.11 Visual Resources

Visual resources are comprised of landform, vegetation, water, color, influence of adjacent scenery, scarcity, and cultural modifications. These features contribute to the landscape's scenic or visual quality and appeal (BLM 1984).

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, such as personal experience, time of day, and weather or seasonal conditions (BLM 1984). Yet researchers have found consistent levels of agreement among individuals asked to evaluate visual quality (BLM 1984).

The BLM visual resource management (VRM) system is a way to identify and evaluate visual resources to determine appropriate levels of management. Specifically, the BLM uses the VRM system to identify and map essential landscape settings to meet public preferences and recreation experiences. The system helps to ensure that actions taken on BLM-managed lands today will benefit the visual qualities associated with the landscapes, while protecting these visual resources for years to come. (The BIA does not have a VRM system, nor does it maintain a visual resources inventory.)

VRM classes are established through the RMP process for all BLM-managed lands. The BLM VRM system begins with a visual resource inventory (VRI), which guides the establishment of VRM classes through the

RMP process. Project proposals are analyzed using a visual contrast rating in order to achieve the goals of the VRM classes.

The VRI involves identifying the visual resources of an area and assigning them to inventory classes. The BLM's VRI process involves rating the visual appeal of a tract of land (scenic quality), measuring public concern for scenic quality (visual sensitivity), and determining the relative visibility of the tract of land from travel routes or observation points (distance zone). This process is described in detail in BLM Handbook H-8410-1, Visual Resource Inventory (BLM 1986a).

Based on these three inventory components, lands are placed into one of four VRI classes, which provide the basis for considering visual values during the RMP process. They do not establish management direction and are not used for constraining or limiting surface-disturbing activities; instead they are considered a baseline for existing conditions.

Project proposals are analyzed with the visual resource contrast rating form, using the VRM classes established in the RMP. The visual resource contrast rating process is used to resolve visual impacts. The process compares the project features with the landscape features, using basic elements of form, line, color, and texture. It is described in detail in BLM Handbook H-8431-1, Visual Resource Contrast Rating (BLM 1986b).

Current Conditions

The landscape in the San Juan Basin is diverse, exhibiting many distinctive features and landforms found in arid regions where water and wind erosion have sculpted the land. It is an area of plateaus and broad valleys. Distinctive features are steep and colorful escarpments, broad vistas, rugged canyons, and pastel-colored badlands, dissected into plateaus and pinnacles. Sagebrush and grassland expanses are prominent in the central and southern portion of the FFO. Pinyon-juniper woodlands, rivers, and human-made structures, such as reservoirs, roads, and oil and gas wells, dominate the northern portion. Sightseeing is popular in the region, where scenic vistas are frequent along highways, high places, and riverfronts. The VRI is used to describe the current condition of visual resources.

Visual Resource Inventory

A VRI of the BLM planning area was completed in 2009 (Otak 2009), using the guidelines in Handbook H-8410-1 (BLM 1986a). The VRI class distribution for the FFO is presented in **Table AE-28**, below.

Visual Resource Management

Neither the BIA nor Navajo Nation have established methods for the inventory of visual resources on Tribal lands; therefore, these agencies have not assigned VRM classes for the Tribal lands they administer.

Based on the 2009 VRI (Otak 2009), the BLM updated its VRM in 2013 (BLM 2014d). The designation of VRM classes is ultimately based on management decisions made during the BLM RMP or RMPA process, which must take into consideration the value of visual resources. During the process, inventory class boundaries can be adjusted as necessary to reflect these resource allocation decisions. The goal of VRM is to minimize the visual impacts of all surface-disturbing activities, regardless of the class to which an area is assigned.

The objectives for each of the four VRM classes are as follows:

- Class I—To preserve the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.

Table AE-28
BLM Visual Resource Inventory Component Distribution

Visual Resource Inventory Component	Acres	Percentage of BLM Decision Area
Scenic Quality		
A	35,800	3
B	322,400	24
C	909,400	69
Not Rated	48,000	4
Sensitivity		
High	165,000	13
Medium	628,000	48
Low	522,400	40
Not Rated	300	<1
Distance Zones		
Foreground/middle ground	1,267,600	96
Background	0	0
Seldom seen	0	0
Not Rated	48,000	4
VRI Class		
Class I	47,800	4
Class II	89,200	7
Class III	299,600	23
Class IV	878,700	67
Not Rated	300	<1

Sources: BLM GIS 2017; Otak 2009
Note: The total acreage of VRI calculations (1,315,600 acres) is less than that of BLM surface ownership (1,316,200 acres), because the base VRI data were produced using an outdated surface ownership dataset.

- Class II—To retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.
- Class III—To partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.
- Class IV—To provide for management activities that require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention; however, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and basic element repetition.

The VRM objectives are established in conformance with land use allocations made in the RMP. The VRM objectives are specific to the area and provide visual standards for planning, designing, and evaluating proposed development projects. Proper implementation of VRM helps prevent environmental degradation and maintains important resource values (BLM 1984).

As part of an environmental assessment that was prepared as part of the RMPA to the 2003 RMP (BLM 2003), in 2014 the BLM-designated VRM classes for the FFO (BLM 2014d). **Table AE-29**, below, shows these classifications.

Table AE-29
Visual Resource Management Classes for the BLM Decision Area

VRM Class	Acres	Percentage of BLM Decision Area
Class I	51,400	4
Class II	90,700	7
Class III	473,600	36
Class IV	690,500	52

Source: BLM GIS 2017
Note: The total acreage of VRM calculations (1,306,200 acres) is less than the BLM surface ownership (1,316,200) because the base VRM data were produced using an outdated surface ownership dataset, prior to the BLM acquiring surface ownership near the Bisti/De-Na-Zin Wilderness.

VRM Class I areas are designated wilderness, WSAs, and selected ACECs. VRM Class II areas are ACECs and the foreground/middle ground surrounding CCNHP. VRM Class III areas are ACECs, special recreation management areas (SRMAs), and the background of CCNHP. VRM Class IV areas are the Bohanon Canyon Fossil Complex, Dunes Vehicle SRMA, and Head Canyon Motocross Track SRMA. Complete details of areas in each class can be found in the Decision Record for the Farmington Field Office, Visual Resource Management RMPA (BLM 2014d).

The only VRM allocations being made in the FMG RMPA/EIS are for BLM-managed lands with wilderness characteristics. **Table AE-30**, below, describes the current VRM classes of these lands.

Table AE-30
Visual Resource Management Classes of Lands with Wilderness Characteristics on BLM-Managed Lands

VRM Class	Acres
Class I	2,800
Class II	10,400
Class III	3,700
Class IV	7,600

Source: BLM GIS 2017

Key Features

There are 9 areas designated as VRM Class I in the planning area, as follows:

- Ah-shi-sle-pah Wilderness Area
- Bis Sa'ani ACEC
- Bisti/De-na-zin Wilderness Area
- Fossil Forest Research Natural Area (RNA)
- Halfway House ACEC
- Morris 41 ACEC
- Pierre's Site ACEC
- Twin Angels ACEC
- Upper Kin Klizhin ACEC

VRI Class I areas with high intrinsic scenic value and visual sensitivity in the FFO are the Bisti/De-na-zin Wilderness Area, Ah-shi-sle-pah Wilderness Area, and Fossil Forest RNA. Protecting vistas from outside influences in these areas is a concern. Also, the visual context is an important component of the cultural resource values of the Chacoan Outliers, Native American Use and Sacred Areas ACECs, and additional TCPs.

BIA sensitive areas include important cultural, archaeological, and wildlife areas, as well as TCPs. These areas are not defined with boundaries but are found throughout the planning area. The resources of interest in BIA sensitive areas are discussed generally in their specific resource sections (**Section AE.2.3**, Water Resources; **Section AE.2.7**, Wildlife; **Section AE.2.8**, Special Status Species; **Section AE.2.9**, Cultural Resources; **Section AE.2.10**, and Paleontological Resources). These sensitive areas also contribute to the visual landscape of the planning area.

Dark Night Skies

The preservation of dark night skies is an emerging issue relevant to BLM-managed lands. Dark night skies are important to many users of those lands. The Bisti/De-na-zin Wilderness in particular has become well known for its unique dark night sky enjoyment and photography opportunities. The NPS manages adjacent lands in the CCNHP within the Planning Area, and it is mandated to preserve, to the greatest extent possible, the natural lightscapes of the park. These are the natural resources and values that exist in the absence of human-caused light (BLM 2014d).

CCNHP representatives have expressed concerns about night sky conditions and impacts on the national park from development on BLM- and BIA-managed lands. The park has a night sky initiative that offers astronomy as part of its interpretive programs. These programs emphasize the practices of the Chacoan people a thousand years ago, as well as modern approaches to viewing the same night sky they viewed. In order to maintain the night sky in similar conditions it is important that the area remain in a remote environment with clear dark skies, free of light pollution. The park was certified as an International Dark Sky Park by the International Dark-Sky Association on August 19, 2013. It is the twelfth park to receive the designation worldwide and only the fourth unit of the US National Park System to receive the designation (NPS 2014).

Dark skies are culturally important to Tribes in the planning area. The Navajo Nation use the word yádiłhił for the universe, cosmos, or outer space; it represents the duality of the earth and sky to the Navajo Nation. The ability to see constellations, as well as negative space between stars, is important to Navajo culture. Dark skies are also important for prayers and ceremonies, such as Holy Ways. Examples are the Night Way Ceremony (Tł'ééjí hataál), Blessing Way, Mountain Top Way, Shooting Way, Beauty Way, Evil Way, and Windways. It also fits into non-Holy Way ceremonies such as the Enemy Way.

In addition, Yádiłhił is the traditional Navajo calendar, which identifies the cycle of the Navajo seasons of fall, winter, spring, and summer. It also gives Navajos a map of when certain activities can be done by tracking the constellations in the dark skies.

Trends

The visual landscape in most of the planning area has been considerably modified, due to the proliferation of gas wells, pipelines, and access roads. The visual character of areas with substantial oil and gas development has progressively changed over the last several decades. These activities disturb the surface, which removes or disturbs the top layers of soil or vegetation to reveal colors that contrast with the surrounding landscape.

Infrastructure associated with this development, such as utility lines, roads, and mineral resource extraction structures, add cultural modifications to the landscape and create disturbances that change the vegetation pattern, the texture of the landscape, and the colors of the area. Flaring and artificial lighting associated with oil and gas and other development has decreased night sky visibility. These impacts are expected to continue as development in the planning area continues.

AE.2.12 Noise Resources

The information in this section is for both BLM- and BIA-managed lands. Where available, BLM- or BIA-specific information is also identified. Any ITAs involving noise resources would be discussed under **Section AE.5.1**, Native American Tribal Interests and Uses.

Current Conditions

Noise is defined as unwanted sound that can be intermittent or continuous, steady or impulsive. Human response to noise varies according to the type of noise source, the sensitivity and expectations of the receptor, the time of day, and the distance between the noise source and the receptor. Exposure to loud noise can cause hearing loss; however, the primary human response to noise is annoyance.

The decibel is the unit of measurement used for sound pressure levels. The most common method for describing noise levels is the long-term equivalent A-weighted decibel (dBA) sound level. **Table AE-31**, below, describes typical noise levels and general human responses to those sounds.

Table AE-31
Characterization and dBA of Common Sounds

Characterization	dBA[1]	Example Noise Condition or Event
Painful and dangerous	140	Fireworks
	130	Ambulance; jackhammer
Uncomfortable	120	Jet engine at take off
Very loud	110	Concert or sporting event; car horn
	100	Snowmobile
	90	Power lawnmower or power tool
	89	Oil and gas compressor facility
	83	Oil and gas well drilling
	82	Oil and gas pump jack operation
	80	Alarm clock
	71	Oil and gas water injection facility
	70	Automobile traffic
Moderately noisy	60	Normal conversation
	50	Moderate rainfall
	40	Quiet library
Soft	30	Whisper
Faint	20	Leaves rustling
Threshold of hearing	0-10	Audiometric testing booth

Sources: American Academy of Audiology 2010; BLM 2003

[1]Sound levels are based on highest measured sound levels and are normalized to a distance of 50 feet from the noise source.

In general, the intensity of noise dissipates as it travels away from the source, resulting in a decrease in loudness. If unobstructed, such as by topography or vegetation, a doubling of distance from the noise source results in an approximately 6-decibel reduction in sound pressure level (La Plata County 2002).

Terrain can create lower or higher noise levels in certain areas. Vertical relief, such as hillsides or canyon walls, can attenuate noise but can also reflect sound and create an echo effect. Generally, for every 3.5 feet of vertical relief above the line of sight from a noise source, there will be a 1.5 dBA noise reduction (La Plata County 2002). Valleys channel sound and maintain higher noise levels at greater distances from the noise source.

Vegetation typically attenuates sound moving outward from a noise source. The planning area's dry climate limits vegetation growth, which allows for greater noise dispersion, compared with areas with taller and denser vegetation.

Local weather conditions also contribute to ambient noise conditions and influence noise dispersion. Ambient noise during fair weather is lower than during windy or rainy conditions. Wind is the most frequent source of weather-related noise. During times of stronger winds, the noise created can drown out other sounds.

Where there are such structures as oil and gas drilling and pumping equipment, transmission lines, and communication towers, wind often generates aeolian noise,[13] which is the result of wind blowing through the structures. Aeolian noise levels fluctuate, due to the combination of such variables as wind speed, direction, and structure type and design. Wind also carries noise, especially when channeled by existing terrain. The macro- and micro-climate conditions that produce wind also influence the direction, intensity, and duration of noise propagation from a given noise source.

The noise sources in the planning area primarily are oil and gas operations, urban areas, transportation routes, access roads, and aircraft. Outside the urban areas of Farmington, Aztec, and Bloomfield, the primary source of human noise is oil and gas activity. Other noise sources in the planning area are sporadic and localized, for example airplanes passing overhead.

During construction of oil and gas well pads, maximum cumulative noise levels from heavy equipment can reach 85 dBA at 50 feet, decreasing to 55 dBA at 1,500 feet from the pad. During drilling, noise levels can exceed 70 dBA at 200 feet, decreasing to approximately 64 dBA at 500 feet, 60 dBA at 1,000 feet, and 50 dBA at 3,000 feet. The maximum noise levels from pumping are typically less than 70 dBA at 50 feet, less than 50 dBA at 500 feet, and approximately 40 dBA at 1,000 feet (La Plata County 2002). Noise produced during operation is mostly from compressors. Exact noise levels at a given distance and time depend on the types of equipment, terrain features, and weather.

Where oil and gas operations and other human-caused noise sources are absent, typical ambient noise levels are 40 dBA during the day and 30 dBA at night (BLM 2009).

Current BLM noise guidance (FFO Noise Notice to Lessees [NTL] 04-2 FFO) defines noise-sensitive areas (NSAs) and establishes the threshold for continuous noise at NSA receptors and boundaries. At these locations, the sound level must be less than or equal to 48.6 dBA over a continuous 24-hour period (dBA Leq). This standard applies to oil and gas lease operators who intend to operate for more than a week and more than 8 hours a day.

The BIA does not have similar guidance for noise associated with oil and gas development.

NSA receptors are locations where noise would be most likely to disrupt normal activities or to create the greatest potential for annoyance. Receptors on BLM-managed lands in the planning area are visitor use areas, camping and picnic areas, and recreation trails. Cultural areas, such as TCPs and NHPs, as well as habitat for sensitive species can also be considered sensitive noise receptors. NSA receptors can be a single point, such as a picnic area, or several acres, such as habitat for a sensitive species or wilderness areas.

Other NSA receptors in the planning area, including on Tribal trust and allotted lands but not on BLM-managed lands, are residences, places of worship, hospitals, and schools. Local government land use ordinances or Tribal land use planning standards for residential and commercial development typically include noise standards. In the absence of local policies, the BLM would enforce the maximum 48.6 dBA Leq standard at these receptor locations. In addition, COAs that could be applied to address this issue are identified in this RMPA/EIS (see **Appendix C**, Section C.1.3).

[13] Sighing or moaning sound

No similar policy standard exists for the BIA.

The FFO Noise NTL also identifies boundary-focused NSAs, which include the Bisti/De-na-zin Wilderness Area and Ah-shi-sle-pah Wilderness Area. The maximum noise level permitted at the boundary of these areas is 48.6 dBA Leq.

The BLM's NTL allows for more stringent standards, depending on the site-specific factors of topography, resource values and uses, and the potential impact of noise on existing resources and uses. The BLM considers these factors on a case-by-case basis during the implementation phase, for example when reviewing a proposed oil and gas APD. The BIA may consider similar standards, as applicable, to avoid excessive noise on adjacent receptors.

Trends

Overall noise trends in the planning area are expected to resemble baseline conditions; however, there will be localized noise level increases as more oil and gas wells are developed.

AE.2.13 Lands with Wilderness Characteristics

Lands with wilderness characteristics apply only to BLM-managed lands; this is because the Navajo Nation and BIA have no comparable direction. See **Section 3.3.8**, Special Status Species, for a discussion of impacts on Navajo Nation sensitive areas.

Current Conditions

Section 603 of FLPMA directed the BLM to inventory all public lands under its jurisdiction for the presence of wilderness characteristics, as specified in Section 2(c) of the 1964 Wilderness Act (16 USC, Section 1131). This one-time process led to the identification of WSAs that are under non-discretionary protective management until Congress designates them as wilderness or releases them for other uses. Although the BLM no longer has the authority to establish WSAs, the bureau has the authority and obligation to maintain an inventory of all resource values including wilderness characteristics under Section 201 of FLPMA and consider management/protection of these resources through the RMP process under Section 202 of FLPMA. In 1979, the BLM completed a wilderness inventory of New Mexico, including the decision area. The current inventory is the first major update since the original inventory was completed. Through the RMP process, various alternatives are considered to protect all or portions of the units containing wilderness characteristics, or to manage them for other uses and resource values.

BLM Manual 6310—Conducting Wilderness Characteristics Inventory on BLM Lands (BLM 2012a) provides policy and guidance for conducting wilderness characteristic inventories under Section 201 of FLPMA for areas not already designated as wilderness or WSAs.

BLM-managed lands are assessed for wilderness characteristics on a continuing basis using the following criteria:

- Size—A parcel inventoried for lands with wilderness characteristics must be a roadless area, with over 5,000 acres of contiguous BLM-managed lands. This acreage determination does not include state or private lands in the parcel. Some exceptions apply, as described in BLM Manual 6310 (BLM 2012a).
- Naturalness—Lands and resources exhibit a high degree of naturalness, are affected primarily by the forces of nature, and are where the imprint of human activity is substantially unnoticeable.
- Outstanding opportunities for solitude—The ability for visitors to have outstanding opportunities for solitude is affected by the sights, sounds, and evidence of other people. Outstanding opportunities for solitude exist when these impacts are rare or infrequent and where visitors can be isolated, alone, or secluded from others.

- Outstanding opportunities for primitive and unconfined types of recreation—Visitors may have outstanding opportunities for primitive and unconfined types of recreation where the use of the area is through nonmotorized, non-mechanical means and where there are no or only minimal developed recreation facilities.
- Supplemental values—Although not necessary for an area to contain wilderness characteristics, when an area's wilderness inventory is being updated, if the following features are found they will be noted: ecological, geological, or other features of scientific, educational, scenic, or historical values that may enhance the characteristics of the area.

BLM Manual 6320 (BLM 2012b) provides further guidance for managing these areas in accordance with the multiple-use mandate required by the FLPMA.

Previous planning documents in the FFO did not provide management decisions for lands with wilderness characteristics outside existing WSAs. This is because no new areas containing lands with wilderness characteristics were identified during project evaluations. The BLM began updating the inventory of lands with wilderness characteristics throughout the FFO, in conjunction with this plan amendment. As part of the update, the BLM reviewed proposals for lands with wilderness characteristics submitted by the New Mexico Wilderness Alliance.

In the inventory update, the BLM reassessed all existing units established in 1986. They included a new route and ROW analysis, GIS and field review, and a current analysis to correct and adjust the original unit boundaries. The inventory also identified roadless units that do not meet the minimum 5,000-acre requirement, which can be eliminated from further consideration. Of the remaining units that met the minimum size requirement, the BLM reviewed the human-caused impacts or disturbances that impair wilderness characteristics. The BLM then determined the existence of naturalness and assessed areas for outstanding opportunities for solitude or primitive and unconfined recreation.

The route analysis and boundary adjustments have been completed, resulting in the identification of 25 inventoried units in the planning area. Six of these units were eliminated from further consideration for failing to meet the minimum size requirements. The remaining 19 units were then further evaluated, according to the guidelines established in Manual 6310, resulting in 4 units being identified to meet the inventory criteria as having wilderness characteristics.

Table AE-32, below, summarizes the inventoried units for wilderness characteristics. The BLM has developed a range of proposed management actions, or allocations, for these units, which are outlined in **Chapter 2** of the FMG RMPA/EIS, Alternatives. **Figure AE-17**, BLM Units Inventoried for Wilderness Characteristics, displays these inventoried units in the planning area.

The BLM developed the current assessment and analysis of lands with wilderness characteristics from the following sources:

- Notes and field data from the original and updated inventories conducted in the FFO
- Public input received during scoping that delineated tracts of BLM-managed lands that possess or lack wilderness characteristics
- The New Mexico Wilderness Alliance proposal for lands with wilderness characteristics, based on its application of BLM Manual 6310, Conducting Wilderness Characteristics Inventory on BLM Lands, and submitted to the FFO in May 2014
- Field review conducted by the BLM interdisciplinary team; this review included only BLM-managed lands and not lands within designated wilderness or WSAs.

Table AE-32
Units Inventoried for Wilderness Characteristics Outside Wilderness Study Areas

BLM Unit Identifier	Acres Inventoried[1]	Acres with Wilderness Characteristics	Acres without Wilderness Characteristics
NM-210-066	4,900	0	4,900
NM-210-067	20,900	0	20,900
NM-210-068	14,600	0	14,600
NM-210-069	5,900	5,900	0
NM-210-070	11,700	0	11,700
NM-210-071	15,000	0	15,000
NM-210-072	2,500	0	2,500
NM-210-073	7,300	0	7,300
NM-210-074	17,100	0	17,100
NM-210-075	8,300	8,300	0
NM-210-076[2]	700	700	0
NM-210-077	4,500	0	4,500
NM-210-078	6,100	0	6,100
NM-210-079	7,600	0	7,600
NM-210-080	5,400	0	5,400
NM-210-081	20,300	0	20,300
NM-210-082	10,100	10,100	0
NM-210-083	2,900	0	2,900
NM-210-084	4,200	0	4,200
NM-210-085	6,500	0	6,500
NM-210-086	18,300	0	18,300
NM-210-087	14,700	0	14,700
NM-210-088	6,500	0	6,500
NM-210-089	5,600	0	5,600
NM-210-090	3,900	0	3,900
Total	**225,500**	**25,000**	**200,500**

Source: BLM 2016b

[1]Acreages are rounded to the nearest 100 acres.

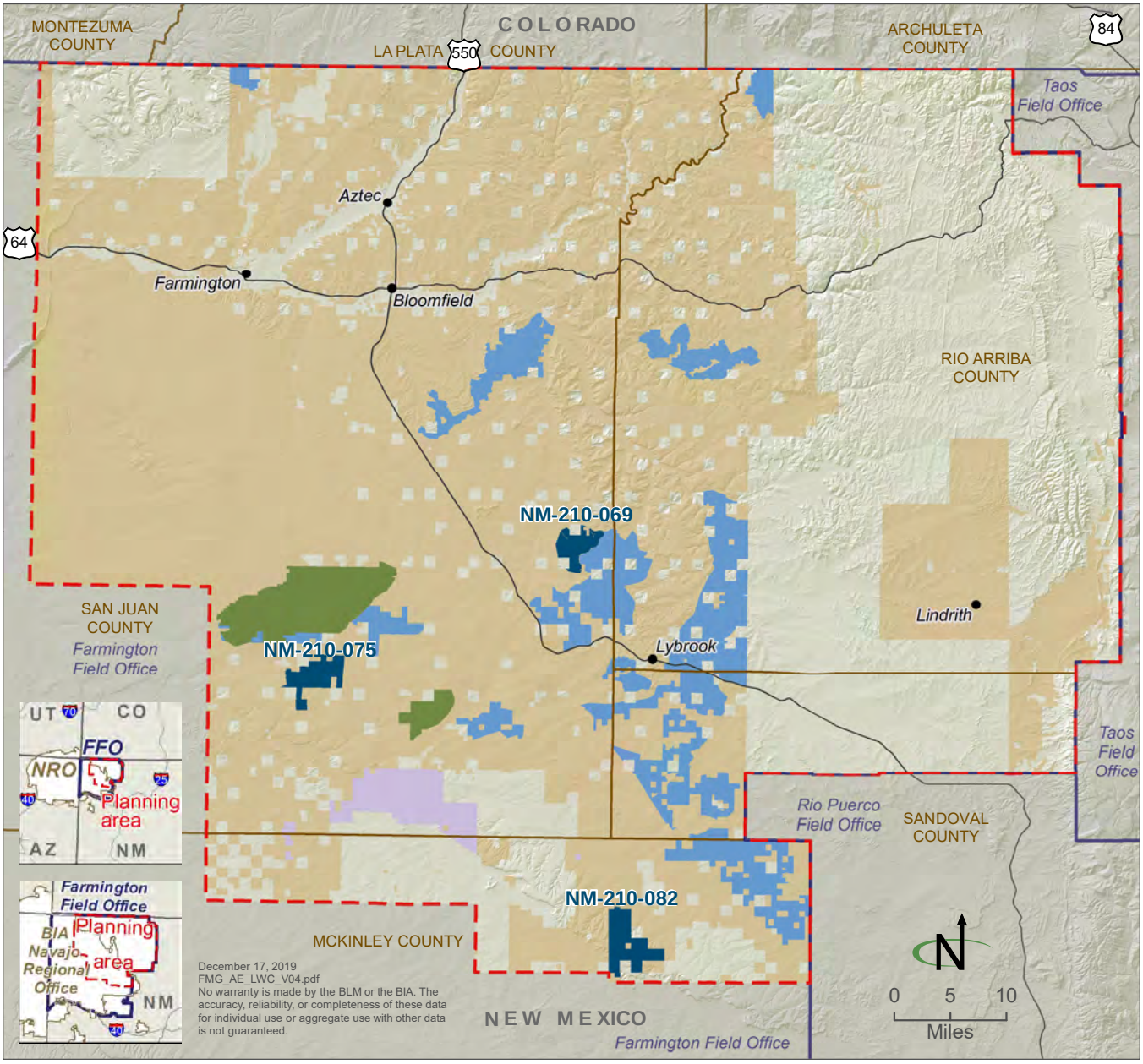
[2]This unit is now within the Ah-shi-sle-pah Wilderness Area, designated on March 12, 2019.

Trends

Current trend information on areas with wilderness characteristics indicates an overall decreasing quality of naturalness and opportunities for solitude and primitive, unconfined recreation. An increasing amount of oil and gas developments, agricultural infrastructure, recreation developments, routes and ROWs, and visitation may influence wilderness characteristics in the planning area over time. In particular, there is increasing regional interest for recreation in areas with wilderness characteristics.

Recreationists are expected to continue using areas with wilderness characteristics because of values such as primitive and unconfined recreation opportunities and outstanding opportunities for solitude.

Figure AE-17
BLM Units Inventoried for Wilderness Characteristics



Source: BLM GIS 2020

- Unit with wilderness characteristics
- Unit without wilderness characteristics
- Existing wilderness area
- BLM and BIA decision area
- Planning area
- National Park Service
- Field office boundary

AE.3 RESOURCE USES

AE.3.1 Livestock Grazing

BLM-Managed Livestock Grazing

The primary laws that govern grazing on public lands are the Taylor Grazing Act of 1934, FLPMA, the Public Rangelands Improvement Act of 1978, and Public land orders, other executive orders, and agreements that authorize the Secretary of the Interior to administer livestock grazing on specified lands under the Taylor Grazing Act or other authority as specified.

An allotment on public lands is a designated area or management unit that allows grazing. Under the Taylor Grazing Act, allotments can be permitted through Section 3 (permits issued on public lands within grazing districts established by the act) or Section 15 (grazing leases issued on public lands outside the grazing districts established by the act). Unique to the FFO and Rio Puerco Field Office, Section 3 Navajo free-use grazing permits are authorized under 43 CFR 4130.5, to individuals "whose products or work are used directly and exclusively by the applicant and his family." The permits are not transferrable. Free-use permits are primarily for subsistence grazing.

One permit or lease typically issued per allotment; however, for large Section 3 Navajo community allotments, there may be many authorizations. In addition, some authorizations are issued for estates, trusts, grazing associations, and partnerships.

To ensure long-term stability and use of BLM-managed lands by the livestock industry, FLPMA authorized 10-year grazing leases. BLM specific grazing management guidance is contained in 43 CFR, Part 4100, Grazing Administration, Exclusive of Alaska; 43 CFR, Part 4, Department Hearing and Appeals Procedures; 43 CFR, Part 1784, Advisory Committees; and BLM Handbooks 4100-4180 and Manual H-4120-1: Grazing Management.

The allowed use of grazing on each allotment is determined based on apportioned or allocated animal unit months (AUMs). An AUM is equal to the approximate amount of forage that one cow and calf or its equivalent would consume during a 30-day period. Permitted use is the forage allocated in an allotment under a lease and is expressed in AUMs.

The BLM, through the development of grazing regulations in 1995, was directed to develop state or regional standards for rangeland health and guidelines for livestock grazing management. The BLM developed standards and guidelines specific to New Mexico in 2001 (BLM 2001a). Through the permit renewal process, the BLM must meet or ensure progress is being made toward standards for each allotment.

Where permitted, range improvements may be implemented on grazing allotments to help achieve standards and manage livestock distribution. These can include structural improvements, such as fences and developed water sources, and nonstructural improvements, such as vegetation treatments.

BIA and Navajo Nation-Managed Livestock Grazing

The BIA Eastern Navajo Agency (ENA) manages permits under 25 CFR, Part 166, Grazing Permits and Navajo Nation Code (NNC), Title 3, Subsections 931–950 (off-reservation grazing).

All grazing use on range units is authorized by a grazing permit. Each permit includes a conservation plan developed with the permittee and approved before it is issued. These plans are consistent with the Tribe's agricultural resource management plan. They provide specific management objectives for grazing, including stipulations defining required uses, operations, and improvements.

Tribal ranch leases on Tribal fee lands are managed under NNC Title 3, subsection 503. For Navajo Nation Tribal ranch program leases, permit applications include a proposed ranch management plan, with

livestock management and range conservation plans. Lease agreements are for 10 years, with the option for renewal for another 10 years, with a recommendation from the Navajo Nation ranch program.

Current Conditions

BLM-Managed Livestock Grazing

As of 2014, there were 208 grazing allotments managed by the BLM (**Table AE-33**). Of the 208 grazing allotments, 143 are Section 3 allotments (permits) and 65 are Section 15 allotments (leases). Of the Section 15 allotments, 30 are in the Lindrith, New Mexico, area; the remaining 35 are in an area of complicated federal, Tribal, state, and private land status at the border of the Navajo Nation known as the Checkerboard.

To address complicated grazing administration issues in the area, the BLM, BIA, and Navajo Nation signed an MOU in 1965 for livestock grazing administration. The MOU was amended and extended in 2003 by all parties. It identifies 30 allotments permitted under Section 15 that are assigned administratively to the BIA ENA and Navajo Nation. There are another five Section 15 allotments that are not included in the MOU and are managed under the Navajo Nation Tribal Ranches program. The MOU also identifies six Section 3 allotments in the area that were assigned to BLM FFO management, three of which are very large Navajo community allotments (Kimbeto, Largo, and Counselor Communities). The remaining 137 Section 3 allotments are not covered under the MOU.

There are an additional 21 allotments that are in or overlap the FFO boundary that are managed by the BLM Rio Puerco Field Office through an interagency agreement. These are not tallied in the 208 allotments in the FFO.

Table AE-33
Livestock Grazing Summary for Allotments Managed by the FFO

Section and Allotment Type	Allotments	Authorizations	AUMs	Total Acres	BLM Acres
Section 3—Non-MOU (permits)	137	140	71,974	1,255,700	941,200
Section 3—MOU (permits)	6	171[3]	15,856[4]	274,600	153,500
Section 15—Non-MOU, Lindrith (leases)	30[1]	30	2,555	59,900	21,200
Section 15—Non-MOU-Tribal Ranches (leases)	5[2]	5	824	138,600	8,000
Section 15—MOU (leases)	30	30	27,953	1,392,100	270,900
Total	**208**	**376**	**119,162**	**3,120,900**	**1,394,800**

Source: BLM 2017a

[1] Managed by the ENA and Navajo Nation.

[2] Managed under the Navajo Nation tribal ranches program.

[3] 165 Authorizations are on 3 Navajo Community Allotments: Kimbeto, Largo, and Counselor.

[4] 9,228 AUMS are Navajo free-use permits on the 3 Navajo community allotments.

There are approximately 311 authorizations on the 143 Section 3 allotments and 65 authorizations on the 65 Section 15 allotments. The Navajo community allotments represent a large portion of the Section 3 allotments; Kimbeto Community has 69 authorizations, Counselor Community has 61, and Largo Community has 35. In addition, the 30 Section 15 authorizations issued to the Navajo Nation and administered by the BIA are leased out to approximately 277 individual Navajo operators.[14]

[14] Effie Delmar, BIA, ENA Natural Resource Manager, email with Jeff Tafoya, BLM, Rangeland Management Specialist, on March 20, 2013.

There are approximately 119,162 AUMs of grazing authorized by the FFO, 9,228 of which are Navajo free use. An additional 26,989 AUMs are currently in suspension. Grazing authorizations in the FFO primarily permit cattle and sheep grazing; a limited number permit some goats and occasionally horses for ranch use only. Allotments range in size from approximately 20 to over 100,000 acres. The grazing allotments in the planning area total over 3,120,900 acres, including approximately 1,394,800 acres on BLM-managed lands.

Grazing permits range from 1 sheep to over 300 cattle and over 3,500 sheep. Most allotments contain a combination of federal, state, and private land. Periods of livestock use vary by allotment, from year-round to seasonal. In addition to the authorized livestock grazing, the BLM is carrying forward management decisions from the 2003 RMP for wild and free roaming horses.

BIA- and Navajo Nation-Managed Livestock Grazing

In addition to allotments managed by the BLM, District 13 of the Northern Navajo Agency extends into the planning area. In this district, the BIA manages 210 Navajo grazing permits on Tribal trust lands. These permits include 10,505 sheep units year-long (SUYL) permitted, roughly equivalent to 2,101 AUMs (BIA 2017). The ENA manages approximately 189,400 acres of permitted grazing in five districts on Navajo Tribal trust Navajo Tribal trust and individual Indian allotment lands in the planning area, supporting around 1,637 AUMs (BIA 2018).

The most recent range inventory to determine carrying capacity was done in 2014, which showed the area examined to be approximately seven times over-allocated for livestock, based on the available forage. Carrying capacities were adjusted to available forage, based on the 2007 and 2013 range inventories.

The Navajo Nation also has a Tribal Ranch Program that administers grazing on Tribal fee lands for individual Indian allottees. In total, 150,400 acres are included in the planning area under the Tribal Ranch Program, supporting grazing for 250 allottees and providing forage for approximately 1,065 AUMs.

AE.3.2 Minerals

Minerals managed by the BLM are classified into two categories: fluid minerals and solid minerals.

Solid minerals are subdivided into locatable, leasable, and salable. Locatable minerals are valuable metallic or nonmetallic minerals, such as copper, gold, and uranium. (A section on solid minerals is not included as a stand-alone section because the scope of the FMG RMPA/EIS is such that no decisions are being made for solid minerals management.) There are no active locatable mineral mines in the BLM planning area. Future locatable mineral activity is not anticipated for the life of the RMP; therefore, locatable minerals are not discussed further in this EIS.

In the planning area, the minerals most commonly found are as follows:

- Leasable—oil and gas (including coal bed methane) and coal
- Salable—sand, gravel, sandstone, fill dirt, and humate

Current Conditions

Fluid Minerals: Oil and Gas

Hydrocarbon production in the planning area is primarily from natural gas, coal bed methane, and oil/condensate, all in the San Juan Basin. Oil-producing intervals include the Jurassic San Rafael Group, including the Entrada Sandstone; and the Cretaceous Gallup Sandstone and Tocito Sandstone "lentils" within the Mancos Shale. Gas is found in the Jurassic Burro Canyon Formation; the Cretaceous Mesaverde Group, Lewis Shale, Pictured Cliffs Sandstone, and Fruitland Formation; and the Tertiary Ojo Alamo Sandstone, Nacimiento Formation, Animas Formation, and San Jose Formation. Formations that are known to produce both oil and gas include the Jurassic Morrison Formation, including the Brushy Basin Member;

the Cretaceous Dakota Sandstone, and members of the Mancos Shale including the Graneros, Greenhorn Limestone, Juana Lopez, and El Vado Sandstone.

The 2019 Reasonably Foreseeable Development (RFD) Scenario for Oil and Gas Activities for the Mancos-Gallup RMPA Planning Area (**Appendix I**) describes historical production amounts and oil and gas activity levels in the San Juan Basin and the planning area. In general, most of the natural gas produced in New Mexico is from the planning area. Statewide natural gas production in 2016 was 1,278 BCF.

San Juan County is the second largest natural gas-producing county in the state, producing 249 BCF in 2016. Rio Arriba County is the fourth largest producing county, with 196 BCF in 2016. These two counties combined produced 46 percent of the total natural gas in New Mexico in 2016 (NMEMNRD 2016).

The planning area produces a smaller percentage of New Mexico's oil. Of a 2016 statewide total of 118 million barrels, San Juan and Rio Arriba Counties produced 2.4 and 1.3 million barrels. These two counties produced a combined total of 3 percent of statewide oil production in 2016 (NMEMNRD 2016).

Changes Since 2003

In the 2001 RFD, the BLM noted that most existing Mancos Shale and Gallup Sandstone reservoirs were approaching depletion, producing less than 30 barrels of oil per month per well. As a result, these reservoirs were considered marginally economic, and the wells were candidates to be plugged and abandoned in the near future; however, high oil prices greater than $100/barrel returned and persisted until late in 2014, so few marginal Gallup wells have been plugged and abandoned.

The 2001 RFD projected a minimal number of new completions in the Gallup/Mancos Formations; however, recent successes in the exploration and development for oil in US shale plays have resulted in a significant increase in domestic oil production. The Bakken in North Dakota, the Eagle Ford shale in Texas, and the Avalon/Bone Spring in southeast New Mexico are all examples of major shale plays contributing to the oil production increase. As a result, the Gallup/Mancos Formations have become major targets for future exploration and development.

Advances in technology have resulted in more industry interest in developing the formations using horizontal well development and stimulation techniques. These technological advances include improved reservoir characterization, leading to improvements in well placement and stimulation techniques.

A total of 37,307 wells have been drilled in the RMPA planning area through August 2017. Approximately 67 percent of these have been gas wells, while 6 percent were oil wells. Other well types include injection wells, abandoned wells, and others. Historically, the San Juan Basin has been dominated by vertical drilling for natural gas. Drilling for coalbed gas in the central basin took off in the late 1980s. Horizontal drilling in the planning area has occurred sporadically since 1980 but began to increase sharply as a share of overall drilling in the mid-2000s (**Appendix I**).

Of wells drilled in the past 10 years, approximately 77 percent were gas wells and 13 percent were oil wells. In 2014, drilling for oil (118 wells) surpassed drilling for gas (43 wells) for the first time. Horizontal drilling peaked in 2014, with 120 horizontal wells drilled (of which 102 were for oil). In 2017, horizontal drilling made up 77 percent of total development (**Appendix I**).

According to the BLM, as of November 2017, there have been approximately 291 total horizontal wells drilled and completed in the Mancos/Gallup Formations. There were 498 federal and 108 BIA APDs for a

total of 607 APDs between 2014 and 2017.[15] CBM production has decreased in share of gas production in the San Juan Basin from approximately 49.5% of gas production in 2006 to 41.0% in 2014 (Natural Gas Intel 2018).

Solid Minerals: Coal

The primary coal resources in the planning area are in the Fruitland and Menefee Formations.

Solid Minerals: Sand and Gravel

These make up most of the other minerals extracted in the planning area, though humate[16] mining also exists in the planning area. The sand and gravel are mostly on mesa tops that consist of remnants of the Quaternary stream-cut terrace. The rock and stone materials are fragments of the weathered Ojo Alamo Sandstone and Farmington Sandstone Member. The humate in the planning area is a thermally immature coal from the Fruitland Coal Formation.

BLM Mineral Decision Area

Fluid Minerals (Oil and Gas)

Approximately 107,800 acres are closed to fluid mineral development; an additional 82,700 acres are open to fluid mineral leasing with NSO stipulations (BLM GIS 2017; **Figures 2-9** and **2-14**). Surface occupancy and surface-disturbing activities associated with fluid mineral leasing cannot be conducted on the surface of these lands.

CSU stipulations are applied to all leases issued on 1,088,600 acres (BLM GIS 2017; **Figure 2-18**). These areas are open to fluid mineral leasing, but the stipulations allow the BLM to require special operational constraints.

TL stipulations are applied on 316,300 acres to protect big game winter range, bird of prey nests, elk calving areas, and other sensitive wildlife resources. The boundaries for each TL are determined either by SDA boundaries or site-specific surveys. These areas are open to fluid mineral leasing, but these stipulations allow the BLM to restrict development during certain times (BLM GIS 2017; **Figure 2-23**).

The remaining 775,100 acres of the BLM mineral decision area are open to fluid mineral leasing subject to standard lease terms and conditions (BLM GIS 2017).

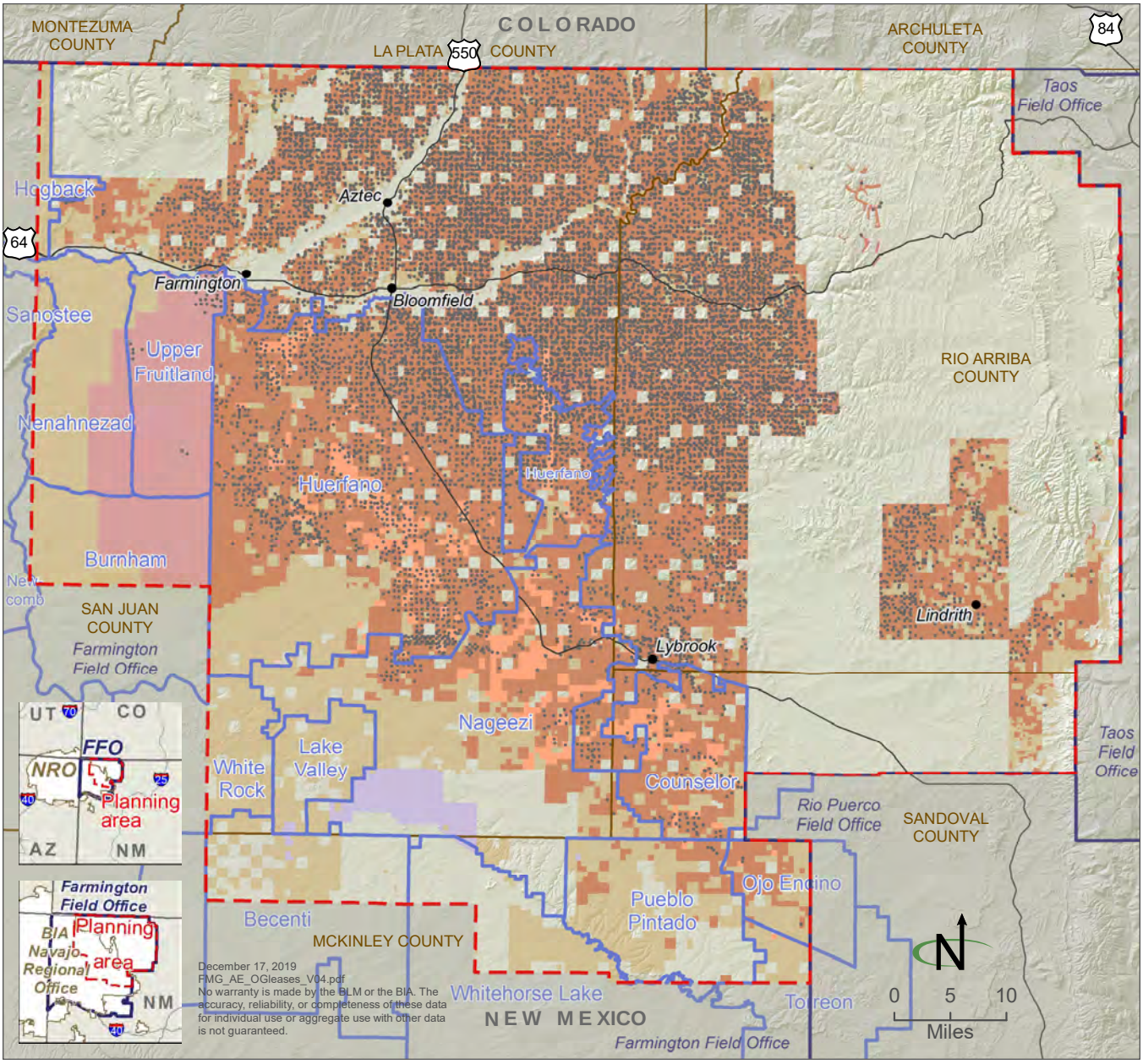
Significant leasing has taken place since the 2003 RMP (see **Figure 1-2**, Leased and Unleased Acreage in the BLM Mineral Decision Areas. Approximately 1.8 million acres are covered by 2,860 active leases. On BLM-managed minerals, 1.6 million acres (80 percent) are covered by 2,300 leases. This includes 190,000 acres of leases on BLM-managed minerals and Navajo Tribal trust surface. On BIA-managed minerals, 260,000 acres (44 percent) are covered by 560 leases (BLM GIS 2017; see **Figure AE-18**, Oil and Gas Leases). Most existing active leases have approved APDs (see **Figure 1-3**, Existing Oil and Gas Leases and Approved APDs).

Solid Minerals: Coal

In the mineral decision area, there are a total of 44,500 acres of active coal leases, and there are 33,600 acres of active coal leases on Navajo Tribal trust Lands (**Figure AE-19**, Coal). The San Juan underground coal mine is active in the northwest portion of the BLM mineral decision area and produces approximately 3.2 million tons annually. The surface operation of the San Juan coal mine is in reclamation. The La Plata

[15] Joe Hewitt, BLM FFO Geologist, comment to Francis Craig, EMPSi geological specialist, December 18, 2017.
[16] A thermally immature form of coal formed from decomposed prehistoric plant and animal matter and commonly used as fertilizer.

Figure AE-18
Oil and Gas Leases

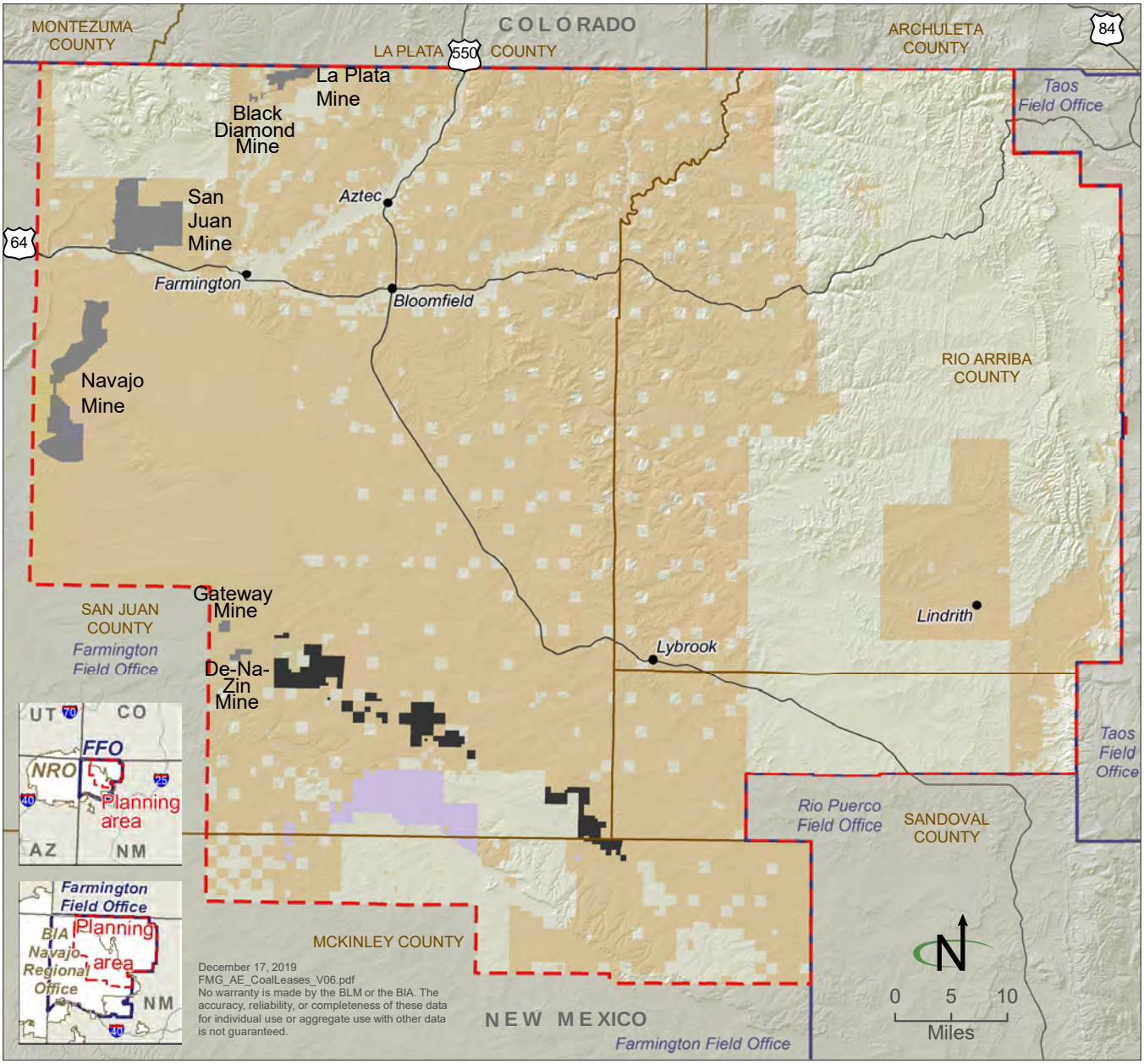


Source: BLM GIS 2020

- BLM lease
- Navajo allotment lease
- Navajo trust lease
- Production well
- BLM and BIA decision area unleased
- Planning area
- National Park Service
- Field office boundary
- Navajo Nation Chapter

Figure AE-19
Coal

Leasable minerals are those minerals or materials designated as leasable under the Mineral Leasing Act of 1920. Coal is currently the only solid leasable mineral developed in the planning area.



Source: BLM GIS 2020

- Coal permit boundary
- Preference right lease application
- BLM and BIA decision area
- Planning area
- National Park Service
- Field office boundary

coal mine was active in the BLM mineral decision area when the 2003 RMP was published, but the area has since been reclaimed. The surface Navajo Coal Mine is in the decision area, but it is on Tribal surface and Tribal minerals.

Salable Minerals: Sand and Gravel

There are 27 active permitted salable minerals operations in the BLM mineral decision area (**Table AE-34**, below, and **Figure AE-20**, BLM Salable Minerals and BIA Nonenergy Solid Minerals). In addition, quarry locations of fewer than the 5 acres associated with oil and gas well sites are used to supply gravel or sandstone to surface access roads. In addition to the permitted operations, the FFO is permitting eight pending salable mineral operations.

Table AE-34
Locations of Permitted Salable Mineral Operations in the Planning Area

Township	Range	Section	Material	Type of Permit
19 North	5 West	19, 30, 34	Humate	Commercial
19 North	5 West	2, 3, 5	Humate	Commercial
19 North	5 West	4	Humate	Commercial
19 North	6 West	10	Humate	Commercial
28 North	11 West	16	Sand and gravel	Free use
29 North	9 West	28	Sand and gravel	Free use
29 North	10 West	13	Sand and gravel	Free use
29 North	10 West	13	Sand and gravel	Free use
29 North	10 West	23	Sand and gravel	Commercial
29 North	11 West	16	Sand and gravel	Free use
29 North	11 West	19	Sand and gravel	Free use
29 North	11 West	31	Sand and gravel	Free use
29 North	12 West	12	Sand and gravel	Commercial
29 North	12 West	13	Sand and gravel	Free use
29 North	12 West	13	Sand and gravel	Commercial
29 North	12 West	13	Sand and gravel	Commercial
29 North	12 West	17	Sand and gravel	Commercial
29 North	12 West	23	Sand and gravel	Free use
29 North	13 West	20	Sand and gravel	Commercial
29 North	13 West	20	Sand and gravel	Free use
29 North	14 West	10	Sand and gravel	Commercial
29 North	14 West	10	Sand and gravel	Commercial
30 North	12 West	11	Sand and gravel	Free use
30 North	15 West	35	Sand and gravel	Commercial
31 North	10 West	19	Sand and gravel	Commercial
31 North	10 West	19	Sand and gravel	Commercial
31 North	10 West	30	Sand and gravel	Commercial

Source: BLM 2016b

BIA Mineral Decision Area

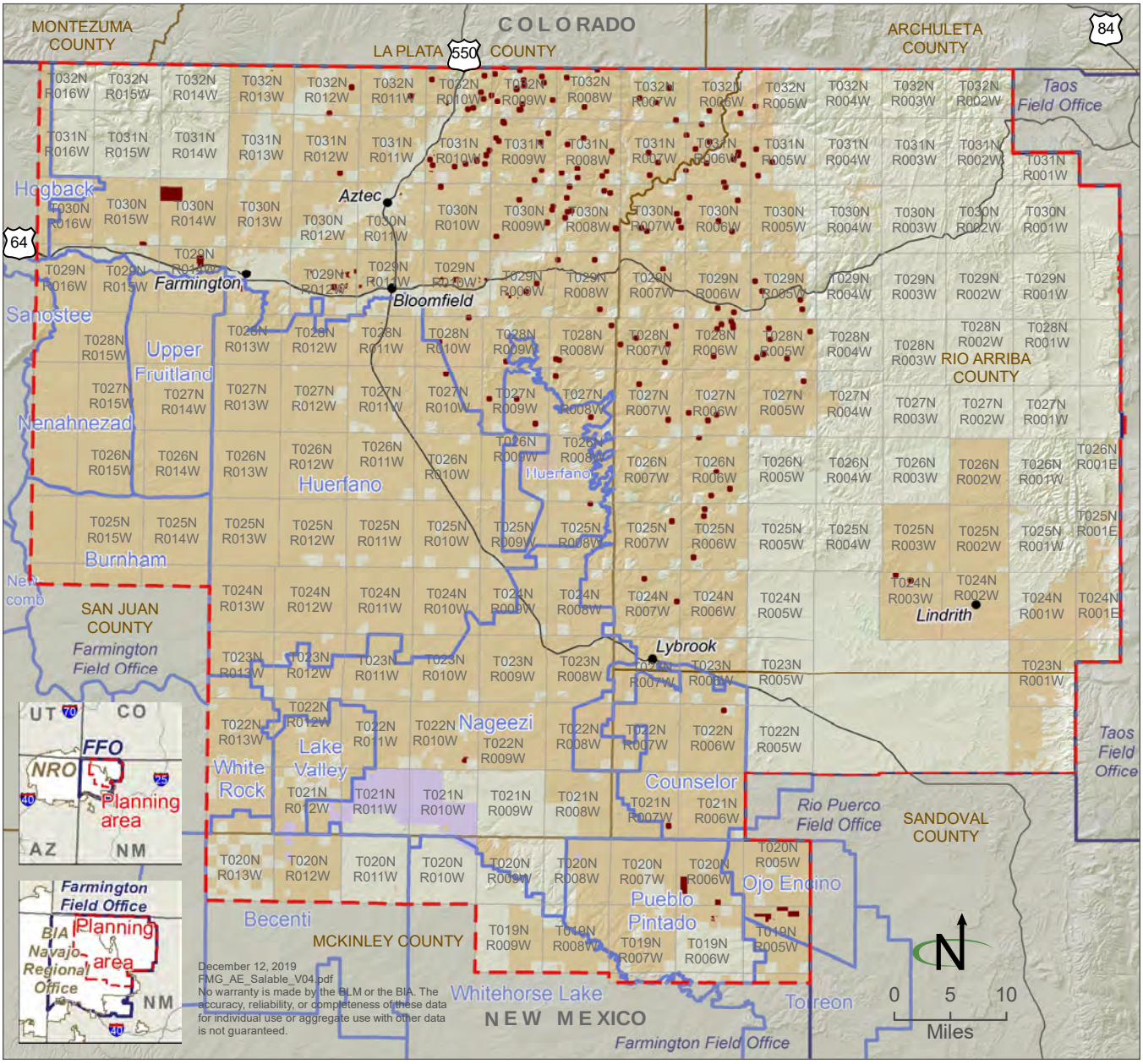
The BIA approves leases for fluid minerals (oil and gas), coal, and nonenergy solid minerals on Navajo Tribal trust minerals and individual Indian allotment minerals (**Section 1.1**, Introduction).

Fluid Minerals (Oil and Gas)

There are 12 oil and gas leases on Navajo Tribal trust minerals in the BIA mineral decision area and 551 leases on individual Indian allotment minerals. These leases cover 260,000 acres (44 percent) of the BIA mineral decision area. The Navajo Nation has not issued a lease on Navajo Tribal trust minerals since

Figure AE-20
BLM Salable Minerals and BIA Nonenergy Solid Minerals

Salable minerals include common varieties of mineral materials, such as soil, sand and gravel, stone, pumice, pumicite, and clay that can be acquired under the Materials Act of 1947, as amended.



Source: BLM GIS 2020

- Gravel or rock pit
- Rock pit
- BLM and BIA decision area
- Planning area
- National Park Service
- Field office boundary
- Navajo Nation Chapter

1975, and they do not expect to issue any new leases on Tribal trust minerals in the planning area in the 20-year planning horizon.[17]

Solid Minerals: Coal

There are 33,600 acres of coal leases in the BIA mineral decision area. Navajo Mine is a surface coal mine on Navajo Tribal trust minerals that supplies the Four Corners Power Plant (**Figure AE-19**, Coal). It is owned by the Navajo Nation and operated by Navajo Transitional Energy Company. In 2016, the mine produced 4.2 million tons of coal (Navajo-tec 2017).

Solid Minerals: Nonenergy Solid Minerals

Sand and gravel materials are extracted for construction and road building projects. The BIA issues sand and gravel leases on Navajo Tribal trust and individual Indian allotment minerals.

Trends

Fluid Minerals: Oil and Gas

While the shale in the Mancos Formation is similar to other productive shale plays in the United States, specific characteristics of the Mancos shale, such as clay content and total organic content, suggest that it may be less productive than other more developed shale plays (Engler et al. 2015). Current oil exploration and development in the Mancos/Gallup Formations is being appraised for the most productive areas. Natural gas production is much more consistent at this time; however, the southern portion of the planning area, near Lybrook and Cuba, contains remote areas that lack infrastructure, such as water, oil, and gas pipelines, power lines, and resource, local, and collector roads. These facilities are necessary to develop the Mancos/Gallup Formations in that area.

Additionally, natural gas production from the Mancos/Gallup Formations is unlikely to increase until the price of natural gas rises. Based on the Energy Information Administration (EIA) reference case, gas prices are forecast to be $4.38 per million BTUs in 2020 and $5.23 per million BTUs in 2025.[18] At a July 2014 presentation to the Legislative Finance Committee meeting, there was a proposed a break-even price of $4.25 per million British thermal units (BTUs) for the San Juan Basin; this is very close to the 2020 value predicted by EIA. As a result, gas development is not anticipated to increase in the Mancos Formation until 2020; however, once the economics become favorable, the activity is anticipated to rapidly increase (Engler et al. 2015). The production of coal bed methane gas in the planning area is also price dependent and is expected to closely track the trends of Mancos/Gallup gas production in the planning area.

Much of the current oil exploration is in this southern portion of the planning area. The lack of infrastructure will challenge oil and gas development in the short term and may limit the initial pace of new development in these formations. Exploratory units are generally poorly explored reservoirs where exceptions to normal spacing requirements are allowed for operators to have flexibility in locating wells in order to test the reservoir and maximize resource recovery. Exploratory units are being formed in this area, which should allow operators to realign the wellbores, thus drilling longer laterals in a perpendicular direction to the fracture gradient.

Checkerboard landownership[19] in the area of the Mancos/Gallup Formations, particularly in individual Indian allotment lands, is creating further difficulties for adding infrastructure and facilitating development. This is because it is more difficult to permit a road or pipeline that crosses both federal and individual Indian allotment land than it is to permit one that crosses only BLM-managed land. Permission for the road

[17] Zaman & Price, pers. comm., October 15, 2018.
[18] Annual average Henry Hub spot prices for natural gas in 2012 dollars.
[19] An area where adjacent parcels are owned by entities other than the federal government.

or pipeline must be granted by each party whose land would be crossed, and both BIA and BLM permits must be secured.

More information on the forecast for oil and gas activity in the planning area is available in the 2019 RFD (**Appendix I**); it identified areas with high, moderate, and low oil development potential in the Mancos-Gallup Formations (**Table AE-35** and **Figure AE-21**, Oil and Gas Development Potential 2018-2037). The 2019 RFD predicts 3,093 new wells to be developed in the planning area under current management. An estimated 2,220 of these wells are expected to be horizontal, while 873 would be vertical.

Table AE-35
Oil and Gas Development Potential, 2018-2037

Potential	BLM-managed Fluid Minerals	*Unleased BLM-managed Fluid Minerals*	BIA-managed Fluid Minerals	*Unleased BLM-managed Fluid Minerals*	Planning Area Total
High	190,600	*13,900*	48,400	*3,000*	273,400
Medium	1,096,300	*132,000*	72,300	*41,500*	1,635,000
Low	584,100	*152,600*	415,700	*230,600*	1,810,000
Negligible	62,300	*61,900*	54,000	*54,000*	249,400

Sources: Appendix I; BLM GIS 2017
Note: Acres do not total to the planning area or any decision area because non-discretionary closures were not included.

Solid Minerals: Coal

San Juan Coal Mine, operated by Westmoreland Coal Company, has a contract to supply the San Juan Generating Station coal-fired power plant with coal from the mine. Westmoreland is expected to reduce production from the mine by approximately 50 percent, to 3.5 million tons per year; therefore, no additional coal leases are expected to be issued for the San Juan Coal Mine over the life of the FFO RMP.

Navajo Mine, operated by Bisti Fuels Company LLC, is projected to produce approximately 5.9 million tons of coal per year (North American Coal 2016). A coal sale agreement with Four Corners Power Plant ensures that the mine will stay operational through 2031 (Navajo-tec 2017).

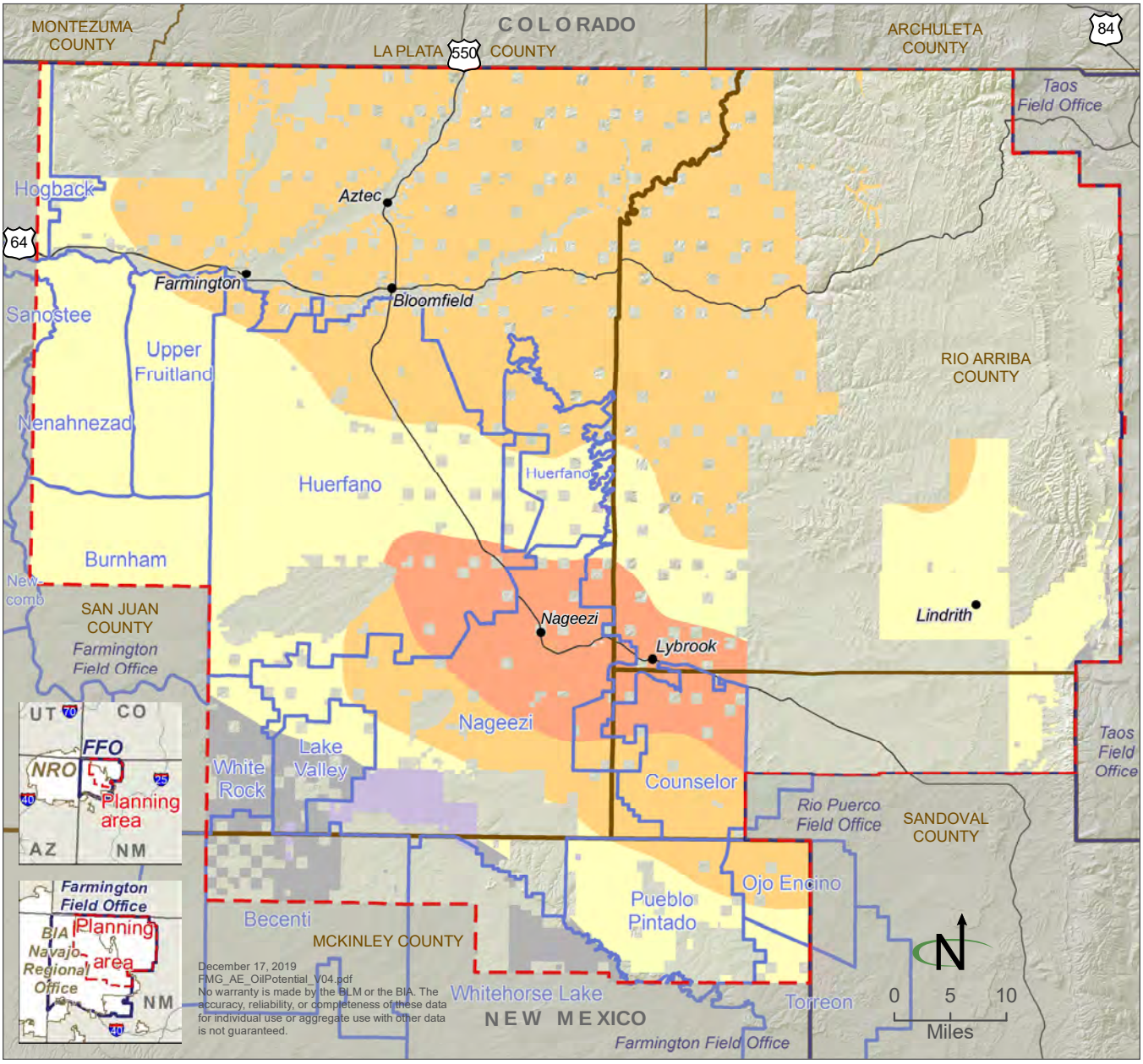
No additional coal mines are expected to open in the planning area over the life of the RMP.

Solid Minerals: Nonenergy Solid Minerals

As demonstrated by continuing permit applications on federal minerals in the planning area, extraction of sand, gravel, and other minerals is likely to continue close to current levels. Future demand will vary, depending on market conditions for these minerals, which differ, according to economic conditions and construction activity. Construction projects may lead to development of the sand and gravel and other mineral deposits within approximately 50 miles.

One driver of construction in the planning area is roads for oil and gas development. As new oil and gas development in the Mancos/Gallup Formations continues, sand, gravel, and other mineral activity is expected to continue at roughly the same level; however, the lack of roads in the vicinity of the Mancos/Gallup Formations may increase sand, gravel, and other mineral development in that area, as oil and gas continue to be developed, and associated access roads are constructed.

Figure AE-21
Oil and Gas Development Potential 2018-2037



Source: BLM GIS 2020

Development Potential
- High
- Medium
- Low
- Negligible

- Planning area
- National Park Service
- Field office boundary
- Navajo Nation Chapter

AE.3.3 Forestry

Current Conditions and Trends

BLM-Managed Forest and Woodland

The BLM manages woodlands to maintain and improve forest resiliency and condition; to protect, restore, and enhance forest ecosystem components; to enhance watershed protection; and to reduce wildfire risks according to the Healthy Forests Restoration Act of 2003. The BLM manages forests on the basis of multiple use and sustained yield per FLPMA and under the Material Disposal Act of 1947, as amended, to dispose of forest products.

BLM forest woodland community types in the planning area boundary include pinyon-juniper, oak woodlands, and ponderosa pine-mixed conifer. In total, these communities cover approximately 1,018,100 acres, or 47 percent of the planning area (**Section AE.2.5**, Upland Vegetation for additional information). There are no specific portions of the planning area identified for forest product harvest; therefore, forest products may be obtained from any areas that are not currently closed to protect other resources.

Forest products in the planning area are firewood, Christmas trees, wildlings, wood posts and poles, and special forest products, such as pinyon nuts. The BLM issues commercial and noncommercial permits to the public for woodland products, in accordance with the 2010 Farmington District Woodlands Standard Operating Plan. **Table AE-36**, below, identifies woodland product sales in the FFO over the past 5 years. In addition, free-use permits for woodland products may be issued to federal or state governmental agencies, provided that the wood products will be used to support public projects. Free-use permits are also issued to Native American individuals for traditional plant gathering for ceremonial, medicinal, or religious purposes.

Table AE-36
Woodland Product Sales

Year	Commodity	Total Number of Permits	Total Cords Personal	Total Cords Commercial	Total Sales
2015	Firewood	3,050	3,471	592	$41,652
	Fence posts				$254
	Christmas trees				$1,910
2014	Firewood	3,368	4,196	698	$50,352
	Fence posts				$90
	Christmas trees				$1,810
2013	Firewood	2,763	3,338	585	$48,831
	Fence posts				$506
	Christmas trees				$1,660
2012	Firewood	2,690	3,226	445	$49,131
	Fence posts				$410
	Christmas trees				$2,375
2011	Firewood	2,869	3,533	396.	$49,201
	Fence posts				$342
	Christmas trees				$1,825
2010	Firewood	3,187	3,855	517.	$48,596
	Fence posts				$3,228
	Christmas trees				$2,690
2009	Firewood	N/A	3,541	416	$47,652
	Fence posts				$100
	Christmas trees				$2,815

Source: BLM 2016c
N/A: not available

Forest resiliency and condition in the assessment area is variable across the landscape. The level to which forest and woodland communities have departed from their historical conditions can affect the risk of disturbance to this community and the level of products that may be available. Details of forest resiliency and condition are in **Section AE.2.5**, Upland Vegetation.

Threats to forest resiliency and condition may affect the level of products available for sale or use. Potential threats are population growth, disease, insects, expansion of wildland urban interface areas, fragmentation due to energy development, and the threat of wildfire from potential drought, disease, climate fluctuations and changes, and successional changes, and establishment and spread of invasive species.

BIA-Managed Forest and Woodland

Then BIA manages Indian forest land, which includes both timberlands and woodlands, in accordance with 25 USC 3101–3120 through the implementation of 25 CFR 163.1-83 and applicable Navajo Nation laws and regulations. The BIA currently undertakes forest land management on Indian forest land, both directly and through a PL 93-638 contract with the Navajo Nation. Navajo Nation forest land management is authorized under 17 NNC 520-529 and 23 NNC 900. Forest resources on the Navajo Nation are vast and are spread over numerous types of terrain, although the planning area primarily includes woodland resources, due to its lower elevations.

The Navajo Nation's Ten-Year Forest Management Plan establishes goals, objectives, and forest management direction for 596,700 acres of the Defiance Plateau-Chuska Mountains, which include commercial timberland (Navajo Nation 2006). The forest management plan is strategic and not an operational plan. Implementing specific projects that conform to plan policies will depend on subsequent procedures for site-specific planning and design. The preferred alternative (Alternative 4) in the Navajo Nation's Ten-Year Forest Management Plan identifies specific forest product harvest objectives for the 10-year planning period; however, it does not provide the site-specific information required for forest product harvests and mandatory site-specific environmental documentation.

The Navajo forest lands have provided valued cultural and subsistence resources to the Navajo people for many hundreds of years. Some of the resources in the Navajo forest lands, such as timber, are recognized for their economic value in today's society, while others, such as medicinal and ceremonial plants, are significant to Navajo culture or tradition. Other resources are valued for their intrinsic value to all humankind, for example threatened and endangered plant and wildlife species (Navajo Nation, n.d.).

The commercial timberland (exclusive of inoperable and restricted areas) is composed of 388,600 acres (Navajo Nation 2001); this does not include operable timberlands of 74,700 acres for specially managed areas and 60,100 acres of marginal timber production areas; thus, the commercial timberland is 253,800 acres where even- and uneven-aged stand development would occur (Navajo Nation 2006). The desired future condition is an even- and uneven-aged mosaic, intermixed with areas of special or no management. Allotted lands are subject to management and regulation by the BIA. Around lakes, streams, wetlands, and cultural and sacred areas, no commercial forest activities are permitted.

According to the draft Navajo Nation Woodland Management Plan, there are 4,818,814 acres of woodlands across the entire Navajo Nation: 1,139,100 commercial acres and 3,679,705 noncommercial acres (Navajo Nation, n.d.). Of the commercial acres, 75 percent—or 854,300 acres—are considered manageable. **Table AE-37** shows that within the Navajo Nation chapters in the planning area there have been nearly 250,000 acres of woodland identified; however, 60 percent of the acreage in these chapters are not included in the Navajo Nation woodland GIS inventory, so the total woodland acreage is unknown (Cathcart et al. 1999).

Table AE-37
Woodland Acreage in Navajo Nation Chapters in the Planning Area

Chapter	Woodland	Non-Forest	Not Covered in Woodland GIS	Total Chapter
Becenti	NDA	NDA	NDA	NDA
Burnham	Juniper: 5,834 Juniper-pinyon: 1,578 *Total woodland: 7,412*	175,166	0	182,578
Counselor	Eastern woodland: 8,849 *Total woodland: 8,849*	0	96,916	105,765
Hogback	Juniper: 16,892 Juniper-pinyon: 394 Pinyon-juniper: 1,314 *Total woodland: 18,600*	44,936	0	65,536
Huerfano	Juniper: 98 Juniper-pinyon: 21 Eastern woodland: 14,350 *Total woodland: 14,468*	324	563,725	551,517
Lake Valley	NDA	NDA	NDA	NDA
Nageezi	Eastern woodland: 13,527 *Total woodland: 13,527*	0	331,724	345,251
Nenahnezad/San Juan	Juniper: 5,456 *Total woodland: 5,456*	114,336	141	119,933
Newcomb	Juniper: 2,962 *Total woodland: 2,962*	55,102	0	58,064
Ojo Encino	Eastern woodland: 103 *Total woodland: 103*	0	61,625	61,728
Pueblo Pintado	Eastern woodland: 35,428 *Total woodland: 35,428*	0	84,364	119,792
Sanostee	Juniper: 12,449 Juniper-pinyon: 9,086 Pinyon: 11,724 Pinyon-juniper: 23,844 *Total woodland: 57,697*[1]	203,460	0	286,030
Torreon/Star Lake	Eastern woodland: 33,235 *Total woodland: 33,235*	0	82,039	115,273
Upper Fruitland	Juniper: 13,812 Juniper-pinyon: 5,347 *Total woodland: 19,159*	76,461	76	95,696
White Rock	Juniper: 1,554 *Total woodland: 1,554*	63,297	44,853	109,704
Whitehorse Lake	Eastern woodland: 28,998 *Total woodland: 28,998*	0	286,819	315,817

Source: Cathcart et al. 1999
[1]594 acres of the Woodland total acres in the commercial Navajo Forest and 24,873 acres in the Sanostee Chapter overall are part of the commercial Navajo Forest.
NDA: no data available

As shown in **Table AE-37**, Navajo woodland types identified in the chapters in the planning area are eastern woodland (54 percent), juniper (24 percent), pinyon-juniper (10 percent), juniper-pinyon (7 percent), and pinyon (5 percent).

The harvesting of any forest product requires a permit or contract (Navajo Nation, n.d.). The Navajo Forestry Department and BIA determine what forest product permits and contracts are required. Most of the harvesting is done by the general public through personal use permits. In many cases the harvest areas are selected by the permittees; however, some permits are issued for specific cutting areas to meet management goals and objectives. Harvesting on allotted lands is subject to the approval of the owners and the Secretary of the Interior.

AE.3.4 Lands and Realty

This section is a discussion of existing land uses and the regulatory framework guiding land use and realty actions on BLM-managed, Tribal trust, allotted, and fee simple lands in the planning area.

Current Conditions

The distribution of BLM-managed, Tribal trust, and allotted lands directly influences the current level and locations of uses in the planning area. The 1,316,200 acres of BLM-managed lands are more contiguous in northeastern San Juan County; a scattered, checkerboard pattern characterizes the distribution of BLM-managed lands throughout the rest of the planning area.

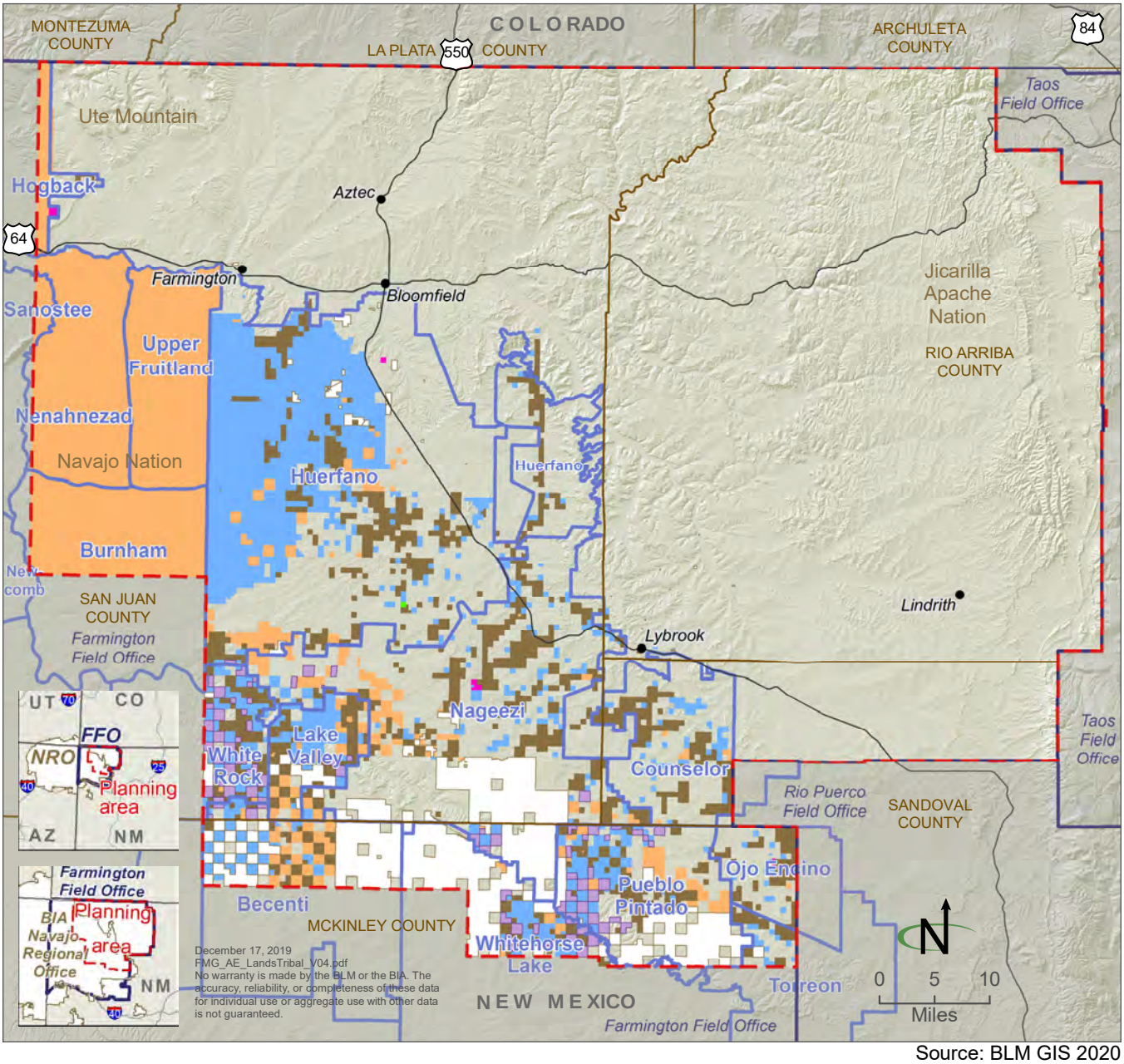
The 1,518,100 acres of Tribal trust lands in the Navajo Nation, Jicarilla Apache Nation, and Ute Mountain Ute Tribe reservation are in the west, northwest, and eastern portions of the planning area, respectively. Navajo Nation lands are also scattered throughout the southern and central portions of the planning area. The surface in the planning area is managed or owned by the BLM, the Forest Service, the BOR, the NPS, Tribal and state governments, and private entities (**Table AE-38** and **Figure AE-22**, BIA Surface and Subsurface Management).

Table AE-38
Surface Landownership in the Planning Area

Landownership	Acres
BLM	1,316,200
Tribal trust	1,518,100
Private	458,300
Forest Service	251,500
individual Indian allotments	210,100
State	203,700
Navajo Tribal fee	170,800
NPS	33,600
BOR	27,200
Total	**4,189,500**

BLM GIS 2017

Figure AE-22
BIA Surface and Subsurface Management



Source: BLM GIS 2020

- Navajo Tribal fee (private land)
- PLO 2198: Public land order which withdrew land from public domain for a proposed reservation adjustment, BIA has administrative management, Navajo Nation has a vested interest
- Other PLO/BIA-administered withdrawn land
- Navajo trust surface land and Navajo trust subsurface mineral estate
- Navajo trust surface land and federal mineral estate
- Navajo allotment surface land and Navajo allotment subsurface mineral estate
- Navajo trust surface land and Navajo allotment subsurface mineral estate
- Planning area
- Field office boundary
- Navajo Nation Chapter

BLM

The BLM lands and realty actions described in this section are land tenure (ownership) adjustments and land use authorizations . Land tenure adjustments focus primarily on land exchange, acquisition (including acquisition through purchase of land and interest in), and sale, exchange, or conveyance. Land use authorizations consist of ROWs, communication site leases, and other leases or permits.

This section also describes utility corridors, which are a land use planning-level designation to facilitate the orderly placement of linear ROWs.

Land Tenure Adjustments

BLM-managed lands are retained in federal ownership, as mandated by FLPMA, with the exception of lands identified in a land use plan for sale, exchange or conveyance. To be eligible for sale, exchange or conveyance, lands must meet certain FLPMA criteria, such as being difficult or uneconomical to manage. Lands identified for sale, exchange or conveyance must have the potential to support community expansion, economic development, or other public purposes that cannot be achieved prudently or feasibly on land other than public land.

Another requirement is that the public purposes for sale, exchange or conveyance outweigh other public objectives and values, including recreation and scenic values, which would be served by maintaining the tract in federal ownership.

Withdrawn federal lands are withheld from settlement, sale, location, or entry under some or all of the general land laws. Allowable uses are limited in order to allow other public benefits. Withdrawn lands may be relinquished, in accordance with the provisions and limitations of FLPMA.

Land tenure adjustments must serve the national interest. Areas with anticipated higher potential for land tenure adjustments are those that can be acquired for access easements, those that contain or are next to areas possessing unique qualities, or those acquired to create a more contiguous landholding for the BLM. This acquisition would result in easier or economical management, and these areas include inholdings or lands in or next to SDAs, such as ACECs, and existing or potential recreation sites.

Land Use Authorizations

Land use authorizations in the decision area include those for roads, electrical transmission lines, water facilities, communication sites, film permits, water pipelines, and oil and gas distribution lines. A ROW is the most common form of authorization to permit uses of FFO BLM-managed lands by commercial, private, or government entities for specific purposes and projects. The ROW authorizes rights and privileges for a specific period and is subject to BLM review and renewal or denial at the end of the authorization period. ROW authorizations may be terminated or suspended for noncompliance with their terms or for other resource concerns.

ROWs are discretionary, and the BLM will consider only qualified individuals, businesses, or government entities. The FFO will administer the authorizations in accordance with governing laws, rules, regulations, and policies to accomplish the objective, as follows:

- Protect the natural resources associated with public lands and adjacent lands, whether private or administered by a government entity
- Prevent unnecessary or undue degradation to BLM-managed lands
- Promote the use of ROWs in common, considering engineering and technological compatibility, national security, and land use plans
- Coordinate, to the fullest extent possible, all BLM actions with state and local governments, interested individuals, and appropriate quasi-public entities (43 CFR 2801.2)

All ROWs are subject to NEPA to analyze potential resource impacts. To the extent possible, linear ROWs, such as roads, transmission lines, and pipelines, are routed where impacts would least disturb environmental resources. Considerations include point of origin and destination of the ROW, the resources that would be affected, the impacts on these resources, and rerouting, grouping, and other mitigation that would reduce the impacts. BLM ROW authorizations include a plan of development, a surface reclamation plan, stipulations, and other mitigation measures, which are developed and modified on a case-by-case basis and under site-specific NEPA analysis.

The nearly 18,000 BLM-issued ROWs in the planning area are for various facilities and are held by private individuals, industry, government entities, and other qualified holders. They include those for roads, power lines, communication sites, fiber optic lines, water facilities, water pipelines, oil and gas pipelines, and facility sites.

There may be multiple types of authorizations issued for a project. For example, an oil and gas project will often include a ROW for a well pad, road, electric power line, waste water disposal pipeline, product pipeline, or other type of authorizations. All use, occupancy, or development, which is above casual use, requires an authorization when it occurs on BLM-managed land. Of the 18,000 ROWs, 76 percent (13,700) are for oil and gas pipelines (BLM 2016b).

The BLM regularly receives applications for new ROWs, as well as requests for amendments, assignments, renewals, relinquishments, or terminations of authorized ROWs.

The BLM evaluates additional authorizations in existing ROWs for compatibility with the authorized infrastructure. In general, there is a higher concentration of ROWs and communication sites near the tri-cities area of Farmington, Bloomfield, and Aztec; therefore, the potential for collocating ROWs with other land uses and implementing mitigation measures is higher in these areas.

Unless specifically designated in the land use plan or amendments to the plan, BLM-managed lands in the planning area are available for land use authorizations. In areas managed as open to ROW development, the BLM analyzes and issues ROWs on a case-by-case basis following site-specific NEPA analysis. Certain lands in the decision area are designated to be avoided or excluded from new ROW development. Examples of avoidance or exclusion areas typically are such SDAs as ACECs, WSAs, wilderness areas, SRMAs, or areas near sensitive cultural or biological resources.

In ROW avoidance areas, the BLM may consider ROW authorizations, subject to certain stipulations and mitigation requirements. This may include alternative siting criteria, design features, or special studies. ROWs are not allowed in exclusion areas. The BLM reviews ROW applications for approval on a case-by-case basis.

The BLM also authorizes solar and wind energy projects via the ROW authorization process. ROW applications for development on BLM-managed lands must be accompanied by a processing fee, as set forth in 43 CFR 2804.14. ROW applications are generally processed in order of receipt, unless the BLM Authorized Officer determines that, due to the receipt of two or more applications for the same project, there is enough interest in competing applications to conduct a competitive bid. Offering BLM-managed lands under competitive bidding procedures for ROW authorizations is regulated by 43 CFR 2804.23.

In 2012, the BLM published the Approved RMPAs/record of decision (ROD) for Solar Energy Development in Six Southwestern States (Solar Programmatic EIS). Based on a high-level resource constraints analysis, the BLM identified developable acreage in solar energy zones (SEZs). It also identified variance areas, which are those outside of SEZs where solar energy development may be appropriate, pending further analysis.

The Solar Programmatic EIS designated non-SEZ areas and those with no variances as exclusion areas for utility-scale solar energy ROWs. There are no SEZs in the FFO; however, there are approximately 391,100 acres of solar variance areas (BLM 2012c).

Solar resources in the planning area are at or above 6 kilowatt hours per square meter per day for photovoltaic technology[20] and at or above 7 kilowatt hours per square meter per day for concentrating solar technology[21] (NREL 2012a). Independent of other factors, such as terrain and access to transmission lines, the solar industry typically considers areas with direct normal insulation of 7 kilowatt hours per square meter per day or higher as economically viable for concentrating solar technology (WGA 2006; Simons 2005). Photovoltaic technology requires less direct sunlight than concentrating solar technology (Simons 2005).

There is currently one solar energy project on private land in the planning area. While the generation facility will not be on BLM-managed lands, the BLM will process ROWs for such facilities as transmission lines and roads that cross BLM-managed land in the decision area.

The City of Aztec is also considering a solar project on adjacent recreation and public purposes (R&PP) land. The 1-megawatt facility would require a change in the underlying use of the property, from recreation to energy development, and would require relinquishing the current R&PP land.

In June 2005, the BLM published a ROD for the Wind Energy Development Programmatic EIS and Associated Land Use Plan Amendments. The programmatic EIS analyzed the development of wind energy projects in the West. The ROD amended 52 land use plans to allow for the use of applicable lands for wind energy development. BLM offices are able to use this EIS to analyze impacts of specific applications to use BLM-managed lands for wind energy. The wind programmatic EIS did not amend the FFO RMP (BLM 2005).

According to the National Renewable Energy Laboratory's (NREL 2010) analysis, the annual average wind speed at an altitude of 80 meters (262 feet) throughout the planning area is less than the speed typically required for utility-scale, wind energy development. The maximum annual average wind speed in the planning area is 6.5 meters (21 feet) per second (m/s); however, most areas have annual average speeds of less than 5.5 m/s. Even with more advanced wind turbine technology, longer blades, and taller towers, the typical minimum speed desired for utility-scale development is 6 m/s. Below this speed, utility-scale, wind energy development is generally not financially practical (NREL and Lawrence Berkeley National Laboratory 2012).

Utility Corridors

There is one BLM-designated utility corridor in the planning area. The BLM designated it as part of the West-wide Energy Corridor Final programmatic EIS (BLM 2009) and under the authority of Section 368 of the Energy Policy Act (PL 109-58). The 3,500-foot-wide corridor extends from the southeastern corner of the planning area to the northwestern corner at the Colorado border. It mostly coincides with US Highway 550 and contains existing pipeline infrastructure.

Tribal Trust, Allotted, and Tribal Fee Lands

Tribal trust lands are those owned by the Tribe for which the title is held in trust by the federal government. These lands include treaty lands that are part of an existing reservation. Allotted lands are held in trust specifically for members of a federally recognized Tribe. Within the Navajo Nation, there are also privately-owned lands that are not held in trust by the Navajo Nation. Navajo and non-Navajo

[20] Generating electricity using solar panels

[21] Generating electricity using mirrors to concentrate solar energy on a fixed point

individuals own these fee simple lands. See **Figure AE-22**, BIA Surface and Subsurface Management, for a depiction of Tribal trust, allotted, and Tribal fee simple lands in the planning area. **Table AE-39**, below, provides acres for each Tribal ownership category; **Table AE-40** provides Tribal ownership acres in the Navajo Nation.

Table AE-39
Tribal Ownership in the Planning Area

Landownership	Acres
Ute Mountain Ute Tribe	103,300
Jicarilla Apache Nation	739,400
Navajo Nation	675,360
Total	**1,518,060**

BLM GIS 2017

Table AE-40
Navajo Nation Ownership

Navajo Nation Landownership	Acres
Navajo Tribal trust (non-allotment)	675,360
Allotted	210,100
Navajo tribal fee (private land)	170,800
Total	**1,056,260**

BLM GIS 2017

The BIA has the authority to grant interest in lands, with the consent of the allotment owners for allotted land and the consent of Tribe for Tribal trust land, including the issuance of ROWs, easements, and leases. The BIA can acquire lands from a willing seller, such as for residential, commercial, or mineral development. When the BIA acquires land in trust for a Tribe, the property is not subject to state or local land use regulations; only federal and Tribal land use regulations are applicable on trust lands. The BIA cannot sell or dispose of Tribal trust lands without the consent of the Tribe.

Regulations governing the placement of land uses, including oil and gas development facilities, infrastructure, and utilities, vary by Tribe. Where applicable, the BIA cooperates with the BLM and local and state authorities on matters related to land use.

The BIA manages lands in the decision area in accordance with 25 CFR, Subchapter H-Land and Water, as follows:

- Part 150 regulations set forth authorities, policies, and procedures governing the recording, custody, maintenance, use, and certification of title documents and the issuance of title status reports for Indian land.
- Part 151 regulations set forth the authorities, policies, and procedures governing the acquisition of land by the United States in trust status for individual Indians and Tribes. Acquisition in fee simple status is not covered by these regulations, even though such land may, by operation of law, be held in restricted status following acquisition. Acquisition of land in trust status by inheritance or escheat (reversion of lands) is not covered by these regulations.
- Part 152 regulations set forth the authorities, policy, and procedures for issuing patents in fee, certificates of competency, removal of restrictions, and sale of certain Indian lands.
- Part 158 regulations set forth the authorities, policies, and procedures for the application and order for change in designating homesteads, exchanging restrictive lands, instituting partition proceedings and partition records, approving deeds, and distributing proceeds of partition sales.

- Part 162 regulations set forth the authorities, policies, and procedures for leasing certain interests in Indian land.
- Part 169 regulations set forth the authorities, policies, and procedures for granting ROWs over and across Tribal land and government land.

Under general supervision of the BIA Superintendent, with wide latitude for exercising initiative, discretion, and independent judgment, BIA Navajo Regional Office (NRO) ENA studies and analyzes, recommends, develops, and puts into place plans for the highest and best use of Tribal and Indian allotment trust lands within the jurisdiction of Eastern Navajo Agency. This oversight includes areas with high economic development potential, suitable for agricultural, commercial, industrial, and residential purposes.

Eastern Navajo Agency management amounts to the following:

- Evaluating the present use of land
- Determining the highest and best potential use of land, using information furnished by experts in and, as needed, outside the federal government
- Recommending changes in uses in specific parcels of land from present use to a more beneficial use, considering socioeconomic, cultural, and political concerns affecting individual tribal members, the Navajo Tribe, surrounding communities and the state
- Acting to implement projects for the ultimate benefit of individuals or groups involved in managing the land in their highest and best use

In addition, Eastern Navajo Agency supports the self-determination goals of the Navajo Nation on land consolidation, natural resources, and mineral and surface rights protection and management. Eastern Navajo Agency manages approximately 1.6 million acres in San Juan, Sandoval, McKinley, Bernalillo, Valencia and Socorro Counties, which also includes the RMPA planning area.

Existing land uses on Tribal trust, allotted, and Tribal fee lands in the planning area generally include homesites, agricultural lands, commercial development, roads, electrical transmission lines, water facilities, communication sites, and oil and gas well pads, pipelines, and access roads.

Existing uses on the Navajo Nation portion of the planning area consist of agricultural lands, residential and commercial development in communities such as Ojo Amarillo, local paved and unpaved roads, State Highway 371, US Highway 550, and oil and gas wells. The agricultural uses in the Navajo Nation are mostly in the northern portion of the planning area. This is because of the availability of irrigation water from the NIIP, which provides water for approximately 70,000 acres of land in the Navajo Nation south of Farmington (BOR 2017). Most oil and gas development in the Navajo Nation is in the southern portion of the planning area.

Various chapter land use plans guide land use planning and economic and community development in the Navajo Nation. The San Juan Chapter Community-Based Land Use Plan (Navajo Nation 2002) includes goals and policies for natural resources and community infrastructure, with an emphasis on housing and community and public facilities.

Land uses in the Ute Mountain Ute Tribe portion of the planning area consist mainly of oil and gas wells and rural, unpaved access roads. There are no lands used for agriculture, urban commercial uses, or residential development. Infrastructure development is mostly associated with the oil and gas wells.

The most prevalent land use in the Jicarilla Apache Nation portion of the planning area is oil and gas development. Most of it is in the northeast portion of the planning area. Uses supporting this development are unpaved access roads, pipelines, and overhead power lines. Other uses consist of paved and unpaved local access roads, State Highway 95, and US Highway 64. There are dispersed residential and commercial

uses throughout the Jicarilla Apache Nation portion of the planning area; these uses are primarily near the northeast corner of the planning area in Dulce and in the southeast portion of the planning area in the communities of La Jara and Regina.

BIA-Administered Withdrawals

In the planning area, there are also 212,600 acres of lands withdrawn from the public domain via Public Land Order 2198 or other administrative action. The BIA administers these lands and the Navajo Nation has a vested interest, but the underlying landownership consists of a combination of Navajo Tribal trust, Navajo allotted, Navajo Tribal fee, and BLM-managed public lands. See **Figure AE-22**, BIA Surface and Subsurface Management, for a depiction of BIA-administered withdrawn lands in the planning area.

Trends

Land Tenure Adjustments and Landownership

The BLM will continue to acquire, sell, and exchange land and interest in land in the FFO on a case-by-case basis. It will give all proposals the full consideration of public benefits and land management goals. The BLM will prioritize acquisitions that would result in the following:

- Consolidate the lands it administers to facilitate and enhance its management
- Support the multiple use mandate, including lands with high oil and gas or other energy-related or resource potential
- Create easements to support resource management

Demand for land tenure adjustments is anticipated to increase, particularly in the tri-cities area. Acquiring land or easements for public access has not been a major focus for the FFO in recent years, in part due to limited opportunities; however, as the demand for securing public access for recreation on BLM-managed land near growing communities continues to increase, acquisitions for access could also increase. Additional management opportunities may exist to identify small isolated land tracts lacking adequate access, parcels that would resolve trespass issues, and those that would meet requirements in Public Law 96-550, Part V, CCNHP.

The BIA will continue to evaluate the acquisition of new trust lands on a case-by-case basis. Any future additions to Tribal trust or allotted lands would be subject to the willingness of the current landowner or administrator to transfer the lands into trust.

The Navajo Nation participated in the outreach portion of the Federal Land Buyback Program, where the federal government purchased fractional interests in allotments and conveyed the interests to the Navajo Nation. The lands are often already held in Tribal trust by the federal government, associated with a specific tribe that exercises jurisdiction over the land. Purchased lands would become Tribal trust lands specifically associated with the Navajo Nation.

No lands in the planning area are anticipated to be transferred out of the Tribal trust.

Land Use Authorizations

Continued population growth in the tri-cities area is likely to increase the demand for ROWs, such as roads, power lines, and communication facilities, to support the urban expansion. This growth will likely lead to more urban and commercial uses on Tribal trust lands, especially in the Navajo Nation south of Farmington. Due to the increase in oil and gas development and the associated infrastructure, it is likely that land use authorizations in rural areas, both on BLM-managed and Tribal trust lands, would also increase.

AE.3.5 Recreation and Visitor Services

There are no decisions being considered that would significantly affect recreation areas and visitor services on BLM- and BIA-managed lands in the decision areas. BLM management of recreation SDAs would continue under the BLM 2003 RMP. Hunting, fishing, and recreational shooting would not be affected by the alternatives considered in the FMG RMPA/EIS; therefore, these topics are not discussed in the FMG RMPA/EIS.

AE.4 SPECIALLY DESIGNATED AREAS

AE.4.1 Wilderness and Wilderness Study Areas

The 1964 Wilderness Act established a national system of lands to preserve a representative sample of ecosystems in a natural condition for the benefit of future generations. With the passage of FLPMA in 1976, Congress directed the BLM to inventory, study, and recommend which public lands under its administration should be designated wilderness. Section 603 of the FLPMA specifically required the BLM to provide Congress with recommendations on the suitability or unsuitability of roadless areas of public lands of 5,000 acres or more and on roadless islands; moreover, it included areas of fewer than 5,000 acres if certain criteria were met.

Congress gave the BLM 15 years to complete the inventory, study, and reporting process for wilderness areas. The BLM conducted the wilderness inventory on a state-by-state basis from 1978 to 1980. Only Congress can decide which areas, if any, will be designated as wilderness and added to the National Wilderness Preservation System.

When the BLM identified wilderness characteristics, as defined by Section 2(c) of the Wilderness Act of 1964 (16 USC 1131), within a defined boundary, it documented the presence of the wilderness resource and classified the area as a WSA. All values, resources, and uses occurring in each WSA were analyzed through legislative EISs.

When completed, the BLM submitted its recommendations of each WSA's suitability or unsuitability to the president, through the Secretary of the Interior, and then to Congress. FLPMA required that the reports be submitted to the president by October 21, 1991, and to Congress by October 21, 1993 (43 USC 1702). The BIA does not manage any wilderness or WSA lands.

Current Conditions

During the intensive inventory, the BLM identified two areas in the planning area that met the criteria for having wilderness characteristics under Section 202 of FLPMA: the Bisti and De-na-zin Wilderness Areas and the Ah-shi-sle-pah WSA. Congress designated the Bisti Wilderness and De-na-zin Wilderness in 1984. The two were combined and enlarged in 1996 to create the Bisti/De-na-zin Wilderness.

On March 12, 2019 Congress enacted PL 116-9, John D. Dingell, Jr. Conservation, Management, and Recreation Act. This act designated approximately 7,200 acres of land within the Ah-shi-sle-pah WSA to be a component of the National Wilderness Preservation System as the Ah-shi-sle-pah Wilderness. This act also expanded the Bisti/De-Na-Zin Wilderness Area boundary by 2,250 acres, for a total of 47,900 acres to be managed as designated wilderness.

There are currently permitted paleontological studies of fossils found from the Fruitland Formation and Kirtland Shale in the Ah-shi-sle-pah Wilderness Area and Bisti/De-na-zin Wilderness Area. For more information on fossils in the planning area see **Section AE.2.10**, Paleontological Resources.

In addition, certain lands outside the BLM and BIA decision areas, but within the planning area, have been evaluated for wilderness suitability. In 2004, the NPS conducted a wilderness suitability study in the CCNHP that evaluated whether areas in the park should be considered for wilderness designation. While

the assessment concluded in a report to the Regional Office that 19,800 acres were suitable for designation as wilderness (NPS 2004), this report was not forwarded to the Washington office.

Current Conditions and Trends

Current conditions for wilderness and wilderness study areas are described in the 2003 RMP (BLM 2003).

AE.4.2 Specially Designated Areas

In the 2003 RMP, the BLM designated portions of the planning area as SDAs, which are defined as "the general term that may apply to ACECs or other areas such as wildlife, recreation, or riparian areas. Each SDA description includes a general description, management goals, management prescriptions, and a corresponding location map" (BLM 2003). SDAs in the planning area include ACECs and RNAs, archaeological protection sites, mapped BLM sensitive species plant and animal habitats, geological formations, fossil areas, riparian areas, wilderness and WSAs, and wildlife areas. Wildlife SDAs are discussed in **Section AE.2.7**, Wildlife, and are shown in **Figure AE-12**, Wildlife SDAs.

This section is a discussion of the general affected environment for these SDAs. More specific analysis for geology, riparian areas, wildlife, special status species, cultural resources, paleontological resources, wilderness and WSAs, and Native American Tribal interests and uses can be found in this report under their respective headings. Appendix C from the 2003 RMP ROD (BLM 2003) further describes each SDA in the planning area.

The BIA does not manage any SDAs; however, the Navajo Nation does manage six designated wildlife areas. These areas are described in **Section AE.2.8**, Special Status Species.

The most common SDAs in the planning area are ACECs, which FLPMA defines as "areas within the public lands where special management attention is required to protect and prevent irreparable damage to important historical, cultural, or scenic values; wildlife resources or other natural systems or processes; or to protect life and safety from natural hazards" (43 USC 1702[a]). Section 202(c)(3) of FLPMA mandates that priority shall be given to the designation and protection of ACECs in the development and revision of land use plans (43 USC,1712[c][1]). BLM regulations for implementing the ACEC provisions of FLPMA are found at 43 CFR1610.7-2. Designating an ACEC applies only to public lands managed by the BLM.

To be designated an ACEC, the area must meet the criteria of relevance and importance found in 43 CFR 1610.7-2(a), and in BLM Manual 1613, Areas of Critical Environmental Concern.

An area meets the ACEC relevance criteria if it possesses significant historic, cultural, or scenic values; fish or wildlife resources, including habitat, communities, or species; natural processes or systems; or natural hazards. In addition, the significance of these values and resources must be substantial in order to satisfy one or more of the following importance criteria:

- Has more than locally significant qualities that give it special worth, consequence, meaning, or distinctiveness or cause for concern, especially compared with any similar resource
- Has qualities or circumstances that make it fragile, sensitive, rare, irreplaceable, exemplary, unique, endangered, threatened, or vulnerable to adverse change
- Has been recognized as warranting protection in order to satisfy national priorities or to carry out mandates of FLPMA
- Has qualities that warrant highlighting in order to satisfy public or management concerns about safety and public welfare
- Poses a significant threat to human life and safety or to property

An ACEC must also require special management attention. This refers to management prescriptions developed during preparation of an RMP expressly to protect the important and relevant values of an area from the potential impacts of actions permitted by the RMP. This includes proposed actions deemed to conform with the terms, conditions, and decisions of the RMP. Such management measures would not be necessary or prescribed if the critical and important features were not present.

ACECs differ from wilderness areas and other SDAs in that their designation by itself does not automatically prohibit or restrict other uses in the area. The special management attention is designed specifically for the relevant and important values and, therefore, varies from area to area. Restrictions that arise from an ACEC designation are determined at the time the designation is made, with the intent of protecting the values for which the designation was made.

An RNA is a type of ACEC, with high scientific research value. Under current BLM policy, RNAs must meet the relevance and importance criteria of ACECs and are designated as ACECs. Criteria for RNAs can be found at BLM Manual 1613 and 43 CFR 1610.7-2(b). RNAs are protected and maintained in natural condition to conserve biological diversity, to conduct non-manipulative research and monitoring, and to foster education. Because of the emphasis on natural conditions, RNAs are excellent areas for studying ecosystems or their component parts and for monitoring succession[22] and other long-term ecological changes.

Current Conditions

ACECs and RNAs

The FFO currently manages 73 ACECs in the planning area to protect their relevant and important values under the general categories of cultural, geology, paleontology, recreation, threatened and endangered species, and wildlife. See **Section AE.2.9**, Cultural Resources; **Section AE.2.2**, Geology; **Section AE.2.10**, Paleontological Resources; **Section AE.2.8**, Special Status Species; **Section AE.2.4**, Riparian Areas and Wetlands; and **Section AE.2.7**, Wildlife, for more information on the resources these ACECs protect.

Figure AE-23, BLM Areas of Critical Environmental Concern, shows the locations of these ACECs in the planning area.

Table AE-41, below, provides the acreages of each ACEC on BLM-managed lands in the planning area as well as the relative and important values behind the ACEC designation.

Recreation Management Areas

In 2013 and 2014, the FFO reallocated the 12 recreation SDAs identified in the 2003 RMP. This changed nine of the SDAs to SRMAs and the other three ERMAs (BLM 2013, 2014f). Some of these recreation management areas are in the RMPA planning area, but no decisions are being made to alter these areas in this RMPA.

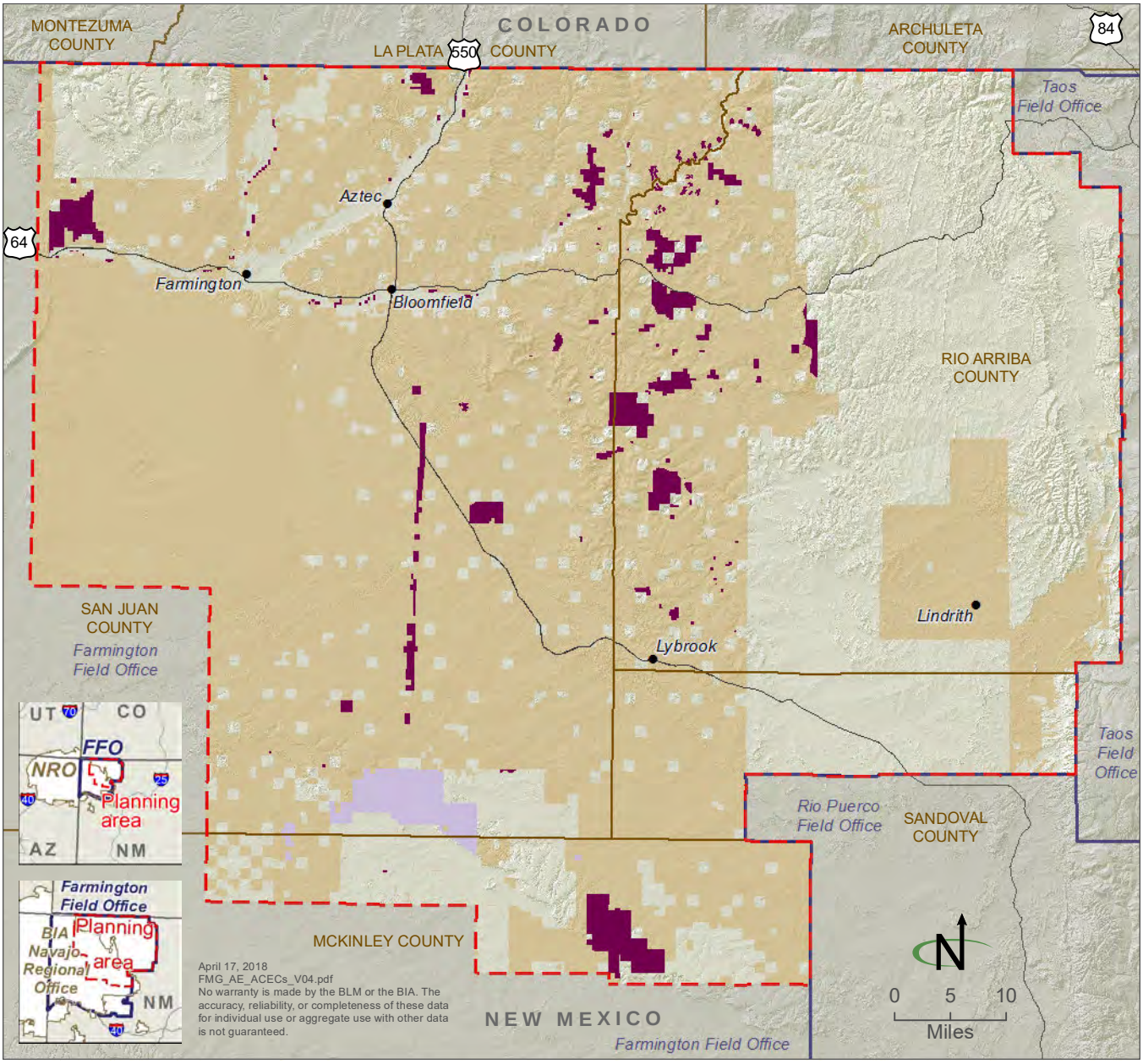
BIA Sensitive Areas

BIA sensitive areas are important cultural, archaeological, grazing, and wildlife areas, as well as TCPs. These areas are not definitively defined with boundaries but exist throughout the planning area. The resources of interest in BIA sensitive areas are discussed generally throughout this report in their specific resource sections (**Sections 2.3**, Water Resources, **2.7**, Wildlife, **2.8**, Special Status Species, **2.9**, Cultural Resources, **2.10**, Paleontological Resources, **2.11**, Visual Resources, and **3.1**, Livestock Grazing).

[22] The process of a natural community giving way to another until the area stabilizes to its natural state.

Figure AE-23
BLM Areas of Critical Environmental Concern

Areas of Critical Environmental Concern (ACECs) are land designations that highlight areas that require special management attention, and are contingent on both relevance and importance criteria. This criteria refers to the significance of important historical, cultural, and scenic values, fish and wildlife resources, additional natural systems and processes, as well as actions to protect human life and safety from natural hazards.



Source: BLM GIS 2017

Areas of Critical Environmental Concern (ACECs)

BLM and BIA decision area

Planning area

National Park Service

Field office boundary

Table AE-41
Areas of Critical Environmental Concern on BLM-Managed Land in the Planning Area

ACEC Name[1, 2]	Relative and Important Value	Acres
Adams Canyon	Cultural	129
Ah-shi-sle-pah Road	Cultural	666
Angel Peak	Geology, recreation, wildlife	248
Ashii Na'a'a' (Salt Point)	Cultural	644
Bald Eagle	Wildlife	3,931
Bi Yaazh	Cultural	75
Bis sa'ani	Cultural	118
Blanco Mesa	Cultural	736
Blanco Star Panel	Cultural	20
Cagle's Site	Cultural	44
Canyon View Ruin	Cultural	39
Casa Del Rio	Cultural	42
Cedar Hill	Cultural	1,937
Chacra Mesa Complex	Cultural	17,649
Cho'li'i	Cultural	360
Christmas Tree Ruin	Cultural	40
Crow Canyon	Wildlife	7,124
Deer House	Cultural	458
Delgadita/Pueblo Canyons	Cultural	548
Devil's Spring Mesa	Cultural	736
Dogie Canyon School	Cultural	8
Dzil'na'oodlii (Huerfano Mesa)	Cultural	3,683
East Side Rincon	Cultural	78
Encierro Canyon	Cultural	74
Encinada Mesa-Carrizo Canyon	Cultural	3,314
Farmer's Arroyo	Cultural	39
Four Ye'i	Cultural	40
Frances Mesa	Cultural	5,896
Gonzales Canyon-Senon S. Vigil Homestead	Cultural	36
Gould Pass Camp	Cultural	38
Halfway House	Cultural	40
Haynes Trading Post	Cultural	10
Hogback, The	Threatened and endangered species	9,448
Holmes Group	Cultural	65
Hummingbird	Cultural	41
Hummingbird Canyon	Cultural	32
Jacques Chacoan Community	Cultural	31
Kachina Mask	Cultural	226
Kin Yazhi (Little House)	Cultural	40
Kiva	Cultural	90
La Jara	Cultural	1,757
Lake Valley	Cultural	28
Largo Canyon Star Ceiling	Cultural	25
Margarita Martinez Homestead	Cultural	10
Martin Apodaca Homestead	Cultural	90
Martinez Canyon	Cultural	51
Mexican Spotted Owl	Threatened and endangered species	2,755
Morris 41	Cultural	94

ACEC Name[1, 2]	Relative and Important Value	Acres
Moss Trail	Cultural	28
Munoz Canyon	Cultural	268
North Road	Cultural	6,461
Pointed Butte	Cultural	102
Pierre's Site	Cultural	443
Pregnant Basketmaker	Cultural	8
Pretty Woman	Cultural	84
Prieta Mesa	Cultural	40
Rincon Largo District	Cultural	660
Rincon Rockshelter	Cultural	381
River Tracts	Threatened and endangered species	2,149
Rock House-Nestor Martin Homestead	Cultural	38
San Rafael Canyon	Cultural	5,048
Santos Peak	Cultural	132
Shield Bearer	Cultural	35
Simon Canyon	Recreation	3,961
Simon Ruin	Cultural	48
Star Rock	Cultural	22
Star Spring-Jesus Canyon	Cultural	165
Superior Mesa	Cultural	5,018
Tapacito and Split Rock	Cultural	311
Torreon Fossil Fauna West	Paleontology	552
Truby's Tower	Cultural	80
Twin Angels	Cultural	365
Upper Kin Klizhin	Cultural	56
Total	**–**	**89,300**

Source: BLM GIS 2017

[1] Andrews Ranch, Bee Burrow, Casamero Community, Church Rock Outlier, Crownpoint Steps and Herradura, Kin Nizhoni, and Toh-la-kai ACECs were designated in the 2003 RMP; they are in the FFO but are not in the RMPA planning area.

[2] Albert Mesa, Cottonwood Divide, Greenlee, Indian Creek, Pork Chop Pass, and String House ACECs were designated in the 2003 RMP; they are in the RMPA planning area but are not on BLM-managed land nor on federal mineral estate. The Albert Mesa, Cottonwood Divide, Pork Chop Pass, and String House ACECs were removed from designation through plan maintenance in 2013.

Trends

Future management opportunities could include modifying the current management goals and objectives for the SDAs to further protect the areas' unique resource values, completing land tenure adjustments to acquire in-holdings in ACECs, and consolidating management objectives for some overlapping ACECs.

AE.5 Social and Economic Conditions

The following sections provide an overview of the social and economic setting of the planning area and the surrounding region. The area is characterized by a diverse population, with lands of historic importance for Native American populations that continue to support a high population of Native Americans (notably McKinley and San Juan Counties; here, the populations are 73.9 and 37.4 percent, respectively). Three Tribal governments have reservations in the planning area: the Jicarilla Apache Nation, the Navajo Nation, and the Ute Mountain Ute Tribe.

The area has variations in levels of economic stability and prosperity. McKinley County in the south-western portion of the planning area has lower income and higher employment than the state average. In contrast, Sandoval County, in the south-eastern portion of the area is influenced by the Albuquerque metropolitan area and has economic indicators above state levels. The area has a history of oil and gas

development, and the ties with this industry are most notable in San Juan County, which has levels of employment, and contributions to general revenue from this industry above that of state levels. Population changes in San Juan County has also been linked with changes in the oil and gas industry.

Planning issues related to oil and gas development in the area are associated with potential conflicts between mineral development and other land uses. Concerns include impacts to local communities and the traditional social setting from direct and indirect impacts of development including, but not limited to construction traffic, potential for water contamination, and changes to population. Impacts to traditional ways of life including ranching, and historical and cultural lands uses for tribal populations are also a concern.

AE.5.1 Native American Tribal Interests and Uses

The BLM and BIA have federal trust responsibility to consult with Native American Tribes to identify and protect their ITAs, cultural values, religious beliefs, sensitive cultural and sacred sites, and traditional practices that may be affected by actions on federal lands. ITAs are legal interests in property that the United States, with the BIA as the responsible agency, holds in trust for recognized Indian Tribes or individual Indians, such as the individual Indian allotments. ITAs are defined as lands, natural resources, money or other assets held by the Federal Government in trust or that are restricted against alienation for Indian tribes and individual Indians (BIA 303, DM 2.5 C). These legal interests include Navajo allottee ownership of mineral and water rights, and part of the BIA's trust responsibilities are to protect and improve these ITAs. Paleontological resources are also considered ITAs and may be culturally significant.

Other Tribal resources or interests could include cultural resources, such as archaeological sites, as well as CIMPPs. As defined in **Section AE.2.9**, Cultural Resources, CIMPPs include a variety of resource types (including TCPs) that are generally distinguished because their significance lies in their importance to living communities, such as Tribes or Tribal individuals.

Tribes in general, along with the Navajo Nation, often take issue with the term TCP, rejecting the notion that a landscape imbued with living, sacred elements for Tribal members can be considered property. The Navajo Nation's Policy to Protect Traditional Cultural Properties aptly summarizes this tension, noting that the term "offends many Navajo traditionalists. One reason is that, by containing the word 'property,' it suggests that such places can be treated as mere commodities, like real estate. Another reason is that the term seems like a long and lackluster euphemism for 'sacred places,' which corresponds more closely to the Navajo term for such places (*hodíyin*)."

While acknowledging the issues with using the term TCP, the Navajo Nation's Policy to Protect Traditional Cultural Properties instead states that "all concerned recognize that the root of what makes a place sacred is its association with aspects of the past that people connect with their present concerns of living. [The Navajo Nation] apologize[s] to traditionalists for perpetuating the use of the term 'traditional cultural properties,' which we find a practical necessity in certain contexts."

In a similar manner, other Tribes often view their connections and relationship to TCPs or cultural practices in the planning area as ongoing and of considerable significance, despite any geographic separation these groups may have from the region.

Typically for CIMPPs, which include TCPs, agencies would consult with Tribes to identify CIMPPs or determine the potential significance of known cultural resources. Consultation with the Tribes or communities that hold the beliefs, carry out the practices in, or are affiliated with these CIMPPs include the Navajo Nation, as well as other Tribes that claim cultural affiliation with cultural resources in the planning area, such as the CCNHP.

The Tribes or Tribal members who continue to visit cultural resources in the planning area can include activities ranging from use of CIMPPs for ceremonial or sacred purposes to gathering plants for medicinal or other purposes. Traditional ceremonies, offerings, or pilgrimages at these CIMPPs occur throughout the planning area but not always on fixed dates or times. Some tribes would consider the areas above, below, and near a CIMPP to be of importance. For example, the Navajo feel that the importance of certain CIMPPs is not be limited to the surface and extends below the ground, such as seeps and springs or the Navajo sacred mountains, which includes Sisnaajiní (Blanca Peak), Tsoodził (Mount Taylor), Dook'o'oosłíí (San Francisco Peaks), Dibé Nitsaa (Hesperus Mountain), and Dził ná oódiłii (Huerfano Mesa).

The BLM and BIA have policies, manuals, and handbooks for consulting with Native American groups and evaluating Tribal cultural resources and CIMPPs, including the 638 contract that the BIA has with the Navajo Nation to review undertakings related to cultural resources on Tribal trust lands and individual Indian allotments. On trust lands in the Navajo Nation, the BIA is also obligated to follow regulations and guidelines established by the Navajo Nation. The statutes, regulations, handbooks, and policies that govern consultation and relationships with Native American Tribes are as follows:

- AIRFA of 1978
- NHPA of 1966
- ARPA of 1979
- NAGPRA of 1990
- EO 13175, Consultation and Coordination with Indian Tribal Governments
- EO 13007, Indian Sacred Sites
- Presidential Memorandum of April 29, 1994, Government-to-Government Relations with Native American Tribal Governments
- Secretarial Order No. 3215, Principles for the Discharge of the Secretary's Trust Responsibility
- BLM Manual 1780, Tribal Relations
- BLM Handbook H-1780-1, Improving and Sustaining BLM-Tribal Relations
- BLM Handbook H-8110, Identifying and Evaluating Cultural Resources
- Navajo Nation Cultural Resources Protection Act (Nation Cultural Resources Protection Act Cmy-19-88 Navajo Nation Code, Title 19 Chapter 11–Sections 1001-1061)
- Navajo Nation Policy for the Protection of Jishchaa': Gravesites, Human Remains, and Funerary Items
- Navajo Nation Historic Preservation Department, Cultural Resource Compliance Section, Policy to Protect Traditional Cultural Properties
- Navajo Nation Policy for the Disposition of Cultural Resources Collections
- Navajo Nation Guidelines for the Treatment of Historic, Modern, and Contemporary Abandoned Sites

Section 101(d) of the NHPA requires that federal agencies consult with Native American Tribes who historically occupied the area of an undertaking or who may attach significance to resources in the region. NEPA also requires that agencies consult with Native American Tribal leaders.

The BLM and BIA coordinate and consult with Native American Tribes, including the Navajo Nation, before approving decisions or actions that could change land use, lands or resources, or access or that could alienate[23] lands.

[23] Legal term meaning to transfer landownership to another person or group.

In accordance with the Indian Self-Determination Act of 1975 (Public Law 93-638), the Navajo Nation is a 638 contractor for the BIA, and its THPO is authorized to make recommendations for appropriate treatment of cultural resources and CIMPPs, with final determinations from the Regional Director of the BIA.

The FFO also has a long history of consultation with the Navajo Nation on projects and issues that might affect its people or interests. This is necessary because of the regulations requiring this consultation and because of the unique character of the FFO where Navajo Tribal trust and fee lands are next to BLM-managed land in a checkerboard distribution.

During the project's inception, the BLM initiated government-to-government consultation in writing with potentially interested Tribes and requested information on known CIMPPs or other locations of importance. Additionally, the agency asked for input on the scope and strategies for identifying cultural and Tribal resources and CIMPPs and how best to evaluate the historical significance of these resources. The BLM also broached other major issues, such as the treatment of human remains.

Government-to-government consultation is ongoing and the introduction of the BIA as a co-lead agency for the project resulted in the BLM and BIA jointly sending additional consultation letters in December 2017 to the following Tribes:

- The Navajo Nation
- Hopi Tribe
- Jicarilla Apache Nation
- Mescalero Apache Tribe
- Pueblo of Acoma
- Pueblo of Cochiti
- Pueblo of Isleta
- Pueblo of Jemez
- Pueblo of Laguna
- Pueblo of Nambé
- Ohkay Owingeh
- Pueblo of Picuris
- Pueblo of Pojoaque
- Pueblo of San Felipe
- Pueblo de San Ildefonso
- Pueblo of Sandia
- Pueblo of Santa Ana
- Pueblo of Santa Clara
- Pueblo of Santo Domingo
- Pueblo of Taos
- Pueblo of Tesuque
- Pueblo of Zia
- Pueblo of Zuni
- Ysleta del Sur Pueblo
- San Carlos Tribe
- White Mountain Apache Tribe
- Southern Ute Indian Tribe
- Ute Mountain Ute Tribe

- Apache Tribe of Oklahoma
- Comanche Indian Tribe
- Fort Sill Apache Tribe
- Kiowa Tribe of Oklahoma
- Pawnee Tribe
- Wichita and Affiliated Tribes

The significance of CIMPPs and other Tribal resources or practices would be determined through consultation with Tribes. This includes those resources deemed not eligible as historic properties under the NRHP but that are considered under AIRFA and EO 13007.

While some CIMPPs are well known, other locations or resources may be privileged information that is restricted to specific Tribes, practitioners, or clans. The Section 106 process of the NHPA recognizes that there may be instances where an Indian Tribe's leadership is willing to share sensitive information only with the federal agency and not with the other consulting parties. This would be the case if the disclosure of such information "may cause a significant invasion of privacy; risk harm to the historic property; or, impede the use of a traditional religious site by practitioners" (36 CFR 800.11[c][1]). For Tribes, maintaining confidentiality and customs of traditional knowledge may take precedence over identifying and evaluating these resources. Under such circumstances, this would result in information being unavailable for inclusion in the NEPA analysis.

The Navajo Nation's Traditional Cultural Program maintains records of previously published CIMPPs—specifically TCPs—that are of significance to the entire Navajo Nation; other CIMPPs in the planning area may be of significance to local Navajo communities, families, and individuals whose significance would be determined through consultation. In contrast, the significance of ITAs, such as water and fluid mineral rights for the Navajo Nation and Navajo allottees, are more clearly identifiable.

Current Conditions

Tribal interests and CIMPPs are identified primarily through consultations with federally recognized Indian Tribes on a government-to-government basis. Present practices to protect Tribal interests are often related to project and site-specific Native American consultations; in these instances, the BLM and BIA (along with their 638 contractor, the Navajo Nation) have attempted to protect Tribal interests and CIMPPs by focusing on specific locations, such as archaeological sites or TCPs.

Tribal leaders and historians generally view the process of consultation in its entirety as one in which representatives of sovereign nations meet to discuss and resolve potential conflicts. From the perspective of the Tribes, most issues often center on the appropriate use and protection of landscapes and places. Some of these locations may also be regarded as sacred by particular Native American Tribes or individuals. Under the framework of existing laws, including the NHPA, AIRFA, ARPA, and EO 13007, the BLM and BIA must consider the impacts of federally linked projects or land uses on these types of locations or resources.

There are no ITAs on the BLM-managed land; however, such lands are close to trust and fee lands of the Navajo Nation, particularly in the area of checkerboard land status in the southern portion of the planning area. Key ITAs on Navajo Tribal trust lands and individual Indian allotments in the planning area are rights for water, fluid minerals, and grazing, for which the BIA has a trust responsibility to protect and help develop for the benefit of the Navajo Nation on trust lands or individual Indian allottees on allotment lands.

A key example of how the BIA's mission can benefit water and fluid mineral ITAs is found in all BIA fluid mineral leases. They contain the stipulation that before abandoning a lease, lessees are required to

recondition oil or gas wells and allow pumping of groundwater for domestic purposes. Grazing ITAs are also considered in all BIA leases, with lessees required to negotiate and compensate landowners for all surface use, including grazing lands.

Based on the records at the NNHHPD, there are 82 CIMPPs (specifically TCPs) on the BIA-managed lands in the planning area in the Navajo Nation (including Tribal trust and fee and individual Indian allotments). These CIMPPs have been previously identified and published by researchers. Additionally, previous consultation identified nearly 500 TCPs in the BLM-managed portion of the planning area that are significant to Tribes for various reasons (BLM GIS 2017).

As a result of scoping, Tribes have indicated there are other CIMPPs and tribal resources in the planning area and requested that these resources be considered during the amendment process. Further, some of these CIMPPs may be archaeological sites or other cultural resources (**Section AE.2.9**, Cultural Resources), and their significance is specific to the Tribal group that considers them important.

Trends

Based on the current condition of Tribal ITAs and CIMPPs, there are several trends to note. The rate of identification of CIMPPs has increased in concert with oil and gas and other development. These undertakings have resulted in a greater frequency of consultations with Tribal governments; this has sometimes led to Tribes identifying more CIMPPs or other Tribal resources.

Just as the trends of changing conditions for Tribal resources and CIMPPs are difficult to determine from permitted activities, the impacts of unpermitted activities on these properties are more difficult to determine. All potential impacts are evaluated by alternative in **Chapter 3** of the FMG RMPA/EIS.

AE.5.2 Social and Economic Uses

This section is an overview of socioeconomic conditions in the planning area. The BLM and BIA collected information for the counties and the state from the Headwaters Economics' Economic Profile System (Headwaters Economics 2017), the US Census Bureau, the US Bureau of Economic Analysis (BEA), and the US Bureau of Labor Statistics.

The current, historical, and forecast population statistics, age distribution, housing, and education levels are presented in the demographic data. Economic characteristics discussed are employment levels and industries, major employers, income, government revenues and expenditures, and dependence on resources administered by the BLM. To the greatest extent possible, the data represent the most current information available.

When possible, data for Native American Tribes in the planning area are included, along with county and state data for comparison. Data for relevant Navajo Nation chapters (political subdivisions of the Navajo Nation) are included where available and appropriate. These are most commonly American Community Survey (ACS) data and not necessarily previous census data or other data sources. (Note that Native American survey and census participation rates tend to be lower than for other populations, potentially skewing the data collected.)

Because data are generally available at the county level, current conditions for socioeconomic conditions for BIA- and BLM-managed lands are addressed together in this combined section. Fiscal and market and commodity contributions specific to the BIA or relevant Tribal nations and the BLM are discussed separately as appropriate in the respective sections below. (Note that, following US Census Bureau datasets (US Census Bureau 2010, 2015a) unless otherwise specified, data for Tribal nations are representative of the Tribal reservation and all off-reservation lands; they are not specific to the portion in the planning area.)

More detailed data and a discussion of conditions and trends are provided in the FFO socioeconomic baseline report prepared in coordination with the FMG RMPA/EIS (BLM 2014e). Data in this EIS have been updated from that provided in the 2014 report, where available and appropriate to reflect the best available information.

Current Conditions and Trends

The planning area encompasses most of San Juan County, northeast McKinley County, western Rio Arriba County, and northwestern Sandoval County. In order to capture the social and economic conditions in and close to the planning area, the socioeconomic study area includes data for these counties in their entirety. Native Americans, Hispanic settlers, and non-Hispanic Euro-American settlers have all played important roles in the socioeconomic study area. Refer to the FMG RMPA/EIS socioeconomic baseline report (BLM 2014e) for an overview of the historic setting.

The planning area today includes approximately 1.7 million acres of Tribal lands belonging to the Navajo Nation, Jicarilla Apache Nation, and Ute Mountain Ute Tribe. The decision area includes 885,500 surface acres of Navajo Tribal trust and individual Indian allotments. Mineral rights underlying these lands include over 292,000 acres of federal minerals as well as 593,500 acres of Tribal trust and individual Indian allotment minerals.

History has resulted in a checkerboard of land ownership in a portion of the planning area, primarily at the eastern boundary of the Navajo reservation. In this area, Tribal lands are intermingled with fee lands (owned by both Native Americans and nonnative Americans) and federal and state lands under various jurisdictions. Tribal trust lands of the Jicarilla Apache Nation and the Ute Mountain Ute Tribe are not part of the decision area; however, they are part of the planning area, due to adjacent or nearby parcels of BLM-managed lands and federal mineral estate. See **Section AE.5.1**, Native American Tribal Interests and Uses, for a discussion of all Tribal groups associated with the planning area.

In the late 1800s, settlement by non-Hispanic Euro-American settlers increased. The economy of these settlements in Farmington and the surrounding region was based on agriculture and included apple and other fruit orchards (City of Farmington 2019).

Development of oil and gas resources in the region began in the early 1920s in the Four Corners Region to the west. Limitations of early development included a lack of a local market for resources and limited transportation opportunities to remote markets. In the 1940s and 1950s, a development surge, with increased market demand and development of regional pipelines, brought with it a large population increase; the population of the Farmington area increased nearly 763 percent in 10 years.

Fossil fuels development continues to represent a significant component of the local economy, and the region has experienced numerous boom and bust cycles of development since the 1940s. Production levels depend on various factors affecting output, including prices, well capacity, and both national and international demand.

Advances in hydraulic fracturing technology in the 1950s and 1960s improved recovery techniques. The next major period of fossil fuels development occurred in the mid- to late 1970s. In the early 1980s, demand was weak, resulting in no significant development. This was followed by increased production, beginning in 1989, with the development of the Fruitland Formation coal play (BLM 2001b).

New Mexico's fossil fuel energy industry, led by oil development, made a strong recovery after the recession. In the 2010s, after years of declining production in the San Juan Basin, companies expressed interest in the Mancos Shale for both natural gas and oil potential. Advances in hydraulic fracturing and horizontal drilling helped operators unlock shale gas and oil.

Production in the San Juan Basin has slumped in recent years, however, due to record low commodity prices and competition from other natural gas fields, such as the Marcellus Region in Pennsylvania. Drilling operations and a new gas field discovery in Mancos Shale in 2017 indicate that there is a potential for increased future production.

Mining, especially of coal and uranium, has also provided significant income on Tribal lands since the 1950s. In the landmark Supreme Court case *Merrion v. Jicarilla* (1982), the Tribes won the right to impose a severance tax on oil and gas produced on their land; however, in the subsequent *Cotton Petroleum v. New Mexico* (1989), the court found states retained the right to impose their own taxes on non-Indian companies operating on Indian lands. Both the Navajo Nation and Jicarilla Apache Nation now have their own energy companies, Navajo Nation Oil and Gas Company and Jicarilla Apache Energy Company.

Based on New Mexico Oil Conservation Division, Oil and Natural Gas Administration and Revenue Database (NMOCD) 2016 Ongard data, active wells in planning area counties included approximately 1,924 Jicarilla Apache Nation wells, 479 Navajo Nation wells, and 162 Ute Mountain Ute Tribe wells (NMOCD 2017a).

The Navajo Nation prohibited further uranium mining as of 2005, due to public health and environmental concerns, and the volume of coal mined has declined in the early twenty-first century. The Navajo Transitional Energy Co. LLC, run by the Tribal government, runs the Navajo Mine near Farmington on the Navajo Reservation; this mine produced 4.2 million tons of coal in 2016, down from 8.1 million tons in 2011(Navajo Minerals Department 2017).

In addition, as of 2014, nearly 300 Navajo allottees in New Mexico had signed leases with oil companies to develop their non-reservation land for energy production. Much of the interest in development is in the San Juan Basin checkerboard area (*Navajo Times* 2014).

Mining's share (including oil and natural gas) of overall employment in New Mexico was about 3.8 percent in 2015, or roughly 23,641 New Mexicans. In contrast, in the socioeconomic study area in 2015, roughly 6.6 percent of employment was in the mining sector, and in San Juan County this figure was 13.9 percent (Headwaters Economics 2017).

Much of the infrastructure and community development in the planning area has been tied to booms in energy development and the related population changes. Demand for public services, including schools, public safety, and roads, generally increases in areas experiencing development booms. County and local level development can in turn be aided by gross receipt and property tax revenue from oil and gas development. This has been particularly true for San Juan County, where oil and gas development has a long history. Here, employment in the mining sector is a significant portion of the total workforce.

Current land uses on Tribal lands are similar to other land statuses in the study area. Uses include an overlapping mix of grazing, agriculture, oil, gas, and coal production and scattered homesteads and isolated sites for commercial and industrial use. On the Navajo Nation, Jicarilla Apache Nation, and Ute Mountain Ute Reservations, casino gaming is also an income source.

Although the mid-twentieth century brought additional economic opportunities, high unemployment and a high percentage of people living in poverty prevails for many Tribal members, as further discussed in **Section AE.5.3**, Environmental Justice.

In the last decade the regional economy has seen increased diversification. Farmington's role as a regional retail and service center has grown. It is the largest city within a 150-mile radius and draws on a market of 250,000 people. It is becoming a regional trade area for northwestern New Mexico and southwestern Colorado. The area also benefits greatly from recreation and tourism in the Four Corners Region. At the

same time, the oil and gas industry remains a primary employer and provides higher-paying jobs than many other economic sectors.

While small in terms of income and employment, agriculture remains the historical legacy of the region. It is highly valued for cultural reasons and as a strategy for a diversified economy. Agriculture remains especially important in the portions of the socioeconomic study area that do not have the same levels of fossil fuel development. Elements of traditional Hispanic culture are retained on small subsistence farms, or ranchos, in the valleys of northern New Mexico; in the planning area this is particularly notable in Rio Arriba County.

Northern New Mexico (in the Farmington and Rio Puerco Field Offices) is also unique, because it contains Navajo free-use permits, which support subsistence grazing. As noted in **Section AE.3.1**, Livestock Grazing, these permits are issued under 43 CFR 4130.5, to individuals "whose products or work are used directly and exclusively by the applicant and his family" and are not transferrable.

Population and Migration

The population base and economic activity in Sandoval County is primarily in the city of Rio Rancho. It is near the Albuquerque metropolitan area, in the southeastern corner of the county. As such, most population and economic data for Sandoval County can be attributed to economic activity from the Albuquerque area. There is some economic contribution from the oil and gas industry; however, the portion of the San Juan Basin oil and gas development in Sandoval County is relatively small. It is expected to have a minor contribution to the economy, compared with that of Albuquerque.

Where possible, additional data or discussions of the conditions outside of Rio Rancho are included in this section. Data for areas outside of Rio Rancho in Sandoval County were calculated by subtracting the data for Rio Rancho from the data for Sandoval County.

Measuring changes in population and migration over time can be an indicator of economic or social trends or changes in an area. These statistics are also used in federal funding allocations in a variety of sectors, including transportation, infrastructure, education, health care, and assistance programs.

In 2015, the New Mexico total population was 2,084,117. In the socioeconomic study area, populations ranged from 39,949 in Rio Arriba County to 136,638 in Sandoval County; for Tribal nations it ranged from 1,314 in the Ute Mountain Ute Tribe to 173,822 in the Navajo Nation.

The average population density for New Mexico was 17.2 persons per square mile in 2015. The population density for counties in the planning area in 2015 ranged from a low of 6.8 persons per square mile in Rio Arriba County to a high of 36.8 persons per square mile in Sandoval County. Tribal population densities in the study area ranged from 1.5 persons per square mile in the Ute Mountain Ute Tribe to 6.3 persons per square mile on the Navajo Nation.

In 2000, the population densities ranged from 7.0 persons per square mile in Rio Arriba County to 24.2 persons per square mile in Sandoval County. It ranged from 2.0 persons per square mile for the Ute Mountain Ute Tribe and Jicarilla Apache Nation to 6.6 persons per square mile for the Navajo Nation.

Between 2000 and 2015, population densities in McKinley and Rio Arriba counties decreased slightly, while population densities increased in Sandoval and San Juan Counties and New Mexico between the same 15-year period. Population density on the Jicarilla Apache Nation increased slightly between 2000 and 2015, while population densities decreased on the Navajo Nation Reservation and Ute Mountain Ute Tribe Reservation during the same 15-year period.

Population densities can change with immigration and emigration to an area following economic shifts, such as increased or decreased employment opportunities, like boom and bust oil and gas development.

In Sandoval County, the total population outside Rio Rancho in 2015 was 38,143, with a population density of 12.4 persons per square mile (**Table AE-42**).

Table AE-42
Study Area Population (2015 Estimate)

Location	Population 2000	Population 2010	Population 2015	Land Area (Square Miles)	Persons per Square Mile, 2000[1]	Persons per Square Mile, 2010	Persons per Square Mile, 2015
New Mexico Counties							
McKinley County	74,798	71,492	73,998	5,450	13.7	13.1	13.6
Rio Arriba County	41,190	40,246	39,949	5,861	7.0	6.9	6.8
Sandoval County	89,908	131,561	136,638	3,711	24.2	35.5	36.8
Sandoval County (excluding Rio Rancho)	(38,143)	(44,040)	(44,831)	(3,608)	(10.6)	(12.2)	(12.4)
San Juan County	113,801	130,044	125,133	5,513	20.6	23.5	22.7
New Mexico	1,819,045	2,059,179	2,084,117	121,298	15.0	16.9	17.2
Tribal Lands[1]							
Jicarilla Apache Nation	2,742	3,254	2,995	1,364	2.0	2.4	2.2
Navajo Nation	181,269	173,667	173,822	27,413	6.6	6.3	6.3
Ute Mountain Ute Tribe	1,712	1,742	1,314	864	2.0	2.0	1.5

Source: US Census Bureau 2000, 2010, 2015a

[1]No Navajo Nation Chapter data available for 2000, or for land area, populations For 2010 and 2015 included in AE-43 .

In 2015, 91,807 people resided in Rio Rancho, which is close to Albuquerque. This constitutes most of the population of Sandoval County; however, Rio Rancho does not lie in the planning area, so it is more heavily influenced by the economic and social conditions of Albuquerque than of the planning area.

The largest population center in the planning area is Farmington in San Juan County. Other population centers are Gallup, with a population of 22,467 in 2015, and Española in Rio Arriba County, with a population of 10,168 in 2015 (US Census Bureau 2015a; **Table AE-43**).

Table AE-44, Study Area Population Trends (1980–2015), below, shows that the total population increased significantly in the study area since 1980, with the highest growth rates occurring from 1990 to 2000. Between 1980 and 1990, every county and Tribal nation in the study area increased in population. Population growth ranged from 7.3 percent in McKinley County to 82.0 percent in Sandoval County; it ranged from 10.9 percent in the Ute Mountain Ute Tribe to 31.1 percent in the Jicarilla Apache Nation. New Mexico increased in population by 16.2 percent during the same period. For Navajo Nation chapters, the majority of chapters experienced population decreases for the time period with available data (2010-2015), with declines seen in all chapters with the exception of Becenti, Hogback and Nenahnezad/San Juan.

Table AE-43
Study Area Population Centers (2015 Estimate)

Location	Population (2015)	In Planning Area?
McKinley County		
Gallup	22,467	Yes
Rio Arriba County		
Espanola	10,168	No
Sandoval County		
Rio Rancho	91,807	No
Bernalillo	8,522	No
San Juan County		
Aztec	6,501	Yes
Farmington	44,865	Yes
Bloomfield	7,735	Yes

Source: US Census Bureau 2015a

Table AE-44
Study Area Population Trends (1980–2015)

Location	1980	1990	1980–1990 Percent Change	2000	1990–2000 Percent Change	2010	2000–2010 Percent Change	2015	2010–2015 Percent Change	1980–2015 Percent Change
New Mexico Counties										
McKinley County	56,536	60,686	7.3	74,798	23.3	71,492	-4.4	73,998	3.5	30.9
Rio Arriba County	29,282	34,365	17.4	41,190	19.9	40,246	-2.3	39,949	-0.7	36.4
Sandoval County	34,799	63,319	82.0	89,908	42.0	131,561	46.3	136,638	3.9	292.6
Sandoval County (excludes Rio Rancho)	(24,814)[1]	(30,814)	(24.2)	(38,143)	(23.8)	(44,040)	15.4	(44,831)	1.8	80.7
San Juan County	81,433	91,605	12.5	113,801	24.2	130,044	14.3	125,133	-3.8	53.7
New Mexico	1,303,445	1,515,069	16.2	1,819,045	20.1	2,059,179	13.2	2,084,117	1.2	59.9
Tribes										
Jicarilla Apache Nation	1,996	2,617	31.1	2,742	4.8	3,254	18.7	2,995	-8.0	50.0
Navajo Nation	110,443	144,000*	30.4	181,269	25.9	173,667	-4.2	173,822	<0.1	57.4
Ute Mountain Ute Tribe	1,138	1,262*	10.9	1,712	35.7	1,742	1.8	1,314	-24.6	15.5
Navajo Nation Chapters[2]										
Becenti Chapter	–	–	–	–	–	403	–	462	14.6	–
Burnham Chapter	–	–	–	–	–	280	–	184	-34.3	–
Counselor Chapter	–	–	–	–	–	870	–	681	-21.7	–
Fruitland Chapter	–	–	–	–	–	2,751	–	2,581	-6.2	–
Hogback Chapter	–	–	–	–	–	1,215	–	1,315	-8.2	–
Huerfano Chapter	–	–	–	–	–	2,633	–	2,635	<.01	–
Lake Valley Chapter	–	–	–	–	–	306	–	303	-.01	–
Nageezi Chapter	–	–	–	–	–	1,095	–	889	-18.8	–

Location	1980	1990	1980–1990 Percent Change	2000	1990–2000 Percent Change	2010	2000–2010 Percent Change	2015	2010–2015 Percent Change	1980–2015 Percent Change
Nenahnezad/San Juan Chapter	–	–	–	–	–	1,792	–	1,959	9.3	–
Newcomb Chapter	–	–	–	–	–	629	–	564	-10.3	–
Ojo Encino Chapter	–	–	–	–	–	688	–	629	-8.6	–
Pueblo Pintado Chapter	–	–	–	–	–	419	–	415	-.01	–
Sanostee Chapter	–	–	–	–	–	1,795	–	1,616	-10.0	–
Torreon Chapter	–	–	–	–	–	1,612	–	1,548	-4.0	–
White Horse Lake Chapter	–	–	–	–	–	406	–	316	-22.2	–
White Rock Chapter	–	–	–	–	–	76	–	51	-39.9	–

Sources: US Census Bureau 1980, 1990, 2000, 2010, 2015a; *Pritzker 2000

[1]Population data are from Rio Rancho Estates, which was incorporated as the City of Rio Rancho in 1981.

[2]No Navajo Nation chapter data available for 1980-2000

Notably, due to nonparticipation or low participation rates, data points for 1990 for the Navajo Nation and the Ute Mountain Ute Tribe are not available in the nationwide census data; instead they were taken from Pritzker (2000). Navajo Nation chapter data from the US Census Bureau is available for only 2010 and newer.

All counties and Tribal nations increased in population between 1990 and 2000. The greatest increase was in Sandoval County (42.0 percent) and the Ute Mountain Ute Tribe (35.7 percent); the lowest increases were in Rio Arriba County (19.9 percent) and the Jicarilla Apache Nation (4.8 percent). New Mexico as a whole showed a 20.1 percent increase during this time.

From 2000 to 2010, the population in all counties of the study area, except Sandoval, showed a slower rate of growth from the two previous decades. New Mexico grew by 13.2 percent during this period. McKinley and Rio Arriba Counties showed negative growth of -4.4 percent and -2.3 percent, and the Navajo Nation showed negative growth of -4.2 percent. Sandoval and San Juan Counties showed a positive growth of 46.3 percent and 14.3 percent, and the Jicarilla Apache Nation and Ute Mountain Ute Tribe also showed positive growth of 18.7 percent and 1.8 percent.

The study area population again grew less intensely from 2010 to 2015, and some areas saw population decreases. The percent change in population ranged from a loss of 3.8 percent in San Juan County to a 3.9 percent gain in Sandoval County. Tribal population percent change ranged from a loss of over 24 percent for Ute Mountain Ute Tribe to a less than 0.1 percent gain for the Navajo Nation. For Navajo Nation chapters, a decline in population was seen in 13 of 16 Chapters. The remaining chapters had no change in population (Lake Valley Chapter), or moderate gains (14.6 percent increase in Becenti Chapter and 9.3 percent increase in Nenahnezad/San Juan Chapter).

There is some evidence that residents involved in the oil and gas industry have left the planning area communities for employment in other areas, with the recent downfall in oil prices and production in the San Juan Basin. According to the *USA Today* article dated April 8, 2016, "America's Fastest-Shrinking Cities," Farmington metropolitan area population shrank 8.8 percent from 2010 to 2015 and had among the highest outward migration rates in the nation (Frohlich 2016).

Overall, New Mexico's population grew by 59.9 percent from 1980 to 2015. Sandoval County saw the greatest percent change in population during this time, at 292.6 percent, while McKinley County saw the smallest percent change of 30.9. In Sandoval County, most of this growth came from the rapid expansion of Rio Rancho. For areas outside Rio Rancho, Sandoval County saw an overall steady growth between 1980 and 2015 of 80.7 percent. While much smaller than the growth experienced by Rio Rancho, this area still outpaced other counties in the planning area. Of the Tribes, the Navajo Nation population grew the most, at 57.4 percent, while the Ute Mountain Ute Tribe saw the smallest population increase of 15.5 percent.

Population in the planning area is projected to increase for all counties from 2015 to 2030, based on a University of New Mexico, Bureau of Business and Economic Research study (2017). After 2030, there are predicted slight population declines in McKinley County and Rio Arriba County, but populations are expected to increase in other counties, with Sandoval County having the greatest projected growth through 2040 (54.0 percent); San Juan County is expected to grow by 12.0 percent from 2015 to 2040. The population of New Mexico is projected to grow by 14.4 percent in the next 25 years. (No population projection data were available for the three Tribal nations.) See **Table AE-45**, below.

Place of birth. Compared with current residence, place of birth can have important social implications for communities, as it affects the ties that residents have to the community and the region. Domestic in-migration plays a moderate role in the demographics of the counties and Tribal nations that comprise the socioeconomic study area. See **Table AE-46**, below.

For all counties and Tribal nations, there are a higher percentage of residents living in the study area born in New Mexico than those who were born in another state and moved to the study area.

Table AE-45
Study Area Population Estimates and Projections (2015–2040)

County	2015 Estimate	2020 Projection	2025 Projection	2030 Projection	2035 Projection	2040 Projection	Percent Change 2015–2040
McKinley	75,397	76,435	76,604	76,623	76,256	75,365	0
Rio Arriba	39,752	41,212	40,649	40,041	39,332	38,496	-3.2
Sandoval (includes Rio Rancho)	138,928	148,708	163,767	180,269	197,371	213,929	54.0
San Juan	123,979	128,162	131,278	134,446	137,173	138,762	12.0
New Mexico	2,099,856	2,187,183	2,247,564	2,308,475	2,360,091	2,401,480	14.4

Source: University of New Mexico 2017
Note: Data were not available for Tribal nations or Navajo Nation chapters and are not included in the study area totals for this table.

Table AE-46
Study Area Place of Birth (2015)[1]

Location	Native (Percent Native Born in the US)	Born in State of Residence (Percent Born in New Mexico)	Born in Other State (Percent Born in Other US State)	Born Outside the US (Percent Born in US territory or abroad to American Parents)	Foreign born (Percent Foreign Born, Naturalized US Citizen, and not US Citizen)	Foreign Born (Percent Foreign Born, Naturalized Citizen)	Foreign Born (Percent Foreign Born, not US Citizen)
New Mexico Counties							
McKinley County	97.7	77.8	19.2	0.7	2.3	0.9	1.3
Rio Arriba County	94.3	77.7	15.9	0.6	5.7	1.7	4.0
Sandoval County (includes Rio Rancho)	94.5	50.8	42.6	1.2	5.5	3.4	2.0
San Juan County	96.3	58.8	37.1	0.4	3.7	1.1	2.7
New Mexico	90.2	52.7	36.4	1.1	9.8	3.4	6.4
Tribes							
Jicarilla Apache Nation	98.5	88.9	9.4	0.2	1.5	0.7	0.8
Navajo Nation	99.2	82.9	16.2	0.1	0.8	0.2	0.6
Ute Mountain Ute Tribe	98.8	68.3	30.0	0.5	1.2	0.0	1.2

Source: US Census Bureau 2015a
[1]American Community Survey estimates are based on data collected over 5 years. The estimates represent the average characteristic of population and housing between January 2011 and December 2015 and do not represent a single point in time.

Sandoval County has the highest domestic immigration rate (42.6 percent), while Rio Arriba County has the lowest (15.9 percent). For the Tribal nations, the Ute Mountain Ute Tribe had the highest domestic immigration rate, at 30.0 percent, while the Jicarilla Apache Nation had the lowest rate, at 9.4 percent.

Foreign immigration plays a much smaller role in the demographics of the planning area. For all counties and Tribal nations, the percentage of those who were not born in the United States but are living in the study area is less than 6 percent, which is less than the state average of 9.8 percent.

Housing

Housing availability in an area is one indicator of the ability of an area to accommodate any changes in population that may occur as a result of proposed management actions (i.e. potential for increased development). For most of the counties in the study area, the number of housing units changed considerably between 2000 and 2015. The most dramatic change was in Sandoval County, where the number of units increased by 53.9 percent. The only county to have a decrease in units was McKinley (-3.5 percent). The change in the remaining counties ranged from 8.6 percent in Rio Arriba County to 14.7 percent in San Juan County. Both of these are below the state rate of change of 16.5 percent. Over the entire study area, the number of units increased by 17.3 percent (**Table AE-47**). The increase in Sandoval County follows the change from rural to suburban development due to its proximity to Albuquerque, as seen throughout many areas in the region.

Table AE-47
Socioeconomic Study Area Household Characteristics (2000 to 2015 Comparison)

Location	Average Household Size			Total Housing Units			Housing Units Percent Change 2000-2015	Occupied Housing Units			Vacant Housing Units					
	2000	2010	2015	2000	2010	2015[1]		2000	2010	2015	2000	Percent Vacant 2000	2010	Percent Vacant 2010	2015	Percent Vacant 2015
New Mexico Counties																
McKinley County	3.44	3.96	3.97	26,718	25,813	25,780	-3.5	21,476	21,968	18,449	5,242	19.6	3,845	14.9	7,331	28.4
Rio Arriba County	2.71	2.65	2.86	18,016	19,638	19,564	8.6	15,044	15,768	13,730	2,972	16.5	3,870	19.7	5,834	29.8
Sandoval County (includes Rio Rancho)	2.84	2.75	2.83	34,866	52,287	53,675	53.9	31,411	47,602	47,931	3,455	9.9	4,685	9.0	5,744	10.7
San Juan County	2.99	3.01	3.04	43,221	49,341	49,562	14.7	37,711	44,404	40,643	5,510	12.7	4,937	10.0	8,919	18.0
New Mexico	2.63	2.61	2.67	780,579	901,388	909,565	16.5	677,971	791,395	763,303	102,608	13.1	109,993	13.9	145,962	16.0
Tribes (for Reference Purposes)																
Jicarilla Apache Nation	N/A	3.47	3.48	N/A	1,175	1,134	N/A	N/A	1,028	845	N/A	N/A	147	12.5	289	25.5
Navajo Nation	N/A	3.86	3.93	N/A	63,998	67,113	N/A	N/A	49,946	44,008	N/A	N/A	14,052	22.0	23,105	36.1
Ute Mountain Ute Tribe	N/A	2.77	2.79	N/A	630	576	N/A	N/A	540	457	N/A	N/A	90	14.3	119	20.7
Navajo Nation Chapters[2]																
Becenti	N/A	4.06	4.56	N/A	202	185	N/A	N/A	781	103	N/A	N/A	1121	59.9	82	44.3
Burnham	N/A	3.21	2.69	N/A	131	122	N/A	N/A	61	69	N/A	N/A	70	53.4	53	43.4
Counselor	N/A	2.51	3.44	N/A	463	307	N/A	N/A	291	200	N/A	N/A	172	37.1	107	34.9
Fruitland	N/A	3.92	3.80	N/A	868	827	N/A	N/A	661	639	N/A	N/A	207	23.8	188	22.7
Hogback	N/A	3.93	3.79	N/A	468	453	N/A	N/A	352	348	N/A	N/A	116	24.8	105	23.2
Huerfano	N/A	3.62	3.68	N/A	831	940	N/A	N/A	617	687	N/A	N/A	214	25.8	253	26.9
Lake Valley	N/A	4.46	2.56	N/A	177	164	N/A	N/A	69	108	N/A	N/A	108	61.0	56	34.1
Nageezi	N/A	5.07	3.49	N/A	519	403	N/A	N/A	305	256	N/A	N/A	214	41.2	147	36.5
Nenahnezad/ San Juan	N/A	3.62	4.79	N/A	665	548	N/A	N/A	481	424	N/A	N/A	184	27.7	124	22.6

Location	Average Household Size			Total Housing Units			Housing Units Percent Change 2000-2015	Occupied Housing Units			Vacant Housing Units					
	2000	2010	2015	2000	2010	2015[1]		2000	2010	2015	2000	Percent Vacant 2000	2010	Percent Vacant 2010	2015	Percent Vacant 2015
Newcomb	N/A	3.22	3.09	N/A	297	287	N/A	N/A	179	184	N/A	N/A	118	39.7	103	35.9
Ojo Encino	N/A	3.03	3.59	N/A	247	246	N/A	N/A	163	163	N/A	N/A	84	34.0	83	33.7
Pueblo Pintado	N/A	4.66	3.56	N/A	191	181	N/A	N/A	133	110	N/A	N/A	58	30.4	71	39.2
Sanostee	N/A	3.01	3.21	N/A	1,149	970	N/A	N/A	553	518	N/A	N/A	596	51.9	452	46.6
Torreon	N/A	4.25	4.77	N/A	609	459	N/A	N/A	423	333	N/A	N/A	186	30.5	126	27.5
White Horse Lake	N/A	4.42	3.29	N/A	225	205	N/A	N/A	109	93	N/A	N/A	116	51.6	112	54.6
White Rock	N/A	5.55	2.58	N/A	62	40	N/A	N/A	15	20	N/A	N/A	47	75.8	20	50.0

Source: US Census Bureau 2000, 2010, 2015a

[1]American Community Survey estimates are based on data collected over 5 years. The estimates represent the average characteristics of population and housing between January 2011 and December 2015 and do not represent a single point in time.

Note: The US Census in 2000 did not collect equivalent housing data for Tribal areas.

In 2015, housing vacancy rates in the study area ranged from a low of 10.7 percent in Sandoval County to a high of 29.8 percent in Rio Arriba County. Sandoval County and San Juan County had a 10.7 and 18.0 percent vacancy rate, respectively, while the state value was 16.0 percent. The overall vacancy rate for the study area was 18.7 percent.

While housing data were not collected for Tribal nations in 2000, data from 2010 and 2015 can be used to compare current vacancy rates. For all three Tribal nations, the 2015 vacancy rates were higher than the state average, with the Navajo Nation having the highest vacancy rate, at 36.1 percent. For Navajo Nation chapters, vacancy rates ranged from 22.5 to 50 percent, with the majority higher than the state and county level.

Housing Characteristics data (**Table AE-48**, Characteristics of Occupied Housing Units (2016)) demonstrate that compared to county levels, Navajo Nation chapters have a higher levels of housing units lacking complete plumbing facilities and kitchens, and a higher reliance on wood as a fuel source. This data is discussed further under Environmental Justice, **Section AE.5.3.**

Income Distribution and Poverty Level

Income distribution. The planning area population has a wide range of income levels. Overall median household income decreased for all counties between 2000 and 2015 (values adjusted to 2015 dollars for inflation), except for San Juan County, which saw an increase in median household income of 6.1 percent. In 2015, Sandoval County had the highest median household income, at $58,982; McKinley County had the lowest, at $28,772.

Per capita income increased from 2000 to 2015, with all counties in the study area exhibiting higher average per capita income levels in that period, except for McKinley County, where per capita income decreased by 6 percent. The highest increase was in San Juan County (15.7 percent) and the lowest (1.5 percent) in Rio Arriba County (US Census Bureau 2015b). In 2015, Sandoval was the only county to surpass the state per capita income of $24,012.

While specific data are not available for median household and per capita incomes for areas outside of Rio Rancho in Sandoval County, these income levels can be inferred by using data for Rio Rancho. The median household income for Rio Rancho in 2015 was $60,893, higher than the county and state averages. This indicates that the median household income for the rest of the county is lower than the county average. The same holds true for per capita income, which was $27,004, again higher than the state and county levels, in Rio Rancho in 2015.

In 2000, only Sandoval County had a median household or per capita income greater than the state average. Between 2000 and 2015, San Juan County had the greatest percent change, boosting its median household income to greater than the state median household income by 2015. McKinley County had the lowest percent change for both categories, leaving income values well below the state average (**Table AE-49**).

Income data for Tribal nations are not available for Census Year 2000, so equal comparisons cannot be made between the counties and the Tribal nations for income distribution. American community survey data for 2011 to 2015 are available, and comparisons can be made for reference purposes. Both the Navajo Nation and the Ute Mountain Ute Tribe had median household incomes, well below the New Mexico average, but the Jicarilla Apache Nation was greater than the state average; however, all of the Tribal nations were below the state average for per capita income. Similarly, all Navajo Nation chapters had median household incomes below that of the state average, with 10 of 16 chapters less than half of the state level. Per capita income exhibited similar trends.

Table AE-48
Characteristics of Occupied Housing Units (2016)

Housing Unit	No Vehicles Available	Lacking Complete Plumbing Facilities	Lacking Complete Kitchen facilities	No Telephone Service Available	Heated with Utility Gas or Electricity	Heated with Wood
			(Percent)			
New Mexico Counties						
McKinley County	12.0	10.4	7.3	11.4	49.6	38.4
Rio Arriba County	5.3	.6	.5	3.6	65.2	20.8
Sandoval County (includes Rio Rancho)	3.0	1	1	3.6	86.2	5.2
San Juan County	5.6	2.5	2.5	4..4	69.2	14.3
New Mexico	5.8	1	1	3.4	83.4	6.8
Tribes (for Reference Purposes)						
Jicarilla Apache Nation	12.7	0	.5	8.9	79.8	11.4
Navajo Nation	13.8	19.8	14.8	15.6	24.0	63.4
Ute Mountain Ute Tribe	8.3	0.6	0	27.4	8.9	6.8
Navajo Nation Chapters						
Becenti	6.7	9.5	7.6	23.8	9.8	70.5
Burnham	20.0	35.0	27.5	5.0	5.0	78.8
Counselor	21.0	34.5	40.8	24.8	5.4	90.8
Fruitland	7.5	3.6	3.6	1.1	16.3	38.3
Hogback	9.1	12.5	11.9	8.5	11.8	47.1
Huerfano	9.0	10.7	7.1	9.4	25.2	52.4
Lake Valley	17.0	33.9	26.8	27.7	8.9	71.4
Nageezi	20.2	21.3	30.0	19.4	8.7	82.2
Nenahnezad/ San Juan	6.6	12.4	11.7	7.1	21.5	54.4
Newcomb	17.8	18.3	15.4	14.4	27.4	62.0
Ojo Encino	8.0	20.7	19.3	33.3	15.3	70.0
Pueblo Pintado	18.3	20.9	24.3	35.7	7.0	72.2
Sanostee	19.6	16.9	15.8	9.7	14.1	77.1
Torreon	13.5	27.6	21.6	17.2	6.8	80.5
White Horse Lake	18.4	61.2	50.5	49.5	4.9	84.5
White Rock	4.5	13.6	9.1	22.7	0	81.8

Source: US Census Bureau 2016b

[1]American Community Survey estimates are based on data collected over 5 years. The estimates represent the average characteristics of population and housing between January 2012 and December 2016 and do not represent a single point in time.

Table AE-49
Study Area Income Distribution (2000 to 2015 Comparison)[2]

Income	Median Household Income in 2015 Dollars				Per Capita Income in 2015 Dollars				Individuals Below Poverty Level (Percent)				Families Below Poverty Level (Percent)			
	2000	2010	2015[1]	Percent Change 2000-2015	2000	2010	2015[1]	Percent Change 2000-2015	2000	2010	2015[1]	Percent Change 2000-2015	2000	2010	2015[1]	Percent Change 2000-2015
New Mexico Counties																
McKinley County	33,990	33,815	28,772	-15.4	13,419	13,955	12,614	-6.0	36.1	33.4	37.5	3.9	31.9	26.6	32.3	1.3
Rio Arriba County	40,003	44,716	36,098	-9.8	19,388	21,489	19,678	1.5	20.3	19.6	23.7	16.7	16.6	15.7	17.0	2.4
Sandoval County (includes Rio Rancho)	61,101	61,682	58,982	-3.5	26,064	28,035	26,742	2.6	12.1	11.4	14.2	17.4	9.0	8.3	9.9	10
San Juan County	45,894	49,844	48,671	6.1	19,414	22,365	22,460	15.7	21.5	20.8	20.0	-7.0	18.0	15.9	15.7	-12.8
New Mexico	46,398	47,288	44,963	-3.1	23,464	24,784	24,012	2.3	18.4	18.4	21.0	14.1	14.5	13.9	15.9	9.7
Tribes																
Jicarilla Apache Nation	N/A	47,807	38,438	–	N/A	16,850	15,406	–	N/A	19.9	24.4	–	N/A	16.5	18.7	–
Navajo Nation	N/A	28,308	26,203	–	N/A	11,382	10,908	–	N/A	37.7	41.7	–	N/A	32.3	37.5	–
Ute Mountain Ute Tribe	N/A	29,125	27,773	–	N/A	13,058	12,611	–	N/A	34.3	32.2	–	N/A	40.3	38.2	–
Navajo Nation Chapters[1]																
Becenti Chapter	N/A	20,447	24,821	–	N/A	8,253	12,291	–	N/A	21.7	43.9	–	N/A	19.9	44.6	–
Burnham Chapter	N/A	38,276	12,917	–	N/A	12,280	8,552	–	N/A	26.4	57.6	–	N/A	28.1	59.1	–
Counselor Chapter	N/A	16,234	15,536	–	N/A	9,147	7,089	–	N/A	25.9	69.9	–	N/A	36.4	60.1	–
Fruitland Chapter	N/A	46,512	37,232	–	N/A	14,503	13,428	–	N/A	16.7	32.5	–	N/A	20.2	27.2	–
Hogback Chapter	N/A	36,500	34,231	–	N/A	14,070	13,517	–	N/A	27.2	26.1	–	N/A	31.5	25.7	–
Huerfano Chapter	N/A	30,381	28,633	–	N/A	13,197	10,708	–	N/A	25.2	38.1	–	N/A	29.7	34.0	–
Lake Valley Chapter	N/A	29,828	20,417	–	N/A	10,039	11,497	–	N/A	39.7	43.6	–	N/A	37.0	39.4	–
Nageezi Chapter	N/A	24,325	21,111	–	N/A	7,471	9,205	–	N/A	33	50.3	–	N/A	32.3	43.8	–
Nenahnezad/San Juan Chapter	N/A	44,321	32,375	–	N/A	15,982	10,566	–	N/A	17.4	31.5	–	N/A	16.9	30.1	–

Income	Median Household Income in 2015 Dollars				Per Capita Income in 2015 Dollars				Individuals Below Poverty Level (Percent)				Families Below Poverty Level (Percent)			
	2000	2010	2015[1]	Percent Change 2000-2015	2000	2010	2015[1]	Percent Change 2000-2015	2000	2010	2015[1]	Percent Change 2000-2015	2000	2010	2015[1]	Percent Change 2000-2015
Newcomb Chapter	N/A	24,717	23,750	–	N/A	12,880	14,183	–	N/A	42	35.5	–	N/A	38.7	34.2	–
Ojo Encino Chapter	N/A	16,881	19,583	–	N/A	8,749	7,099	–	N/A	27.9	58.6	–	N/A	39.7	52.9	–
Pueblo Pintado Chapter	N/A	30,468	19,000	–	N/A	7,311	9,421	–	N/A	21.6	52.5	–	N/A	37.1	46.2	–
Sanostee Chapter	N/A	20,735	20,152	–	N/A	14,035	10,664	–	N/A	19.4	45.5	–	N/A	26.5	40.2	–
Torreon Chapter	N/A	33,223	24,583	–	N/A	9,638	8,445	–	N/A	35.2	49.1	–	N/A	45.4	46.4	–
White Horse Lake Chapter	N/A	19,436	12,708	–	N/A	7,458	8,030	–	N/A	43.7	53.2	–	N/A	56.9	43.1	–
White Rock Chapter	N/A	13,819	20,833	–	N/A	4,455	11,916	–	N/A	63.6	29.4	–	N/A	76.9	23.1	–

Source: US Census Bureau 2000, 2010, 2010b[1], 2015a

[1]American Community Survey estimates are based on data collected over 5 years. The estimates represent the average characteristics of population and housing over a 5 year period and do not represent a single point in time. US Census Bureau 2015 data represents 2011-2015, and 2010b data displayed for Navajo Nation Chapters represents 2006-2010.

2000 and 2010 values were adjusted for inflation to 2015 dollars using the Bureau of Labor Statistics CPI Inflation Calculator for the purposes of comparison (BLS 2017c).

Note: The US Census did not collect equivalent income data for Tribal nations or Navajo Nation chapters in 2000.

Income source. Income is derived from two major sources: labor earnings (income from the workplace) and non-labor income. The latter source includes dividends, interest, and rent (collectively often referred to as money earned from investments), and transfer payments (payments from governments to individuals, including Medicare, disability, and Social Security insurance payments). Labor income is the main source of income for all study area counties; however, non-labor income provides a significant percentage in some counties.

McKinley County had the highest percentage of non-labor personal income in the study area for 2015, at 50.9 percent. McKinley County and Rio Arriba County both had higher non-labor income percentages than the state average of 42.6 percent, while Sandoval County and San Juan County had lower percentages than the state average (BEA 2016; **Table AE-50**).

Table AE-50
Study Area Labor and Nonlabor Income (2015)

County	Personal Income Total (Thousands of Dollars)	Labor Income (Net Earnings)		Nonlabor Income (Dividends, Interest, Rent, Personal Transfer Receipts)	
		Thousands of Dollars	Percent of Personal Income Total	Thousands of Dollars	Percent of Personal Income Total
New Mexico Counties					
McKinley County	1,914,651	941,028	49.1	973,623	50.9
Rio Arriba County	1,289,437	638,679	49.5	650,757	50.5
Sandoval County (includes Rio Rancho)	5,349,613	3,466,619	64.8	1,882,994	35.2
San Juan County	4,543,789	2,903,134	63.9	1,640,655	36.1
New Mexico	80,132,447	46,021,113	57.4	34,111,334	42.6

Source: BEA 2016 (Table CA5N)
Notes:
All state and local area dollar estimates are in 2016 dollars.
Nonlabor income and labor earnings may not add to total personal income because of adjustments made by the BEA analysis to account for contributions for Social Security, cross-county commuting, and other factors.
Labor and non-labor personal income data are not available for Tribal nations or Navajo Nation chapters.

Income inflow and outflow. Data collected for personal income may not accurately reflect the money available in a community if a high percentage of area workers live outside of the community. Earnings from those commuting into the study area counties were compared with earnings from those commuting out of the counties to work. Net flow, also known as net residential adjustment, is simply inflow minus outflow. If a county has positive net flow, this indicates that the commuters who live in the county are bringing more income into the county (inflow) than commuters from elsewhere are taking out (outflow).

In 2015, only McKinley County experienced a negative net residential adjustment, indicating that there is significant in-commuting to this county from other counties. Rio Arriba, Sandoval, and San Juan counties all had positive net residential adjustments. This indicates that these counties may be bedroom communities, with income derived from workers commuting out of the county exceeding the income of workers commuting in. For a more detailed breakdown, refer to **Table AE-51**, Study Area Income Inflow and Outflow (2015), below.

The BEA compiles data by county, metropolitan, micropolitan, and other statistical areas, as defined by the Office of Management and Budget. Tribal areas are not included as part of these definitions, and equivalent data are not available for an accurate comparison with the counties in the study area; consequently, Tribal members' income data are not discussed in this report.

Table AE-51
Study Area Income Inflow and Outflow (2015)[1]

Location	Outflow of Earnings ($1,000)	Inflow of Earnings ($1,000)	Net Flow ($1,000)
New Mexico Counties			
McKinley County	124,536	114,545	-9,991
Rio Arriba County	94,480	302,525	208,045
Sandoval County (includes Rio Rancho)	501,384	2,245,345	1,743,961
San Juan County	150,996	185,096	34,100

Source: BEA 2016 (Table CA91)
[1]BEA data are not available for Tribal nations or Navajo Nation chapters.
Note: Outflow is defined as personal income earnings that are leaving the county through workers that work in the county but reside outside of the county. Inflow is personal income earned outside the county by workers who reside in the county.
All dollar estimates are in 2016 dollars and are not adjusted for inflation.

Poverty level. The percent of individuals below the poverty level, according to 2011 to 2015 estimates, ranged from 14.2 percent in Sandoval County to 37.5 percent in McKinley County. Rio Arriba County (23.7 percent) and San Juan County (20.0 percent) had rates of individuals below the poverty level close to the state average (21.0 percent). All counties saw minor reductions in individual poverty levels from 2000 to 2010, ranging from less than 1 to 2.5 percent (US Census Bureau 2010).

From 2010 to 2015, the percentage of families below the poverty level ranged from a low of 9.9 percent in Sandoval County to a high of 32.3 percent in McKinley County. San Juan County (15.7 percent) and Sandoval County both had lower rates of families below the poverty level than the New Mexico average (15.9 percent); McKinley County and Rio Arriba County (17.0 percent) were above the state average. Only Sandoval County saw a minor reduction in family poverty levels from 2010 to 2015 (0.2 percent). All other counties saw increases in family poverty levels from 2010 to 2015, ranging from 1.6 to 5.7 percent, which is greater than the state increase of 2.0 percent between 2010 and 2015 (US Census Bureau 2015b).

Equivalent income data for Tribal nations are not available for Census Year 2000, preventing comparisons of income distributions between the counties and Tribal nations in the study area for that period. Data for 2010 and 2015 are available, and comparisons can be made for reference purposes.

In 2015, the Jicarilla Apache Nation, Navajo Nation, and Ute Mountain Ute Tribe had percentages of individual poverty greater than the state average of 21.0 percent (24.4, 41.7, and 32.2 percent). Similar trends occurred for families below the poverty level; the Navajo Nation (37.5 percent) and the Ute Mountain Ute Tribe (38.2 percent) had much higher percentages of families below the poverty level, compared with the state average of 15.9 in 2015. The Jicarilla Apache Nation percentage of families in poverty (18.7 percent) is just above the state average (US Census Bureau 2016a). Similarly, in Navajo Nation chapters, poverty levels for individuals and families are higher than the state average. For most chapters, poverty levels are double that of the state population. Poverty levels are further discussed in **Section AE.5.3**, Environmental Justice.

Jobs and Employment

Employment of residents. Employment is a key economic indicator, as patterns of growth and decline in a region's employment are largely driven by economic cycles and local economic activity. Employment patterns are discussed below for the study area counties and Tribal nations.

The employment rates of the workforce population in the planning area counties ranges from 42.4 percent in McKinley County to 55.1 percent in Sandoval County; all counties were within a few percentage points of the state rate of 53.6 percent. Rio Arriba, Sandoval, and San Juan Counties and the state all have similar

rates of labor force participation, between 50.2 and 60.9 percent; McKinley County had a larger percentage of the population not in the workforce. This indicates that there may be many retirees or unemployed persons in the area who have dropped out of the pool of active job seekers.

For the Tribal nations, employment rates varied between 35.5 percent on the Navajo Nation Reservation lands to 58.9 percent in the Jicarilla Apache Nation Reservation lands (**Table AE-52**). For Navajo Nation chapters, there was similar variation, ranging from a low of 19 percent in Burnham Chapter to 44.2 percent in Fruitland Chapter. In general, chapters had a lower percent of labor force participation than that of the state or counties.

Table AE-52
Study Area Employment Status 2015[1] (Population 16 Years and Over)

Location	Total Population (16 Years and Over)	Labor Force Participation Rate (Percent)	Labor Force Employed[2] (Percent)	Unemployment Rate[3] (Percent)	Not in Labor Force (Percent)
New Mexico Counties					
McKinley County	53,919	50.2	42.4	15.5	49.8
Rio Arriba County	31,467	54.8	48.5	11.4	45.2
Sandoval County (includes Rio Rancho)	106,060	60.9	55.1	9.2	39.1
San Juan County	94,394	60.4	54.6	9.2	39.6
New Mexico	1,633,310	59.6	53.6	9.2	40.4
Tribes					
Jicarilla Apache Nation	1,987	66.9	58.9	11.9	33.1
Navajo Nation	126,882	44.5	35.5	21.5	55.5
Ute Mountain Ute Tribe	905	48.2	44.2	8.3	51.8
Navajo Nation Chapters					
Becenti Chapter	358	45.0	36.9	18.0	55.0
Burnham Chapter	147	35.4	19.0	46.2	64.6
Counselor Chapter	479	41.3	24.2	41.4	58.7
Fruitland Chapter	1880	52.2	44.2	15.4	47.8
Hogback Chapter	1076	45.3	36.6	19.1	54.7
Huerfano Chapter	1951	55.2	41.4	25.5	44.8
Lake Valley Chapter	228	44.3	33.3	24.8	55.7
Nageezi Chapter	622	44.7	32.3	27.7	55.3
Nenahnezad/San Juan Chapter	1405	47.8	36.2	24.1	52.2
Newcomb Chapter	440	48.6	38.9	20.1	51.4
Ojo Encino Chapter	410	45.4	30.0	33.9	54.6
Pueblo Pintado Chapter	336	52.2	31.7	39.2	47.9
Sanostee Chapter	1246	44.8	35.8	20.1	55.2
Torreon Chapter	1076	57.0	37.5	34.3	43.0
White Horse Lake Chapter	260	42.3	29.2	30.9	57.7
White Rock Chapter	45	28.9	24.4	15.4	71.1

Source: US Census Bureau 2015a

[1]American Community Survey estimates are based on data collected over 5 years. The estimates represent the average characteristics of populations and housing between January 2011 and December 2015 and do not represent a single point in time.

[2]Labor Force employed data represents percent of total population over 16 years and over employed in civilian employment . Armed forces employment was less than 0.5 percent of labor force for all populations examined and is not included in this table

[3]Employment rate represents percent of civilian labor force employed. US Census Bureau unemployment data may differ from data from the US Department of Labor, Bureau of Labor Statistics presented in **Table AE-48**, due to differences in collection methods.

The 2016 annual unemployment rates in McKinley County (15.5 percent), Rio Arriba (7.5 percent), and San Juan County (8.9 percent) were all higher than the average unemployment rate of 6.7 percent for New Mexico. Sandoval County unemployment rate was the same as the state, at 6.7 percent. It is likely that the low unemployment rate in Sandoval County is due to the Rio Rancho area and employment from businesses in Albuquerque (**Table AE-52**).

Annual trends in unemployment based on Bureau of Labor Statistics data have followed that of the state, with differences between the counties remaining. Since 2006, unemployment rates in have remained higher than the state for McKinley and Rio Arriba Counites. San Juan County and Sandoval County have generally been within one percentage point of the state average (**Table AE-53**). Unemployment rates from the Bureau of Labor Statistics are not available for Tribal nations or Navajo Nation chapters. American Community Survey Census Bureau data from 2011-2015 indicate that unemployment rates for Navajo Nation chapters were above the state average for all chapters and ranged from 15.4 percent in the Fruitland and White Rock chapters, to 46.2 percent in Burnham Chapter.

Table AE-53
Study Area Annual Unemployment Rate Percentages by County (2006–2016)

County	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
McKinley County	5.6	4.6	5.5	8.3	9.9	9.9	9.6	10.2	10.2	9.8	9.5
Rio Arriba County	5.5	4.8	5.5	7.6	9.2	9.3	9.2	9.5	8.8	8.0	7.5
Sandoval County (includes Rio Rancho)	4.3	4.3	5.2	8.5	8.4	8.0	7.8	7.5	7.2	6.7	6.7
San Juan County	4.3	3.4	3.9	7.9	9.4	7.9	7.1	6.8	6.4	6.9	8.9
New Mexico	4.2	3.8	4.5	7.5	8.1	7.5	7.1	7.0	6.7	6.6	6.7

Source: BLS 2017a
Note: Data are not seasonally adjusted to eliminate the impact of intra-year variations, which tend to occur during the same period annually. Data are not available for Tribal nations or Navajo Nation chapters from the BLS.

Based on 2015 data, the retail trade industry and the arts/entertainment/recreation/accommodation/food industry are the second and third largest employment sectors in the study area. They are surpassed only by the education/health care/social assistance industry. This sector is particularly important in McKinley County and in the Navajo Nation and Ute Mountain Ute Tribe, where 30 percent or more of the workforce is employed in these sectors. Public administration employment also plays a moderate role in the study area.

Similar trends are seen in the Navajo Nation chapters, where the education/health care/social assistance industries employ the largest percent of the workforce in all but one chapter.

The construction sector provides a sizable contribution to the employment spectrum in the study area. While construction sector figures include building for residential and commercial development, they also include infrastructure for energy development, which may include development on public lands.

The agriculture, forestry, fishing and hunting, and mining industries have a relatively small impact in most study area counties; however, for San Juan County these employment sectors play a much larger role, accounting for 11 percent of employment (US Census Bureau 2015a; **Table AE-54**).

Employment specific to the mining sector (including oil and gas) is examined in greater detail in **Table AE-55**, Employment in Mining 2015.

Table AE-54
Study Area Employment by Industry Sector (2015)[1]

Location	Agriculture, forestry, fishing and hunting, and mining	Construction	Manufacturing	Wholesale trade	Retail trade	Transportation and warehousing, utilities	Information	Finance and insurance, real estate and rental leasing	Professional, scientific, management, and administrative	Education, health care, social assistance	Arts, entertainment, recreation, accommodation, food	Other services, except public administration	Public administration	Total employment
New Mexico Counties														
McKinley	700	1,348	1,434	470	2,780	919	320	588	1,150	7,767	2,631	657	2,101	–
County	3.1%	5.9%	6.3%	2.1%	12.2%	4.0%	1.4%	2.6%	5.0%	34.0%	11.5%	2.9%	9.2%	22,865
Rio Arriba	326	1,285	226	136	1,306	613	108	599	2,103	3,593	2,146	757	2,074	–
County	2.1%	8.4%	1.5%	0.9%	8.6%	4.00%	0.7%	3.9%	13.8%	23.5%	14.1%	5.0%	13.6%	15,272
Sandoval	878	4,078	4,795	1,270	6,904	2,507	1,291	3,332	6,252	14,159	6,145	2,360	4,462	58,433
County	1.5%	7.0%	8.2%	2.2%	11.8%	4.3%	2.2%	5.7%	10.7%	24.2%	10.5%	4.0%	7.6%	–
San Juan	5,713	3,847	2,046	1,644	6,678	3,476	491	1,922	3,387	12,111	4,597	2,886	2,763	51,561
County	11.1%	7.5%	4.0%	3.2%	13.0%	6.7%	1.0%	3.7%	6.6%	23.5%	8.9%	5.6%	5.4%	
New Mexico	39,103	59,855	41,183	19,106	99,211	39,036	13,681	36,658	98,163	220,235	97,501	42,100	67,203	876,035
	4.5%	6.8%	4.7%	2.2%	11.3%	4.5%	1.6%	4.2%	11.2%	25.1%	11.1%	4.8%	7.7%	–
Tribes														
Jicarilla	60	71	0	39	79	23	10	43	18	236	97	17	478	1,171
Apache Nation	5.1%	6.1%	0.0%	3.3%	6.7%	2.0%	0.9%	3.7%	1.5%	20.2%	8.3%	1.5%	40.8%	–
Navajo Nation	1,579	4,026	1,507	402	4,070	2,335	347	949	1,468	17,676	4,589	1,194	4,231	44,373
	3.6%	9.1%	3.4%	0.9%	9.2%	5.3%	0.8%	2.1%	3.3%	39.8%	10.3%	2.7%	9.5%	–
Ute Mountain	9	33	11	2	17	4	0	5	4	123	53	28	110	400
Ute Tribe	2.3%	8.3%	2.8%	0.5%	4.3%	1.0%	0.0%	1.3%	1.0%	30.8%	13.3%	7.0%	27.5%	–
Navajo Nation Chapters														
Becenti	9	9	0	0	13	3	0	2	1	77	5	0	13	132
Chapter	6.8%	6.8%	0.0%	0.0%	9.8%	2.3%	0.0%	1.5%	0.8%	58.3%	3.8%	0.0%	9.8%	–
Burnham	2	4	0	1	0	4	0	0	2	4	10	0	1	28
Chapter	7.1%	14.3%	0.0%	3.6%	0.0%	14.3%	0.0%	0.0%	7.1%	14.3%	35.7%	0.0%	3.6%	–

Location	Agriculture, forestry, fishing and hunting, and mining	Construction	Manufacturing	Wholesale trade	Retail trade	Transportation and warehousing, utilities	Information	Finance and insurance, real estate and rental leasing	Professional, scientific, management, and administrative	Education, health care, social assistance	Arts, entertainment, recreation, accommodation, food	Other services, except public administration	Public administration	Total employment
Counselor	6	0	0	0	0	19	0	0	3	78	8	0	2	–
Chapter	5.2%	0.0%	0.0%	0.0%	0.0%	16.4%	0.0%	0.0%	2.6%	67.2%	6.9%	0.0%	1.7%	116
Fruitland	134	63	28	6	99	59	9	11	48	200	93	35	46	831
Chapter	16.1%	7.6%	3.4%	0.7%	11.9%	7.1%	1.1%	1.3%	5.8%	24.1%	11.2%	4.2%	5.5%	–
Hogback	44	53	12	4	29	6	3	9	2	151	38	11	32	394
Chapter	11.2%	13.5%	3.0%	1.0%	7.4%	1.5%	0.8%	2.3%	0.5%	38.3%	9.6%	2.8%	8.1%	–
Huerfano	48	77	61	31	69	46	7	2	42	209	133	31	46	802
Chapter	6.0%	9.6%	7.6%	3.9%	8.6%	5.7%	0.9%	0.2%	5.2%	26.1%	16.6%	3.9%	5.7%	–
Lake Valley	2	5	2	0	6	0	0	1	7	29	11	0	13	76
Chapter	2.6%	6.6%	2.6%	0.0%	7.9%	0.0%	0.0%	1.3%	9.2%	38.2%	14.5%	0.0%	17.1%	–
Nageezi	21	23	11	0	11	17	0	2	11	67	9	17	12	201
Chapter	10.4%	11.4%	5.5%	0.0%	5.5%	8.5%	0.0%	1.0%	5.5%	33.3%	4.5%	8.5%	6.0%	–
Nenahnezad/	66	38	26	9	73	40	4	6	11	151	26	16	43	509
San Juan Chapter	13.0%	7.5%	5.1%	1.8%	14.3%	7.9%	0.8%	1.2%	2.2%	29.7%	5.1%	3.1%	8.4%	–
Newcomb	13	17	4	3	10	9	7	1	0	80	2	5	20	171
Chapter	7.6%	9.9%	2.3%	1.8%	5.8%	5.3%	4.1%	0.6%	0.0%	46.8%	1.2%	2.9%	11.7%	–
Ojo Encino	3	5	1	2	11	6	0	4	1	61	10	5	14	123
Chapter	2.4%	4.1%	0.8%	1.6%	8.9%	4.9%	0.0%	3.3%	0.8%	49.6%	8.1%	4.1%	11.4%	–
Pueblo	0	3	0	4	8	9	0	0	6	53	7	0	6	96
Pintado Chapter	0.0%	3.1%	0.0%	4.2%	8.3%	9.4%	0.0%	0.0%	6.3%	55.2%	7.3%	0.0%	6.3%	–
Sanostee	41	62	12	11	33	21	0	10	24	155	16	20	43	448
Chapter	9.2%	13.8%	2.7%	2.5%	7.4%	4.7%	0.0%	2.2%	5.4%	34.6%	3.6%	4.5%	9.6%	–
Torreon	21	55	6	8	20	40	0	0	0	200	34	7	12	403
Chapter	5.2%	13.6%	1.5%	2.0%	5.0%	9.9%	0.0%	0.0%	0.0%	49.6%	8.4%	1.7%	3.0%	–

Location	Agriculture, forestry, fishing and hunting, and mining	Construction	Manufacturing	Wholesale trade	Retail trade	Transportation and warehousing, utilities	Information	Finance and insurance, real estate and rental leasing	Professional, scientific, management, and administrative	Education, health care, social assistance	Arts, entertainment, recreation, accommodation, food	Other services, except public administration	Public administration	Total employment
White Horse	7	6	1	0	4	0	0	0	0	43	0	4	11	76
Lake Chapter	9.2%	7.9%	1.3%	0.0%	5.3%	0.0%	0.0%	0.0%	0.0%	56.6%	0.0%	5.3%	14.5%	–
White Rock	0	0	0	0	0	0	0	0	0	7	0	0	4	11
Chapter	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	63.6%	0.0%	0.0%	36.4	–

Source: US Census Bureau 2015a

[1]American Community Survey estimates are based on data collected over 5 years. The estimates represent the average characteristics of civilian employment between January 2011 and December 2015 and do not represent a single point in time.

Notes:

Data represent the total number of full- or part-time employees and the percent of total employment.

Definitions of industries are based on the North American Industry Classification System Manual (1997). An overview is provided on the US Census Bureau website (https://www.census.gov/eos/www/naics/).

Employment estimates may vary from the official labor force data released by the Bureau of Labor Statistics, because of differences in survey design and data collection.

Table AE-55
Employment in Mining 2015

Employment Type	McKinley County	Rio Arriba County	Sandoval County (includes Rio Rancho)	San Juan County	New Mexico
Total Private Employment	16,080	6,306	23,872	39,736	626,284
Mining	33 0.2%	22 0.3%	53 0.2%	5,543 13.9%	23,641 3.8%
Oil and gas	0 0%	24* 0.4%	31 0.1%	3,646 9.2%	18,286 2.9%
Extraction	0	0	0	774 1.9%	4,128 0.7%
Drilling	0	6* 0.1%	0	279 0.7%	2,478 0.4%
Support	0	18* 0.3%	31 0.1%	2,593 6.5%	11,680 1.9%
Coal mining	0	0	0	1,602* 4.0%	2,260* 0.4%
Metal ore mining	2* <0.01%	0	0	0	1,848* 0.3%
Nonmetallic minerals mining	36* 0.2%	2* <0.01%	17* 0.1%	14* <0.01%	1,433 0.2%
Mining related	38* 0.2%	14* 0.2%	2* <0.01%	1,200 3.0%	2,657 0.4%
Oil and gas pipeline	14* 0.1%	0	0	915 2.3%	1,952 0.3%
Pipeline transportation	24* 0.1%	14* 0.2%	2* <0.01%	285 0.7%	705 0.1%

Sources: US Census Bureau 2016; County Business Patterns, as reported in Headwater Economics 2017
*Estimates for data that were not disclosed
Notes:
Data represent the number of part- or full-time employees and the percent of total employment.
Definitions of industries are based on the North American Industry Classification System Manual (1997). An overview is provided on the US Census Bureau website (www.census.gov/eos/www/naics/).
Data are not available for Tribal nations or Navajo Nation chapters.
Employment estimates may vary from the official labor force data released by the Bureau of Labor Statistics, because of differences in survey design and data collection.

Annual average wages varied by industry and by county. In McKinley County and San Juan County, the industry with the highest annual wage was natural resources and mining, with an average annual wage of $55,102 and $77,921, respectively. In Sandoval County, the industry with the highest annual wage was manufacturing, at $115,273. For Rio Arriba County, the industry with the highest average annual wage was professional and business services, at $48,112. In the study area overall, the non-services industries provided higher wages than the service industries, by almost $30,000 per year. This is representative of the high-paying jobs of the oil and gas extraction industry found in the study area (**Table AE-56**).

Adjusted for inflation, average annual wages in study area counties had only minor increases, or decreased, when compared in 2006 wages (BLS 2017b).

Many of the counties and Tribal nations in the study area are rural. Because of this, they may be affected to a greater extent by changes in public land management than more urban counties or counties with greater proportions of private land in other parts of the state.

Table AE-56
Average Annual Wages by Industry in 2016 Dollars

Industry	McKinley County	Rio Arriba County	Sandoval County	San Juan County	New Mexico
All sectors, private	$25,659	$31,450	$43,023	$44,000	$41,060
Services	$24,505	$31,471	$31,927	$36,895	$39,052
Trade, transportation, utilities	$28,203	$28,122	$33,399	$44,436	$35,494
Information	$27,549	$19,947	$50,055	$31,707	$51,086
Financial activities	$31,000	$37,460	$39,644	$40,524	$52,635
Professional and business	$33,389	$48,112	$38,873	$35,499	$58,965
Education and health	$25,980	$40,485	$34,887	$43,466	$39,847
Leisure and hospitality	$14,042	$15,718	$16,659	$14,935	$17,503
Other services	$23,843	$30,358	$30,370	$31,126	$30,882
Non-services	$37,593	$31,239	$87,424	$64,703	$51,506
Natural resources and mining (including oil and gas)	$55,102	$29,947	$42,247	$77,921	$57,832
Construction	$33,564	$32,862	$40,322	$48,013	$44,375
Manufacturing	$41,617	$28,273	$115,273	$44,948	$55,659

Source: BLS 2017b
Notes:
Data are preliminary.
Definitions of industries are based on the North American Industry Classification System Manual (1997). Data are not available for Tribal nations or Navajo Nation chapters.

Public Services

The availability and capacity of public services in an area, including but not limited to medical services and public safety services, may be impacted if proposed management results in population changes (i.e. from potential for increased development).

Medical services. San Juan County has the San Juan Regional Medical Center, with 254 beds. It is designated as a Level III Trauma Center, with medical, surgical, and rehabilitation services.

The San Juan Regional Rehabilitation Hospital contains 16 beds and is the only acute rehabilitation hospital in the Four Corners Region (San Juan Regional Medical Center 2014; San Juan Regional Rehabilitation Hospital 2014). Both facilities are in Farmington and serve the Four Corners Region.

The Dzilth-Na-O-Dith-Hle Health Center is in Bloomfield, New Mexico. It operates as part of the Shiprock Service Unit, with the primary referral center being the Northern Navajo Medical Center. The health center has two beds and primarily serves Navajo patients living in the eastern area of the Navajo Nation (DZHC 2018).

The Northern Navajo Medical Center in Shiprock has 55 beds. It is on the Navajo Nation Reservation and services mostly patients from the Tribal community (IHS 2014). In the city of Gallup in McKinley County, the Rehoboth McKinley Christian Health Care Services has 60 acute care beds, as well as outpatient clinics, behavior health services, and addiction treatment programs (RMCHCS 2014). The Crownpoint Health Care Facility, a 32-bed Navajo Nation facility in Crownpoint, with emergency and outpatient services, also provides services to planning area residents (IHS 2017).

The Navajo Nation also operates the Navajo Nation Emergency Medical Service, with several field offices across the planning area, including in Crownpoint, Shiprock, and Torreon. The field offices are open 24 hours and provide emergency medical response to the rural community and across the Navajo reservation. Response times from the Navajo Nation Emergency Medical Service vary widely, from

minutes to more than an hour. This is due to difficult terrain, unpaved roads, and a lack of systematic addressing, which often requires navigation by landmark (Navajo EMS 2017).

Public safety. The sheriff's office for San Juan County is based in Aztec and staffs 102 certified and commissioned law enforcement personnel, 16 civilian employees, 3 animal control officers, and 2 mechanics. The sheriff's office provides public safety services, such as law enforcement, civil process, prisoner extradition, and animal control. It also participates in the Region II Narcotics Task Force, along with the Farmington Police Department and assorted federal agencies. It has a special weapons and tactics team for high-risk missions (San Juan County 2013). The sheriff's offices for Rio Arriba, McKinley, and Sandoval counties provide similar services and work closely with their town and city police departments.

San Juan County consists of 14 fire districts, 23 fire stations, and 1 administrative office in Aztec. It employs 246 paid and volunteer firefighters trained in basic fire suppression, emergency medical services, high angle rescue, swift water rescue, and scuba diving (San Juan County 2013). Sandoval County has 8 fire districts and 20 fire stations and employs 264 paid and volunteer firefighters (Sandoval County 2014). McKinley County has 18 fire stations; it has 350 volunteer firefighters and can provide emergency medical and rescue services, fire suppression, and hazardous waste cleanup (McKinley County 2014). Rio Arriba County has 18 fire districts and also participates in the Code Red emergency public awareness system (Rio Arriba 2014). These county-based fire departments work in conjunction with town and city fire response teams in their counties.

Navajo Nation police have one office in the Eastern Navajo Agency in Crownpoint and one in the Northern Navajo Agency in Shiprock. It also runs the Navajo Nation Corrections Department in Crownpoint. A lack of Navajo Nation police substations throughout rural Tribal lands in the planning area has been a long-standing social and safety issue.

The Navajo Nation also operates volunteer fire stations, but all are outside the planning area. Because the stations operate by volunteer and are often in remote areas, emergency response times can vary. Most fire station volunteers are also trained as EMTs and first responders and can perform basic lifesaving acts, such as CPR. Navajo Nation fire districts also respond to and perform other rescue services beyond fire suppression, including motor vehicle accident response, water rescues, and hazardous substances response (NNFD 2018).

For further discussion of medical, health, and public service providers in the planning area refer to the FMG RMPA/EIS socioeconomic baseline report (BLM 2014e) for an overview of available public services.

Fiscal Conditions

Planning area land use contribute to local, state, and tribal revenues through taxes and royalties collected from uses on public lands and, and from development of BLM and BIA-managed minerals.

State of New Mexico revenues. The major components of general fund revenue in New Mexico are the gross receipts tax (GRT), income taxes (both corporate and personal), and natural resource extraction revenues, which include severance taxes, rents, and royalties (**Table AE-57**).

Fiscal impacts of the recession can be seen in the decreasing revenue from each of these major components in 2009 and 2010. Total general fund revenue also fell in 2013 and in 2016. GRT is the largest revenue source for the state and for the years shown. Severance taxes, rents, and royalties include revenue from all natural resource extraction, but these figures are dominated by oil and gas-related contributions. In 2016, due to fuels commodity prices and production, the contribution to the GRT from oil and gas revenue declined. The full impact of oil and gas industry operations on the general fund goes beyond these categories and includes production taxes, royalties, bonuses, and taxes on direct and indirect activities.

Table AE-57
Major Components of General Fund Revenue, 2012–2016 in Thousands of Dollars

Tax/ Revenue	2012		2013		2014		2015		2016	
	Revenue	Percent Change	Revenue	Percent Change	Revenue	Percent Change	Revenue	Percent Change	Revenue	Percent Change
Gross receipts tax	$1,928,500	5.8	$1,917,700	-0.6	$1,992,000	3.9	$2,095,200	5.2	$1,957,200	-5.7
Income tax	$1,431,500	10.9	$1,508,100	5.4	$1,451,700	-3.7	$1,594,200	9.8	41,437,600	-9.3
Severance tax	$456,400	7.7	$438,400	-3.9	$557,100	27.1	$427,500	-23.3	$276,000	-34.6
Rents and royalties	$595,001	24.7	$504,200	-15.3	$617,300	22.4	$584,400	-5.3	$443,800	-25.1
Percent of general fund revenue	76	–	77	–	76	–	76	–	72	–
Total general fund revenue	$5,817,100	6.3	$5,708,600	-1.9	$6,040,500	5.8	$6,219,300	3.0	$5,690,600	-8.4

Source: New Mexico Department of Finance and Administration 2016b
Note: Revenue is not adjusted for inflation. Severance tax includes the oil and gas school tax, oil conservation, resource excise, and natural gas processors.

Local government revenues. GRT is also a major component of both state and local government revenue. The GRT rate varies throughout the state, from 5.125 to 8.6875 percent, depending on the location of the business. It varies because the total is a combination of the rates imposed by the state, counties, and, if applicable, municipalities where the businesses are located. Businesses pay the total gross receipts tax to the state, which then distributes their portions to the counties and municipalities.

Revenue from oil and gas extraction represents from approximately 3.8 to 8.5 percent of total GRT revenue in all counties but Sandoval, where it represents only 0.2 percent. **Table AE-58**, below, depicts annual GRT collections in study area counties.

Property taxes are another substantial source of revenue for the counties in the socioeconomic study area. Property tax revenue (assuming 100 percent collection) and current tax rates are shown in **Table AE-59**, below.

Ad valorem production taxes represent tax on the assessed value of products severed and sold in a given area. The ad valorem tax rate is a composite of rates imposed by local taxing authorities, including counties and school districts. Ad valorem equipment taxes are collected on equipment used in production of oil, natural gas, carbon dioxide, and nonhydrocarbon gas.

Tribal government revenue: The Navajo Nation collects revenue from minerals production and sales on Tribal trust and fee lands, land rentals, and various other fees. Some key taxes collected are as follows:

- Possessory interest tax of 3 percent is collected on all leases granted by the Navajo Nation with a value of more than $100,000 (Navajo Nation 2008b).
- Business activity tax is collected at a rate of 5 percent of net source gains (gross receipts less deductions) from the sale of Navajo goods or services (Navajo Nation 2008c).
- Oil and gas severance tax is collected on oil, natural gas, or other liquid hydrocarbons severed from the soil on Navajo Nation Tribal trust and fee lands at a rate of 4 percent (Navajo Nation 2008d).

An overview of revenue is in **Table AE-60**, Navajo Nation General Fund Revenue 2013–2017 (in Thousands of Dollars), below, and in **Table AE-61**, Navajo Nation Tax Revenue Collected.

Payments in lieu of taxes. Payments in lieu of taxes (PILT) are federal payments to local governments that help offset losses in property taxes due to nontaxable federal lands within their boundaries. Congress appropriates PILT annually, and the BLM disburses it to individual counties. PILT is determined according to a formula that includes population and the amount of federal land in the county. It offsets certain federal payments to counties, such as timber, mineral leasing, and grazing receipts.

PILT payments are transferred to state or local governments, as applicable, and are in addition to other federal revenues, including those from grazing fees. The study area counties received over $7 million in PILT in 2016 (**Table AE-62**). Note that PILT amounts include payments from all federal lands in each county and are not limited to BLM-managed lands in the planning area.

Local Economic Activity

Local economies realize direct and indirect benefits from expenditures and revenues generated by a variety of activities in the planning area.

Economic sectors for which the BLM or BIA provide direct or indirect support of jobs and economic output are oil and gas development and, to a lesser extent, recreation and livestock grazing. Activities that the BLM and BIA management decisions directly and indirectly affect are discussed in the sections below.

Table AE-58
Gross Receipts Tax Revenue, 2012–2016

Year	Industry	McKinley County		Rio Arriba County		Sandoval County (includes Rio Rancho)		San Juan County	
		Revenue	Percent Oil and Gas	Revenue	Percent Oil and Gas	Revenue	Percent Oil and Gas	Revenue	Percent Oil and Gas
2012	Total	$93,281,422	–	$32,488,097	–	$102,461,596	–	$246,559,667	–
	Oil and gas	$14,717,594	15.8	$1,978,647	6.1	$241,749	0.2	$48,699,921	19.8
2013	Total	$86,728,520	–	$30,634,393	–	$99,852,850	–	$	–
	Oil and gas	$14,106,306	16.3	$1,417,777	4.6	$838,005	0.8	$43,726,780	17.9
2014	Total	$87,083,440	–	$31,889,498	–	$104,183,383	–	$241,140,816	–
	Oil and gas	$14,333,318	16.5	1,915,509	6.0	$1,206,818	1.2	$29,726,735	12.3
2015	Total	$91,581,767	–	$34,680,417	–	$110,718,508	–	$253,732,818	–
	Oil and gas	$12,948,485	14.1	$2,453,052	7.1	$557,574	0.5	$17,569,439	6.9
2016	Total	$76,958,184	–	$35,162,275	–	$99,262,426	–	$207,522,638	–
	Oil and gas	$6,531,207	8.5	$997,840	2.8	$161,917	0.2	$7,831,275	3.8

Source: New Mexico Department of Taxation and Revenue 2017
Note: Tax collections are distributed the second month after the accrual (business activity) month. Annual revenue shown reflects GRT distributions during that year. Oil and gas data reflect GRT from all mineral extraction activities, including oil and gas extraction.

Table AE-59
Property Tax Obligations, 2016 Tax Year (in 2016 Dollars)

Area	Rate (%)	Residential	Rate (%)	Nonresidential	Rate (%)	Ad Valorum Production	Rate (%)	Ad Valorum Equipment
New Mexico	--	$998,057,053	--	$568,890,653	--	$116,141,394	--	$22,405,102
McKinley County	32.2	$8,612,296	34.9	$20,633,545	32.8	$15,378	32.8	$4,386
Rio Arriba County	20.3	$10,456,983	32.2	$9,857,310	35.2	$10,382,162	35.6	$2,104,915
Sandoval County (includes Rio Rancho)	33.9	$85,161,329	36.9	$28,228,050	28.5	$1,447,187	28.5	$264,330
San Juan County	23.5	$33,227,774	26.2	$44,998,933	27.0	$11,285,761	27.0	$2,256,511

Source: NMDFA 2016a
--: Rate not available

Table AE-60
Navajo Nation General Fund Revenue 2013–2017 (in Thousands of Dollars)

Industry	2013	2014	2015	2016	2017 (Projected)
Oil and gas	$59,260	$60,725	$34,588	$32,246	$24,700
Coal	$63,816	$56,036	$56,898	$55,102	$55,850
Taxes	$75,400	$71,632	$64,379	$66,983	$64,150
Investment income	$778	$1,376	$1,409	$400	$1,600
Land rentals, royalties, business sites	$64,225	$62,395	$72,946	$62,354	$58,450
Court fines and fees	$472	$519	$464	$400	$400
Miscellaneous	$720	$507	$669	$200	$500
Total general fund revenue	$265,671	$253,190	$231,344	$217,785	$205,650

Source: Navajo Nation 2017b (general fund revenue)
Note: Taxes include possesseory interest, business activity, and oil and gas severence taxes. Revenue represented here is for the entire Navajo Nation.

Table AE-61
Navajo Nation Tax Revenue Collected

Area	2012	2013	2014	2015	2016
Possessory interest	$36,595,284	$38,311,613	$35,141,254	$34,941,327	$29,416,796
business activity	$7,638,058	$8,240,433	$6,329,603	$7,768,990	$3,910,277
Oil and gas severance	$9,769,502	$9,244,839	$10,049,784	$6,268,328	$3,498,297
Hotel occupancy	$1,459,180	$1,635,030	$1,890,394	$1,938,508	$1,488,990
Tobacco products	$366,692	$606,512	$330,385	4391,413	$227,674
Fuels excise	$14,605,548	$13,841,494	$12,534,371	$12,987,794	$12,515,702
Sales, non-retail	$30,905,204	29,999,760	$33,565,923	$40,304,605	$49,398,286
Sales, retail	$7,699,417	$8,645,365	$10,530,378	$10,320,721	$10,422,204
Other	0	0	0	$334,083	$1,952,737
Total	$109,038,885	$110,525,046	$110,372,092	$115,255,769	$112,830,963

Source: Navajo Nation 2017c (tax)
Note: Revenue data are not adjusted for inflation. Tax revenue collected is for the entire Navajo Nation.

Table AE-62
Socioeconomic Study Area PILT (Fiscal Year 2016)

Location	PILT Amount
McKinley County	$914,129
Rio Arriba County	$2,234,329
Sandoval County	$2,142,162
San Juan County	$2,224,906

Source: DOI 2017

Market and Commodity Values

Activities directly affected by BLM management. The BLM collects revenues from recreation and commercial activities that take place on the land that it manages. A portion of these revenues are redirected to the state and county governments and are collected from facilities, such as the following:

- Campgrounds
- Recreation permits (special, competitive, organized group activity, and event use permits)
- Mining leases and mineral revenues
- Grazing fees
- Forestry sales (wood products, seeds, and timber)

Revenue for various programs is summarized in **Table AE-63**, below; details are included for relevant resources in the sections below and in the resource use sections, as noted.

Table AE-63
Summary of FFO Revenue Collected (2016)

Source	Total Collected
Grazing fees	$149,170
Forestry/woodland product (2015)	$52,770
ROW receipts	$2,879,630
Special recreation permit receipts	$22,300

Source: BLM 2016c, 2017a, 2017c, 2017d, 2017b

Activities directly affected by BIA management. The BIA manages revenues for Native Americans. Relevant management areas that may be affected by proposed management are the following:

- Mining leases and mineral revenues
- Grazing permits
- Forestry permits (primarily fuels)

Details are included for relevant resources in the sections below.

Wood product harvest. Forest product harvesting remains an important source of fuel and other products for area residents. Primary products harvested from BLM-managed lands include personal and commercial firewood and fence posts. Personal firewood permits sell for $12 a cord, and commercial permits sell for $15 a cord. Individuals are limited to four cords per permit. Based on 2015 data, the FFO sold 3,050 wood permits, resulting in a total of $52,767.50 in wood product sales. Details are in **Section AE.3.3**, Forestry.

For BIA-managed lands, wood product regulations are determined by the Tribal administration. For the Navajo Nation, permits are issued for firewood for two truckload increments (approximately 2 cords) at

the locally designated offices. According to data from the Navajo Forestry Department, a total of 490 permits were issued in Tribal offices overlapping the planning areas in 2016.[24]

Mineral and energy resources. New Mexico remains a leading US mineral producer, with 2015 rankings of first in potash, second in copper, and twelfth in coal (NMEMNRD 2016). More than $2.5 billion worth of minerals was extracted from New Mexico mines in 2015.

In addition to federal minerals underlying BLM-managed lands, the BLM also manages federal mineral estate underlying lands managed by other agencies and land on reserved mineral estate underlying private lands. Generally, mineral management programs include locatable minerals (e.g., metals and gypsum), leasable minerals (e.g., fluid leasables, such as oil and gas and geothermal, and solid leasables, such as coal), and salable mineral materials (e.g., common varieties of sand and gravel, clay, and rock).

The BIA NRO manages fluid and solid mineral leasing for Indian mineral owners, including the Navajo Nation, on Tribal trust lands and individual Navajo allottees on their trust lands in the planning area. These responsibilities require coordinating with the BLM and other agencies on leasing and APDs. Specific roles are specified in an interagency agreement (BIA 2013). Both agencies work closely with the Federal Indian Minerals Office (FIMO), which assists allottees in all aspects of their mineral interests.

The economic contributions of different categories of resources in the FMG planning area are examined in depth below. Renewable energy is discussed in a separate section immediately following.

Leasable minerals—oil, gas, and coal. In 2012, approximately 1,252,865,611 thousand cubic feet (mcf) of gas were produced in New Mexico. Statewide gas production has remained relatively flat in the past 5 years, with a total of 1,272,144,967 mcf in 2015. Federal production represented approximately 63 percent of the state total (NMEMNRD 2016).

In 2012, approximately 85,548,602 barrels of oil were produced in New Mexico. Production increased to a high of 147,395,326 in 2015. Production of federal oil represented approximately 55 percent of the total production in 2015 (NMEMNRD 2016).

Downturns in commodity prices have resulted in a decrease in wells drilled and completed in recent years; statewide, 514 natural gas wells were drilled in 2011, and only 53 were drilled in 2016. Similarly, 1,411 oil wells were drilled in 2011, and only 17 were drilled in 2016 (NMEMNRD 2016).

San Juan County ranked second in natural gas production and third in oil production for New Mexico in 2015, while Rio Arriba County was fourth in gas production and oil production. Sandoval County ranked fifth in oil production and seventh in gas production, while McKinley ranked eighth in oil production but was not in the top eight counties for gas production (NMEMNRD 2016).

Production estimates by county for 2015 and 2016 are provided in **Table AE-64**, below.

In socioeconomic study area counties, in 2016, there were approximately 20,697 active oil and gas wells, including 14,594 federal mineral wells, 2,019 private (fee) wells, 1,481 state wells, and 2,603 Tribal wells (**Table AE-65**).

[24]Alex Becanti, Navajo Forestry, personal communication with Zoe Ghali, EMPSi Socioeconomics Specialist. August 9, 2017.

Table AE-64
Oil (Barrels) and Gas (mcf) Production in Study Area Counties (2015–2016)

Industry	McKinley County	Rio Arriba County	Sandoval County (includes Rio Rancho)	San Juan County
2015				
All oil	33,048	2,667,590	2,150,702	4,360,938
Federal Oil	12,350	2,202,703	1,670,927	3,223,036
Navajo Nation Indian Allotted Lands oil	8,278	14,353	1,510	617,131
Navajo Nation Tribal Trust Lands oil	165	1,747	0	28,009
Jicarilla Apache Nation oil	0	225,414	100,311	0
Ute Mountain Ute Tribe oil	0	0	0	78,392
Unspecified Tribal oil	0	1,478	0	137,632
All gas	162,655	272,142,513	14,817,280	402,230,318
Federal gas	160,523	206,905,890	11,170,156	292,528,244
Navajo Nation Indian Allotted Lands gas	0	251,532	60,989	6,840,458
Navajo Nation Tribal Trust Lands gas	0	161,589	4,184	180,087
Jicarilla Apache Nation gas	0	28,571,095	849,327	0
Ute Mountain Ute Tribe gas	0	0	0	5,926,792
Unspecified Tribal gas	0	53,891	4,714	440,449
2016				
All oil	15,196	1,989,578	1,425,757	3,935,996
Federal oil	7,142	1,598,740	1,042,152	3,124,249
Navajo Nation Indian Allotted Lands oil	7,098	10,335	65,755	393,622
Navajo Nation Tribal Trust Lands oil	212	1,372	0	4,545
Jicarilla Apache Nation oil	0	200,820	71,404	0
Ute Mountain Ute Tribe oil	0	0	0	53,700
Unspecified Tribal oil	0	1,314	0	79,324
All gas	122,570	256,133,606	12,565,881	373,692,064
Federal gas	122,567	196,331,986	9,225,808	273,165,181
Navajo Nation Indian Allotted Lands gas	0	280,222	276,187	6,086,802
Navajo Nation Tribal Trust Lands gas	0	150,190	277	180,474
Jicarilla Apache Nation gas	0	26,116,038	776,434	0
Ute Mountain Ute Tribe gas	0	0	0	5,245,334
Unspecified Tribal gas	0	56,155	5,433	380,364

Sources: USEITI 2017 (federal data); NMOCD (tribal) 2017a, 2017b
Note: Due to different sources of data collection for federal and nonfederal production data, there are some inconsistences in data.
Federal minerals data provided by USETI 2017 include data tracked and managed by the DOI's Office of Natural Resources Revenue (ONRR). The data do not include Indian lands, privately owned lands, or US state lands.

Table AE-65
Active Oil and Gas Wells in Planning Area Counties by Landownership (2016)

Surface Owner	McKinley	Rio Arriba	Sandoval (includes Rio Rancho)	San Juan	Total
Federal	58	5,392	142	9,002	14,594
Private	96	414	3	1,506	2,019
State	27	449	7	998	1,481
Navajo Nation Indian Allotted Lands	1	5	21	354	381
Navajo Nation Tribal Trust Lands	1	13	2	119	135
Jicarilla Apache Nation	0	1,768	156	0	1,924
Ute Mountain Ute Tribe	0	0	0	162	162
Not specified Tribal	1	12	4	21	38
All	184	8,053	335	12,162	20,734

Source: NMOCD 2017b Ongard database
Notes: includes water disposal and injection wells
Tribal includes Navajo Nation, Jicarilla Apache Nation, Ute Mountain Ute Tribe, and not specified Tribal.

The oil and gas industry is one of the largest private sector employers in New Mexico. Based on 2015 data, the mining industry, which includes oil and gas extraction, provided approximately 6.6 percent of total employment for the cumulative study area and 13.9 percent of total employment in San Juan County. This is compared with only 0.6 percent in the United States overall (Headwaters Economics 2017).

In addition to direct and indirect employment, the leasable minerals program provides tax revenue to state and local communities. The following are brief descriptions of taxes collected (NMDTR 2014):

- The oil and gas emergency school tax is levied on the "privilege of doing business as a severer of oil, gas, liquid hydrocarbon, or carbon dioxide." Natural gas is generally taxed at 4 percent and all other products at 3.15 percent.
- The oil and gas severance tax is levied at the rate of 3.75 percent "taxable value" (price for the product minus federal, state, and Indian royalties and reasonable trucking expenses to the "first place" of market) for the privilege of severing oil and gas from the soils of New Mexico.
- The oil and gas conservation tax is levied on the sale of oil and gas products at the rate of 19/100 of 1 percent of taxable value.
- The oil and gas ad valorem production tax is in lieu of property taxes levied on the value of oil and gas natural reserves, wherein annual production is used as an approximation of the value of reserves. It is based on the property tax in the district of production.
- The ad valorem production equipment tax is a property tax on oil and gas production equipment. Assessed value is determined at 27 percent of the sales value of the product for the previous calendar year against which the 33.3 percent "uniform assessment ratio" is applied.
- The natural gas processors tax is imposed on processing plants, at $0.0220 per one million BTU tax on the volume.

Revenues from these taxes are paid into the state general fund, severance tax bonding fund, and land grant permanent fund. Revenues, which are based on the variable value of the product, are prone to fluctuate. Considering that over 70 percent of all natural gas produced in the state comes from the San Juan Basin, and the region is also a major producer of oil, the planning area contributes significantly to state revenues.

Approximately 19.6 million tons of coal was produced from New Mexico coal mines in 2015. Most of the production goes to electrical generation at power stations in New Mexico and Arizona. Annual production values exceed $691 million. The mines employed 11,300 people, with an annual payroll of over $133 million (NMEMNRD 2016).

Active coal mines in the socioeconomic planning area include underground mining at the San Juan Mine (federal, state, and private mineral) and surface mining at the El Segundo Mine (state and private minerals), and Navajo Mine (Navajo nation minerals) (EIA 2017). A forth mine, the Lee Ranch mine, is in suspended operations.

Revenues are generated from severance taxes, resources excise taxes, and conservation taxes on the state's coal production. The severance tax on coal is $.57 per short ton (2,000 pounds) for surface coal and $.55 per short ton for underground coal (NMDTR 2009). In addition, gross receipts taxes on coal (at an effective rate of 5.3 percent of gross sales revenues) generated an estimated $29 million and about $7.2 million in property taxes for the producing counties.

For the Navajo Nation mine, in 2016, approximately 4.6 million short tons were produced, resulting in collection of over $25 million in royalties. Productions and related revenues have decreased since 2011, when 8.1 million tons were produced, resulting in $31.18 million in royalties (Navajo Minerals Department 2017).

Additional revenues from oil, gas, and coal extraction come from rents and royalties paid by producers on public lands. Lease holders competitively bid, pay an initial bonus, and subsequently pay rent for the right to develop the resources on public lands. These funds are collected and distributed to the federal and state governments and are known as lease revenue and, in the case of rents, lease royalties. Lease revenues and royalties to the state and county provide an additional economic benefit of mineral resource extraction.

Federal mineral lease revenues are collected by the Office of Natural Resources Revenue in the DOI (**Table AE-66**). For BLM -managed minerals, production value is taxed at 12.5 percent (43 CFR 3103.3). Approximately 49 percent of the revenues are transferred to the New Mexico State Treasurer for disbursement to counties of origin. For BIA-managed minerals, royalty rate is an amount agreed upon by Indian leases owners, with a default rate of 16.67 percent of gross proceeds from the first arm's-length-sale (25 CFR 211.41). 100 percent of the revenues received for energy and mineral production goes directly to the tribes (for Tribal-trust lands) and individual mineral owners (for individual Indian allotted lands) through the BIA and the Office of Special Trustee for American Indians. Revenues for individual Indian allottees are considered personal income and taxed accordingly. For Tribal trust lands, tribes then distribute the revenues among all citizens. Alternately, they apply the revenues to health care, infrastructure, education, and other critical community development programs, such as senior centers, public safety projects, and youth initiatives. Many individual mineral owners use these revenues as a major source of income to support their families and communities.

Table AE-66
Socioeconomic Study Area Oil and Gas Federal Revenue Collected[1]

Location	2012	2013	2014	2015	2016
McKinley County	$389,344	$557,024	$3,064,789	$5,842,109	$2,702,589
Rio Arriba County	$126,733,831	$5,632,522	$145,937,997	$78,627,531	$62,141,940
Sandoval County (includes Rio Rancho)	$1,060,432	$131,713,923	$10,555,424	$13,093,040	$5,324,128
San Juan County	$159,393,740	$178,952,954	$199,837,880	$124,505,777	$95,961,208

Source: USEITI 2017
[1] Includes rents, royalties, bonuses, and other fees

Salable minerals. Salable minerals include common sand, gravel, rock, and fill material. Most of the salable materials contracted are sand and gravel. There are 27 active permitted operations listed in **Table AE-34**. In addition, there are quarries of fewer than the 5 acres associated with oil and gas well sites; these quarries supply gravel to surface access roads.

Salable minerals are sold to individuals and corporate entities through negotiated sales. Federal, state, and local governments and nonprofit organizations are permitted free use of these materials for qualified purposes, and local availability can be important for constructing and maintaining roads. Demand for materials is driven by the level of construction within 50 miles.

One driver of construction activity in the planning area is roads for oil and gas development. As new oil and gas development in the Mancos/Gallup Formations continues, salable mineral activity is expected to continue at roughly the same level; however, the lack of roads in the vicinity of the Mancos/Gallup Formations may increase salable mineral development in that area, as oil and gas is developed, and associated access roads are constructed.

Lands and realty. One of the primary activities in the FFO lands and realty program is the review, issuance, and management of land use authorizations for energy-related ROWs for roads, pipelines, communication facilities, and transmission lines. Of the 17,000 ROWs, 81 percent (13,700) are for oil and gas pipelines (BLM 2017b).

ROW authorizations are primarily issued for oil and gas development. Commercial developers have not pursued solar energy development in this area, but there may be future development, considering the area's potential. There are currently two applications for solar energy projects on private land in the planning area. Total receipts from fiscal year 2016 were $2.8 million.

Wind energy potential is not defined in most of the planning area and is marginal where defined. Wind energy development in the planning area does not show the potential that it does in other parts of the state; however, it may play a future role if the popularity for development continues and the technology improves for optimizing the use of marginal resources.

Solar may play a role in the local economy, with one development planned on private land. The future level of development of renewable energy resources is likely to be influenced by availability of relevant government incentives and market conditions for traditional and nontraditional energy sources.

Demand for land use authorizations in the FFO is anticipated to increase with future oil and gas development, renewable energy development, and demand from residential, commercial, and agricultural activity. Demands for future lands actions are expected to be greatest for those that support the continued development of the oil and gas industry, including on and off leases. This could spread to the supporting infrastructure for renewable energy as its popularity and development improves.

Land disposals and exchanges could affect local community finances. BLM-managed lands do not contribute tax dollars to local economies but would result in some economic contributions due to PILT. Disposing of lands to local communities may increase the level of tax dollars contributed to their economies, especially if this land were to be developed for oil and gas.

The R&PP Act authorizes the sale or lease of public lands for recreation or public purposes to state and local governments and to qualified nonprofit organizations. Approximately 340,118 acres of BLM-managed land were identified in the 2003 RMP as available for disposal.

Tourism and recreation. The New Mexico Department of Tourism estimated that visitor travel set a new high of 34 million visitors in 2015, a gain of 700,000 since 2014. Visitors to New Mexico spent $6.3 billion in 2015, which generated $8.8 billion in total business sales, when indirect and induced impacts are considered. In addition, tourism sustained 90,400 jobs in New Mexico last year, with total income of $2.4 billion (Tourism Economics 2016; **Table AE-67** for study area county contributions). Recreation has important economic value, both in terms of the satisfaction it provides residents and the activity it generates for the regional economy.

Table AE-67
Economic Impacts of Tourism (2015)

Location	Visitor Spending	Tourism Employment (Direct and Indirect)	Tourism Labor Income (Direct and Indirect)	Tourism Tax Receipts	Percent County Tourism Dependence
McKinley County	$216,100,000	2,877	$63,000,000	$39,200,000	14.3
Rio Arriba County	$100,800,000	1,304	$29,900,000	$17,800,000	13.7
Sandoval County (includes Rio Rancho)	$221,900,000	3,061	$79,200,000	$45,100,000	10.6
San Juan County	$291,500,000	4,485	$124,800,000	$63,000,000	8.9
Socioeconomic study area	$830,300,000	11,727	$296,900,000	$165,100,000	–

Source: Tourism Economics 2016
–: Data not available

Employment data in recreation and tourism are not collected as a separate industry category; therefore, data on jobs generated are estimates only. Jobs are generally reflected in the arts, entertainment, recreation, and accommodation services and in retail trade sectors. According to data assembled by Headwater Economics, travel and tourism jobs in the socioeconomic study area represent approximately 17,531 jobs, or 20.4 percent of total private jobs (Headwaters Economics 2017). Not all of this employment is related to travel and tourism, and other industrial sectors may also contribute jobs. Furthermore, some of this employment is likely related to the other federal lands in the area, although the BLM contribution is expected to be significant.

Visitors to the planning area are often attracted to its lower elevation, sunnier climate, and distinctive recreation opportunities. Regionally distinctive recreation that brings people and outside dollars into the area are the motorized and nonmotorized vehicle events and dispersed recreation opportunities. In the planning area, Aztec Ruins National Monument and CCNHP respectively boasted 57,692and 57,781visitors in 2018 (NPSIRMA 2019a, 2019b). These activities and visitors make direct use of surrounding BLM-managed lands, although some of this activity is individual and unrecorded.

As noted in **Section AE.3.5**, recreation use is the primary management emphasis for eight SDAs in the FFO. Total visitor days[25] were estimated at an average of 421,987 visits and 282,783 visitor days in 2016 (BLM 2017c).

The BLM requires special recreation permits (SRPs) for commercial uses, competitive events, organized groups, and recreation in certain special areas. SRPs allow specified recreation uses of public lands with applicable stipulations. Over the past 15 years, an average of 30 SRPs have been issued annually, 45 in 2016, mostly for hunting big game. Receipts generated from SRPs over the past 10 years are displayed in **Table AE-68**, below.

In the past decades planned recreation included several biking, motorcycle, motocross, and four-wheeler events on BLM-managed lands. They attracted over 2,000 participants annually, with an estimated economic impact of over $2,533,000 generated by visitor spending (Preister 2001). Downtown Aztec has opened a number of stores oriented to recreation, supplying bicycling, mountaineering, and other outdoor sports; however, since 2009, a decrease in large competitive events for rock crawling has likely decreased associated revenues. Average visitor spending varies by activity and location of activity, as compared with place of residence.

[25] Visits represent the actual number of people who take part in a recreation activity, while visitor days represent an aggregate 12 visitor hours to a site or area.

Table AE-68
Special Recreation Permit Receipts

Year	Commercial and Competitive Receipts
2006	$7,040
2007	$15,164
2008	$10,969
2009	$9,795
2010	$18,887
2011	$10,213
2012	$14,788
2013	$13,683
2014	$22,308
2015	$15,353
2016	$15,499

Source: BLM 2017d

Fishing on the San Juan River is popular, due to low fees and year-round use. The NMDGF distributes fishing and hunting licenses. Big Game Units 2A and 2B overlap with the lands with highest hunting potential, while Unit 7 is also in the planning area. While hunting and fishing fees are collected by the state, visitors who travel to the region for these activities may contribute to the local economy.

The 2011 National Survey of Hunting, Fishing, and Wildlife found that these activities contributed an estimated $885 million in expenditures in New Mexico (**Table AE-69**). Economic stimulus occurs as visitors spend money in the local economy, generating jobs, income, and additional spending by residents. Indirect expenditures added economic benefits throughout the state (USFWS and US Census Bureau 2011).

Table AE-69
Hunting, Fishing, and Wildlife Watching in New Mexico (2011)

Activity	Number of Participants	Number of Days	Total Expenditures	Average Expenditures per Person per Day
Anglers	278,000	3,899,000	$418,249,000	$60
Hunters	69,000	927,000	$139,264,000	$71
Wildlife watchers	566,000	5,962,000	$325,117,000	$25

Source: USFWS and US Census Bureau 2011

Agriculture and livestock grazing. Agriculture and livestock grazing played a traditional role in the study area economy and continue to be important today. There were 7,850 farms, totaling over 7.7 million acres, in the study area in 2012 (USDA NASS 2014; **Table AE-70**). BLM management actions have the potential to influence farming, due to the purchase of farmland and through management practices influencing livestock grazing on public lands, as discussed in detail below.

There are approximately 119,162 AUMs of grazing authorized by the FFO, 9,228 of which are Navajo free use. These free-use grazing permits are authorized under 43 CFR 4130.5, to individuals "whose products or work are used directly and exclusively by the applicant and his family"; they are not transferrable. Navajo free use is unique to the Farmington and Rio Puerco Field Offices and is primarily for subsistence grazing.

Table AE-70
Summary of Socioeconomic Study Area Agriculture (2012)

County	Number of Farms	Acres in Farms	Market Value (Crop Sales)	Market Value (Livestock Sales)
McKinley	2,297	3,022,704	$623,000	$7,766,000
Rio Arriba	1,892	1,432,897	$ 7,113 ,000	$ 11,866 ,000
Sandoval (includes Rio Rancho)	1,029	950,133	$5,605,000	$34,981,000
San Juan	2,628	2,350,432	$ 63,365,000	$ 7,946,000
Tribe				
Jicarilla Apache Nation	N/A	N/A	N/A	N/A
Navajo Nation	14,456	16,971,989	73,215,000	19,013,000
Ute Mountain Ute Tribe	N/A	N/A	N/A	N/A

Source: USDA NASS 2014
N/A = data not available
Note: The National Agricultural Statistics Service (NASS) agricultural census definition of a farm is any place from which $1,000 or more of agricultural products were produced and sold, or normally would have been sold, during the census year.

There are 208 grazing allotments managed by the FFO, with 390 grazing authorizations that permit cattle, sheep, and horse grazing in the planning area (BLM 2017a). Most allotments contain a combination of federal, state, and private land. Periods of livestock use vary, from year-round to seasonal. See **Section AE.3.1**, Livestock Grazing, for additional details.

The BLM calculates federal grazing fees annually each March. Fees are based on a formula that is calculated using the 1966 base value of $1.23 per AUM for livestock grazing on public lands in western states. Annual adjustments are based on three factors: current private grazing land lease rates, beef cattle prices, and the cost of livestock production. The federal grazing fee for 2017 is $1.87 per AUM. The 2016 public land grazing fee was $2.11 per AUM (BLM 2017e).

Permit values fluctuate, based on market forces, but generally they depend on the number of AUMs and other terms of the lease or permit and the estimated average value of replacement forage. The average grazing fee on grazing land is calculated based on the cost of replacement forage. In 2016, the average fee per AUM on private lands in New Mexico was $14.00 (USDA NASS 2017).

Based on 109,934 permitted AUMs in the planning area (excluding Navajo free-use permits), the total annual grazing value of all traditional leases is approximately $1,539,076. Under the 2016 federal rate of $2.11 per AUM, the comparative total annual grazing fee is $213,961. This is approximately $1.3 million less than the private grazing fee for all authorized grazing in the planning area. Note, however, that grazing on federal lands may represent additional costs of management that are not accounted for in the federal grazing fee.

Generally, there is some correlation between ranch land values and federal grazing permits, with ranches that hold such permits having a higher value (Winter and Whittaker 1981). This value is based on the premise that the permit's value reflects, at least to some extent, the capitalized difference between the grazing fee and the competitive market value of federal forage. It also reflects the requirement for the permittee to hold private base property to which the federal permitted use is attached. This gives the base property holder priority for renewal over other potential applicants. This value is recognized by lending institutions during a loan process and by the Internal Revenue Service when a property is transferred.

Nonmarket Values

Some of the most important socioeconomic factors associated with planning area BLM-managed lands are the nonmarket values offered by public lands management. Nonmarket values are the benefits derived by

society from the uses or experiences that are not dispensed through markets and do not require payment. For example, there are unique and sensitive natural and cultural resources on public lands, which support Native American traditional uses and the special spiritual contribution and foundations that public lands provide to Native American cultures. These values enhance the quality of life and enjoyment of place, thereby improving regional and local economic conditions.

Examples of nonmarket contributions from public land resources are discussed below in terms of contributions to social setting and quality of life. The value of non-market factors often varies by specific groups for whom management of public lands is of particular interest. In the planning area, these groups of interest with the greatest potential to be impacted by proposed management include local residents, recreational users, Native Americans, livestock grazing lessees and area ranchers, mineral estate owners and ROW lease holders. Furthermore, special interest groups and individuals who represent resource conservation or resource use perspectives constitute additional groups with an interest in planning area lands management. Additional details on and local communities and groups of interest are included in the FMG RMPA/EIS socioeconomic baseline report (BLM 2014ef).

Social setting and way of life. The economy of the planning area was historically based on rural agriculture. As discussed in the regional demographics and economic context introduction, Native Americans, settlers of Hispanic descent, and those of non-Hispanic descent have all played a role in the development of the region and continue to live in the area today.

Oil and gas development has played an important role in local economy population changes, economy, and social setting since the 1950s. Community development has formed around oil and gas development booms in portions of the socioeconomic study area. Energy development in the area resulted in the building of roads and increases in housing and improvements to public services; however, cycles in development can result in swings in population, which may strain public services and introduce large influxes of people from outside the region, potentially straining the social setting. Large population changes may alter perceptions of the friendliness, neighborliness, and trustworthiness of other residents; they may fear for their security, safety, and risk of victimization by crime and may question how satisfying community life is in general (Smith et al. 2001).

Crime Rates Crime rate information is provided as one indicator of social setting. Uniform crime rates (UCRs) are reported by law enforcement agencies to the Federal Bureau of Investigation. UCRs are instances of personal and property crimes, both violent and nonviolent offenses. Personal crimes are instances of homicide, forcible rape, robbery, and aggravated assault. Property crimes are burglary, larceny, motor vehicle theft, and arson.

See **Table AE-71**, Uniform Crime Report: 2016 Crime Rates* by Planning Area County, for reported crimes by all law enforcement agencies in each of the four planning area counties for 2016. Crime rates are overall considered low in the planning area, when compared with the New Mexico and United States rates, with larceny (non-motor vehicle theft) being the most reported crime.

UCR statistics for 2016 indicate that crime rates in the planning area counties for homicide, forcible rape, robbery, burglary, larceny (non-motor vehicle theft) were all below the New Mexico State crime rates. Only the crime of assault was seen at a greater rate per 100,000 inhabitants in McKinley (1788.3), Rio Arriba (883.6), and San Juan Counties (1102.7), when compared with New Mexico (491.0) as a whole (NMDPS 2017a; USDOJ 2017).

The occurrence of crime in Tribal jurisdictions has historically been underreported. This issue is two-fold: first Tribal crime is underreported to Tribal law enforcement; second, crime statistics are often not shared with national record and information systems, such as the FBI's UCR program (Wakeling 2001).

Table AE-71
Uniform Crime Report: 2016 Crime Rates* by Planning Area County

County	Homicide	Forcible Rape	Robbery	Assault	Burglary	Larceny	Motor Vehicle Theft
McKinley	2.7	41.0	116.1	1788.3	504.1	1896.2	213.1
Rio Arriba	2.0	16.0	58.1	883.6	645.2	787.5	134.2
Sandoval (includes Rio Rancho)	1.2	19.3	18.1	261.3	240.1	773.3	158.0
San Juan	0.5	63.6	36.2	1102.7	362.1	1112.0	142.1
New Mexico	6.7	73.3	131.5	491.0	830.4	2542.4	564.3
United States	5.3	40.4	102.8	248.5	468.9	1745.0	236.9

Sources: NMDPS 2017a; USDOJ 2017
*Rate is per 100,000 inhabitants.
Note: All law enforcement agencies in each county did not report data for every month of 2016. UCR statistics generally also include arson; these statistics were unreported in the planning area, so arson was omitted from the table. Tribal police statistics are not included in county crime rate aggregates. Similar UCR statistics are not reported and are unavailable for the Tribal Nations in the planning area.

The first tier of underreporting is attributed to cultural and demographic factors, including a distrust of police, stigma associated with certain types of crime, and fears of retaliation. Underreporting to national crime record programs can be attributed to underfunding, outmoded facilities and equipment, lack of personnel, and often large patrol districts covering large swaths of land (Wakeling 2001).

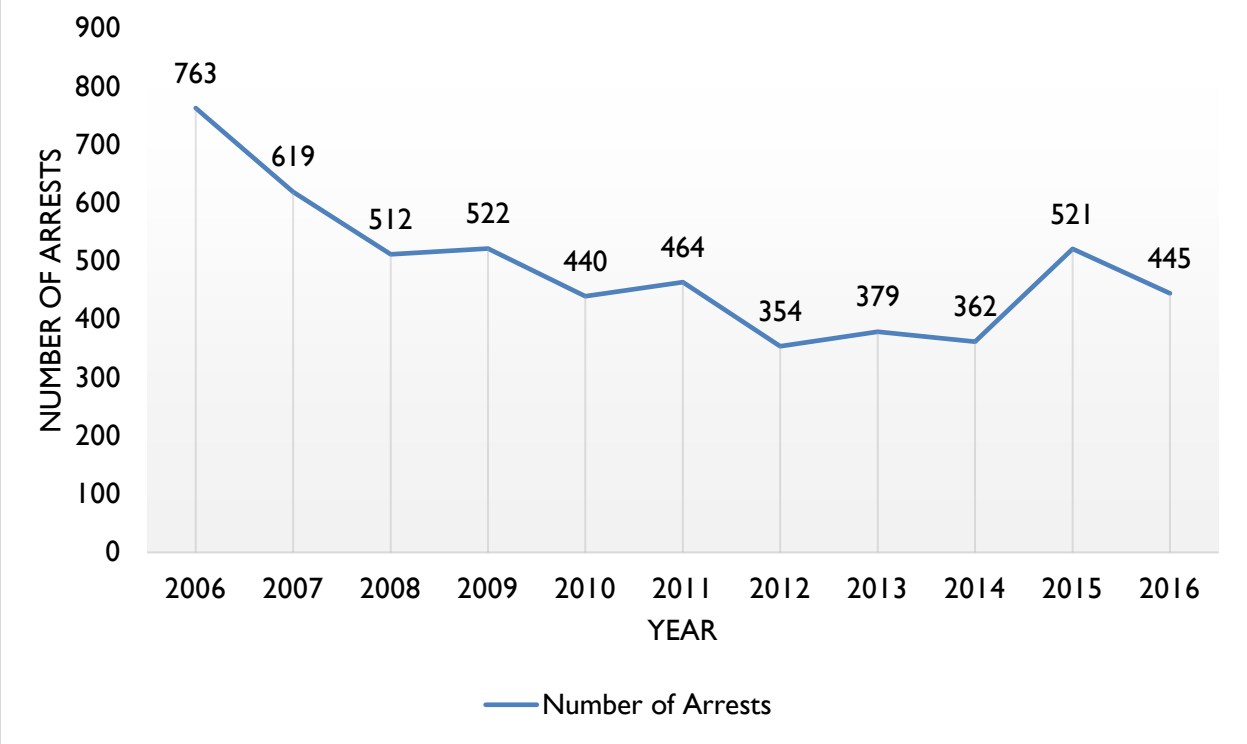
The number of Tribal law enforcement agencies that report to the FBI's UCR program has been on the rise since 2008. That year, only 12 Tribal law enforcement agencies reported statistics to the UCR program for all 12 months of the year. By 2013, that number rose to 158 Tribal law enforcement agencies reporting statistics to the UCR program for all 12 months in the year (Perry 2015).

The Navajo Nation Division of Public Safety (NNDPS) has detailed the number of arrests and calls for services in two distinct categories, referred to as part one offenses and part two offenses, on the Navajo Nation. Part one offenses are the general categories of crimes similar to those outlined by the FBI's UCR program: homicide, rape, robbery, aggravated assault, burglary, larceny, motor vehicle theft, and arson. Part two offenses are criminal offenses, such as assault, forgery/counterfeiting, fraud, embezzlement, stolen property, vandalism, weapons, prostitution, sex offenses, drug abuse, gambling, driving while under the influence, liquor law violations, drunkenness, disorderly conduct, child abuse, domestic violence, suspicious persons, curfew violations and loitering, runaways, and all other offenses.

The number of arrests on the Navajo Nation in part one offenses between 2006 and 2016 are shown in **Figure AE-24**, Number of Arrests for Part One Offenses on the Navajo Nation; the number of arrests on the Navajo Nation in part two offenses between 2006 and 2016 are shown in **Figure AE-25**, Number of Arrests for Part Two Offenses on the Navajo Nation. Arrests in this instance includes the number of persons arrested, cited, or summoned for an offense (NNDPS 2017). The number of arrests for a certain crime does not indicate the conviction rate or crime rate. The number of arrests can be affected by crime rate, police presence, and crime reporting.

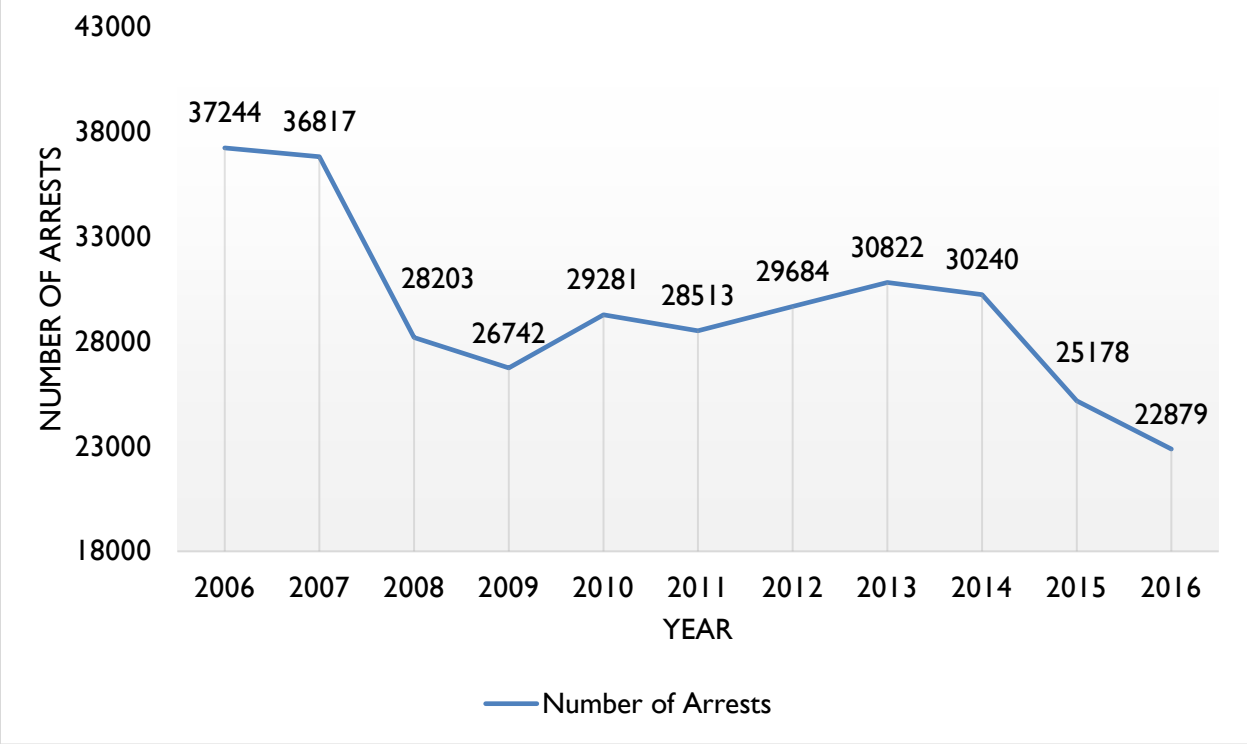
The number of arrests for both part one and part two category offenses on the Navajo Nation have generally been in decline since 2006, with a slight uptick for part two offenses from 2009 to 2014. Arrests for part two offenses reached a 10- year low in 2016 (NNDPS 2017). Declines in arrest rate could be

Figure AE-24
Number of Arrests for Part One Offenses on the Navajo Nation



Source NNDPS 2017

Figure AE-25
Number of Arrests for Part Two Offenses on the Navajo Nation



Source NNDPS 2017

attributed to multiple factors, including a reduction to the crime rate, changes in crime reporting, a change in police presence, and changes to law and police policy.

During the 2016-2017 FMG RMPA/EIS public scoping period, some commenters had anecdotal evidence of a potential increase in crime associated with oil and gas development. Studies centered around crime in oil and gas boomtowns have shown that increases in crime rates and the public perception of increased crime rates are likely driven by the rapid population growth associated with oil and gas development (Archbold 2015).

Changing demographics can lead to the perception of a decrease in safety and an increase in crime in these boomtowns (Archbold 2015). Examples are an increase in the male-to-female population ratio and changing social structures, where migrants to the community do not have the same traditional social affiliations and connections that long-time residents of the boomtowns have.

Despite what we know about oil and gas boomtown population growth and associated increases in crime, it is difficult to extrapolate statistical increases or decreases in crime to pinpoint the exact cause of a spike or decline in crime rates. Economic shifts, poverty levels, increased population, changing community demographics, educational attainment, public awareness, and police presence can all affect local crime rates.

Crime reporting and the public perception of crime rates are also important factors. As communication technologies improve and the use of social media continues to rise, so does real-time crime awareness. Victims reporting instances of crime may also increase, with improved communication and awareness. Both factors could lead to the public perception of crime rate escalation.

Additionally, should development bring an influx of workers from outside, the population would likely still reflect the traditional ethnic/racial background of the planning area, with its large proportion of Hispanic and Native American residents.

Commenters during the public scoping period asked the BLM to consider the rich and diverse socioeconomic background in the planning area. The commenters noted that current and future oil and gas development may result in impacts on communities; these include impacts from increased traffic, air and water quality degradation, those on noise and visual resources, tourism and recreation, and general changes to the quality of life.

Commenters in both the initial 2014 scoping period and the 2016/2017 scoping period noted the importance of economic contributions of oil and gas in the planning area and emphasized the importance of analyzing both market and nonmarket impacts (BLM 2014f, Section 6.13, pp. B-333-B-342, and BLM 2017f, Section 15, pp. B-427-B-492).

Changes to the social setting are more likely to occur when development and associated population change is introduced to communities that do not have a long history of natural resource development. With changes in technology, different portions of the planning area may be affected by development. An area of particular interest is that portion of the planning area that is in a checkerboard landownership pattern. Exploration for oil and gas has recently increased in this area.

Changes to the social setting can also affect the ability of different groups to access historical land uses. Subsistence agriculture, including sheep and cattle herding, is of historical importance for the Native American Tribal groups in the area, particularly the Navajo. In addition, approximately 26 percent of Native Americans surveyed in the socioeconomic study area reported gathering traditional plants or hunting as a food source. Firewood from BLM-managed lands is also important, as it represents a primary

heating source for many area residents, particularly Native Americans (Rio Puerco Alliance and Hasbidito 2013).

In addition, the planning area contains CIMPPs, which have cultural values for Native Americans and other groups that historically used the area. These also can be affected by development.

Attracting non-labor income. Open space can be an important contributor to the quality of life for communities next to public lands. These areas provide scenic views, recreation opportunities, and other benefits. In addition, nonmarket resources may provide indirect economic benefits.

Public lands in the planning area may provide enhanced value to adjacent private parcels. Additionally, open space and related amenities may attract new residents, who in turn bring new sources of income to the area. Communities next to public lands may offer a high level of natural amenities that often attract retirees and others with non-labor sources of income. These communities may attract sole proprietors and telecommuters, who bring income from other regions into the local economy. These new residents, in turn, spur economic development. Residents who rely on non-labor income become both a pool of customers and clients for new businesses and a potential source of investment capital (Hafele et al. 2007).

Ecosystem services

Ecosystem services are those goods that an ecosystem provides for human use. The value of these goods may not be captured in the traditional marketplace. Batker et al. (2014), examined the ecosystem service contributions from the Colorado River Basin, including sub-basin of the San Juan River within the planning area. Following the Millennium Ecosystem Assessment approach, this study defined four main groups of ecosystem services: 1) provisioning services (goods including food, water and materials from public lands, including such as oil and gas and wood products), 2) regulating services (services from intact ecosystem such as regulation of climate, water, soil, floods, and storms), 3) supporting services (habitat for wild plants and animals which thereby contribute to the conservation of biological diversity), and 4) information services (services from interaction with nature, such as recreation, spiritual, aesthetic, historic, educational, scientific, and subsistence values).

Maintenance or environmental restoration of lands can have economic value for local communities related to ecosystem services provided. Maintaining or improving land and water quality would maintain or improve the value of these resources. Conversely, if land or water quality is degraded by development, the value of these commodities decreases.

Commenters in the public scoping period noted concerns about the impacts on air and water quality in the region overall, from continued and increased oil and gas development. Ecosystem services supported by planning area lands are discussed applicable to all residents and visitors to the planning area.

AE.5.3 Environmental Justice

Environmental justice populations consist of individuals and families with incomes below the national poverty level and people who self-identify as belonging to one or more ethnic or racial minority groups. Impacts on these populations from proposed federal actions would normally be the same as those considered for the entire population of a planning area. If, however, some impacts would have an adverse and disproportionate impact on identified environmental justice populations, then environmental justice impacts would be assessed.

Current Conditions

Regulations and Guidance

Environmental justice refers to the fair treatment and meaningful involvement of people of all races, cultures, and incomes, with respect to the development, implementation, and enforcement of

environmental laws, regulations, programs, and policies. It focuses on environmental hazards and human health to avoid disproportionately high and adverse human health or environmental impacts on minority and low-income populations.

EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, requires federal agencies to identify and address any disproportionately high and adverse human health or environmental impacts of their programs, policies, and activities on minority and low-income populations.

According to the Council on Environmental Quality's (CEQ's) Environmental Justice Guidelines for NEPA (1997), "In order to determine whether a proposed action is likely to have disproportionately high and adverse human health or environmental impacts on low-income populations, minority populations, or Indian Tribes, agencies should identify a geographic scale, obtain demographic information on the potential impact area, and determine if there is a disproportionately high and adverse impact on these populations.

Agencies may use demographic data available from the Bureau of the Census to identify the composition of the potentially affected population. Geographic distribution by race, ethnicity, and income, as well as a delineation of Tribal lands and resources, should be examined."

It further states that "minority populations should be identified where either the minority population of the affected area exceeds 50 percent or where the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis." For this analysis, "meaningfully greater' is classified as ten percentage points or higher than that of the state level reference population.

Minorities are defined as individuals who identify as of one or more of the following population groups:

- American Indian or Alaskan Native
- Asian or Pacific Islander
- Black, not of Hispanic/Latino origin
- Hispanic/Latino of any race

Further, CEQ states that in identifying minority communities, agencies may consider as a community either of the following: a group of individuals living in geographic proximity or a geographically dispersed/transient set of individuals, where either type of group experiences common conditions of environmental exposure or impact.

A minority population also exists if there is more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the above-stated thresholds.

Low-income populations are defined as persons living below the poverty level, based on total income of $12,082 for an individual and $24,036 for a family of four for 2015 data (US Census Bureau 2016a). The BLM, BIA, CEQ, and EPA guidance do not provide a quantitative threshold[26] for determining whether a population should be considered low income. For this analysis, the percentage of persons in poverty in the study area is compared with that of the state.

The RMPA planning area includes all or portions of McKinley, Rio Arriba, Sandoval, and San Juan Counties in New Mexico. For environmental justice analysis, populations in all counties have been examined using US Census data to determine the percentage of low-income, minority, and Tribal populations. In addition,

[26] A limit on the percentage of persons in poverty

where data were available, key communities and Tribal populations in the area were examined. For the purpose of identifying a minority or a low-income population concentration, the comparison population used in this study is New Mexico as a whole. The information below applies to BLM and BIA lands.

In addition to the consideration of specific thresholds, other factors may determine if a population should be considered for further examination of impacts on low-income or minority populations. The BLM and BIA have incorporated the recommendations provided in the EPA's Promising Practices for EJ Methodologies in NEPA Reviews (EPA 2016c). Specifically, the agencies worked with the Navajo Nation and other potentially affected groups in the planning area to identify available data sources and topics of concern. Unique conditions of the potentially affected minority populations and low-income populations that may be affected by the proposed action are noted where applicable below.

Low-Income Populations

The BLM and BIA used income and poverty data estimates for study area counties from the US Census Small Area Poverty Estimates model to examine poverty at the county level. These data indicate that the percentage of the population living below the poverty level ranged from 34.1 percent in McKinley County to 11.2 percent in Sandoval County. Sandoval County and San Juan County had a lower percentage of the population in poverty than that of the state average, and only Sandoval county had a lower percent of the population than the national average (**Table AE-72**). US Census Small Area Poverty Estimates model data represent a single point in time, and therefore may differ slightly from the American Community survey five year poverty data displayed previously in Table AE-48, Study Area Income Distribution (2000 to 2015 Comparison).

Table AE-72
Study Area County Income and Poverty (2015)

Statistic	McKinley County	Rio Arriba County	Sandoval County (includes Rio Rancho)	San Juan County	New Mexico	United States
Percent of individuals in poverty 2015	34.1	24.2	11.2	18.8	19.8	14.7
Per capita income 2015	$12,614	$19,678	$26,742	$23,143	$24,012	$28,930
Median family income 2015	$28,772	$36,098	$73,181	$51,875	55,049	$66,011

Source: US Census Bureau 2015b

Similarly, estimates from 2015 indicate that Sandoval County had a family median income ($73,181) above that of the state level of $55,049. All other counties were below the state level in 2015, notably McKinley County ($28,772) was around half of the state level. Estimates for poverty in communities are available from US Census Bureau American Community Survey data. The highest poverty rates were seen in the communities of Espanola (28.0 percent) and Gallup (25.5 percent). See discussion in **Section 5.2** and **Table AE-73**, below.

Census tracts are geographic regions within the United States that are defined by the US Census Bureau in order to track changes in a population over time. Census tracts are based on population sizes and not geographic areas. The average population of a census tract is about 4,000 people, so rural areas that are sparsely populated may have very large census tracts, while densely populated urban areas may have very small census tracts.

When broken down by census tract, 47 out of the 87 census tracts had a greater level of individuals living below the poverty line than the state level. In addition, 2 out of 87 tracts in the socioeconomic study area

Table AE-73
Study Area Key Community Race/Ethnicity and Poverty Data (2015)

Community	Percent of Population Racial or Ethnic Minority	Percent of Individuals Below Poverty
Aztec	32.9	15.2
Bernalillo	75.4	18.9
Bloomfield	61.2	18.0
Crownpoint	95.6	31.6
Espanola	91.9	28.8
Farmington	50.2	16.5
Gallup	76.2	25.5
Nageezi	100.0	68.9
Pueblo Pintado	98.0	23.1
Rio Rancho	48.8	11.4
Shiprock	96.6	34.2
Torreon	97.6	60.2

Source: US Census Bureau 2015a
Note: American Community Survey estimates are based on data collected over 5 years. The estimates represent the average characteristics of populations between 2011 and 2015. They do not represent a single point in time.

have greater than 50 percent of individuals living below the poverty line: Census Tract 9405 in southwestern McKinley County and Census Tract 9409 in northwestern Sandoval County (US Census Bureau 2015a). These census tracts are all relatively large, indicating a sparsely populated, rural area. See **Figure AE-26**, Low-Income Populations by Census Tract.

Minority Populations

Based on 2015 data, minorities made up 60.8 percent of the population in New Mexico, compared with 37.7 percent in the United States as a whole. See **Table AE-74**, Study Area County Population by Race/Ethnicity (2015). The proportion of minorities in socioeconomic study area counties substantially exceeded the United States and is slightly higher than the state average; the population ranged from 90.1 percent minority in McKinley County to 54.5 percent in Sandoval County.

Within reservations, Native Americans represented most of the population. The largest minority groups outside of Tribal reservations were Hispanics/Latinos in Rio Arriba and Sandoval Counties and Native Americans in McKinley and San Juan Counties.

When broken down by census tract, 62 out of 87 tracts have a minority population greater than 50 percent, with most of the minority populations self- identified as American Indian and Alaska Native under the US Census categorization system. Most of the study area is predominately minority, and areas that are not predominantly minority are based around Rio Rancho, the Aztec/Farmington/Bloomfield area, southeastern McKinley County, and north of Española. See **Figure AE-27**, Minority Populations by Census Tract.

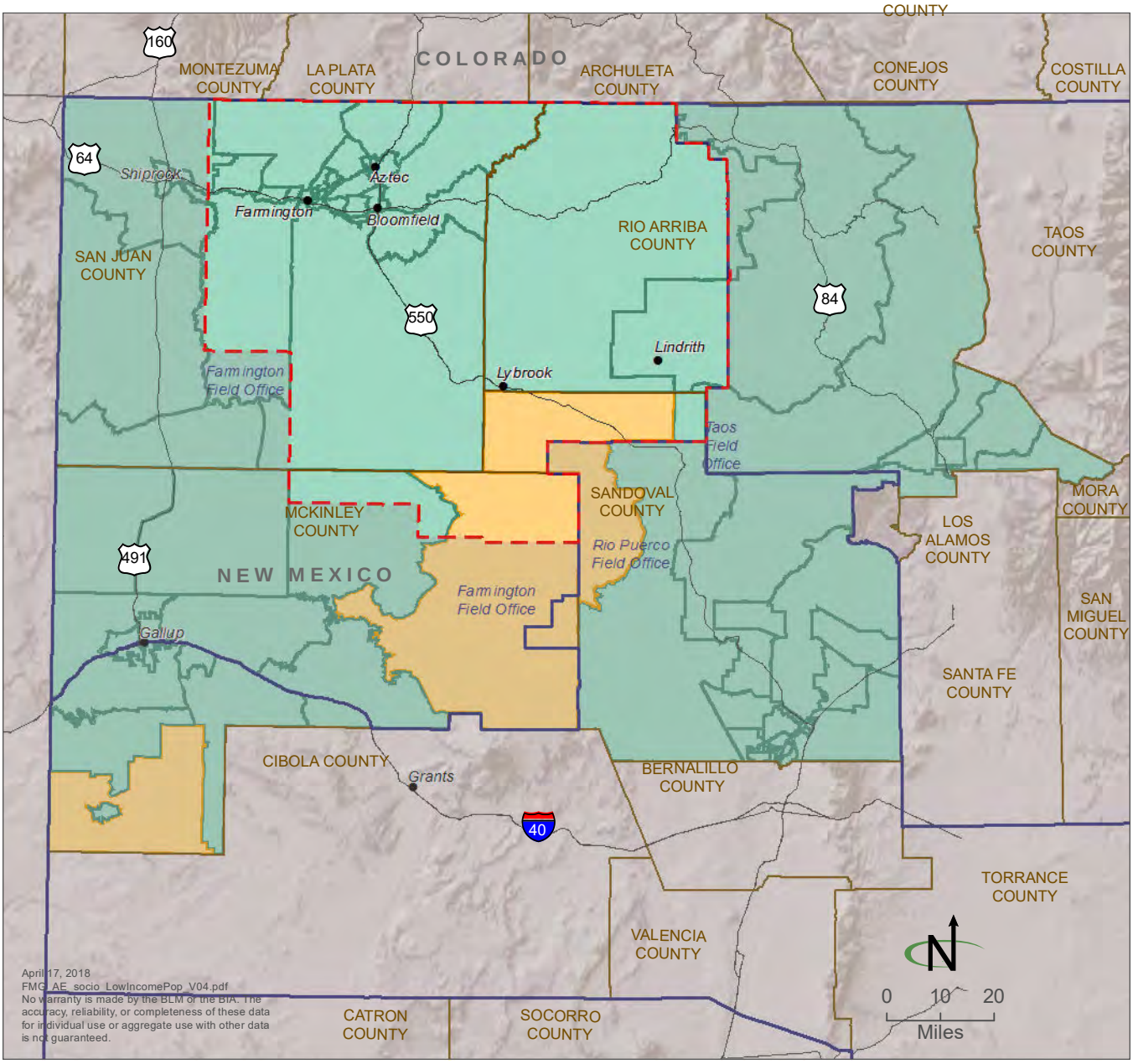
CEQ's definition of a minority population area is one where the minority residents exceed 50 percent of all residents or meaningfully greater than the minority population percentage in the comparison population, which is that of New Mexico. As such, Bernalillo, Bloomfield, Espanola, and Gallup all are considered minority communities. See **Table AE-73**, above.

Native American Populations

Native Americans account for a substantial portion of the study area population in some areas, notably McKinley and San Juan Counties; here, the populations are 73.9 and 37.4 percent, respectively, American Indian.

Figure AE-26
Low-Income Populations by Census Tract

A low-income population is determined based on annual statistical poverty thresholds developed by the US Census Bureau. In 2012, poverty level is based on total income of $11,720 for an individual and $23,283 for a family of four.



Source: BLM GIS 2017, US Census Bureau 2012b, 2014

Greater than 50% of individuals live below the poverty line

Less than 50% of individuals live below the poverty line

Planning area

Field office boundary

Table AE-74
Study Area County Population by Race/Ethnicity (2015)

Population	McKinley County	Rio Arriba County	Sandoval County (includes Rio Rancho)	San Juan County	New Mexico	United States	Jicarilla Apache Nation	Navajo Nation	Ute Mountain Ute Tribe
Hispanic or Latino ethnicity of any race	10,303	28,544	50,357	24,504	986,972	54,232,205	280	3,003	119
	13.9%	71.5%	36.9%	19.6%	47.7%	17.1%	9.3%	1.7%	9.1%
White alone	12,530	24,974	95,608	66,443	1,524,911	232,943,055	180	3,765	102
	16.9%	62.5%	70.0%	53.1%	73.2%	73.6%	6.0%	2.2%	7.8%
Black or African American alone	603	210	3,638	691	43,738	39,908,095	35	723	11
	0.8%	0.5%	2.7%	0.6%	2.1%	12.6%	1.2%	0.4%	0.8%
American Indian or Alaskan Native alone	54,674	6,115	16,807	46,829	190,528	2,569,170	2,629	165,296	1,120
	73.9%	15.3%	12.3%	37.4%	9.1%	0.8%	87.8%	95.1%	85.2%
Asian alone	717	144	1,891	644	28,761	16,235,305	42	1,099	11
	1.0%	0.4%	1.4%	0.5%	1.4%	5.1%	1.4%	0.6%	0.8%
Native Hawaiian and Other Pacific Islander alone	20	3	50	68	1,276	546,255	0	144	0
	<0.01%	<0.01%	<0.01%	0.1%	.01%	0.2%	0%	0.1%	0%
Some other race	2,764	7,592	13,301	6,450	226,850	14,865,258	16	371	0
	3.7%	19.0%	9.7%	5.2%	10.9%	4.7%	0.05%	0.2%	0%
Two or more races	2,690	911	5,343	4,008	68,053	9,447,883	93	2,424	70
	3.6%	2.3%	3.9%	3.2%	3.3%	3.0%	3.1%	1.4%	5.3%
Percent minority	66,678	34,711	74,449	24,504	1,267,069	119,256,743	2,934	170,653	1,271
	90.1%	86.9%	54.5%	59.0%	60.8%	37.7%	98.0%	98.2%	96.9%
Classified as minority population based on CEQ guidelines?	Yes	Yes	Yes	Yes	Yes	N/A	Yes	Yes	Yes

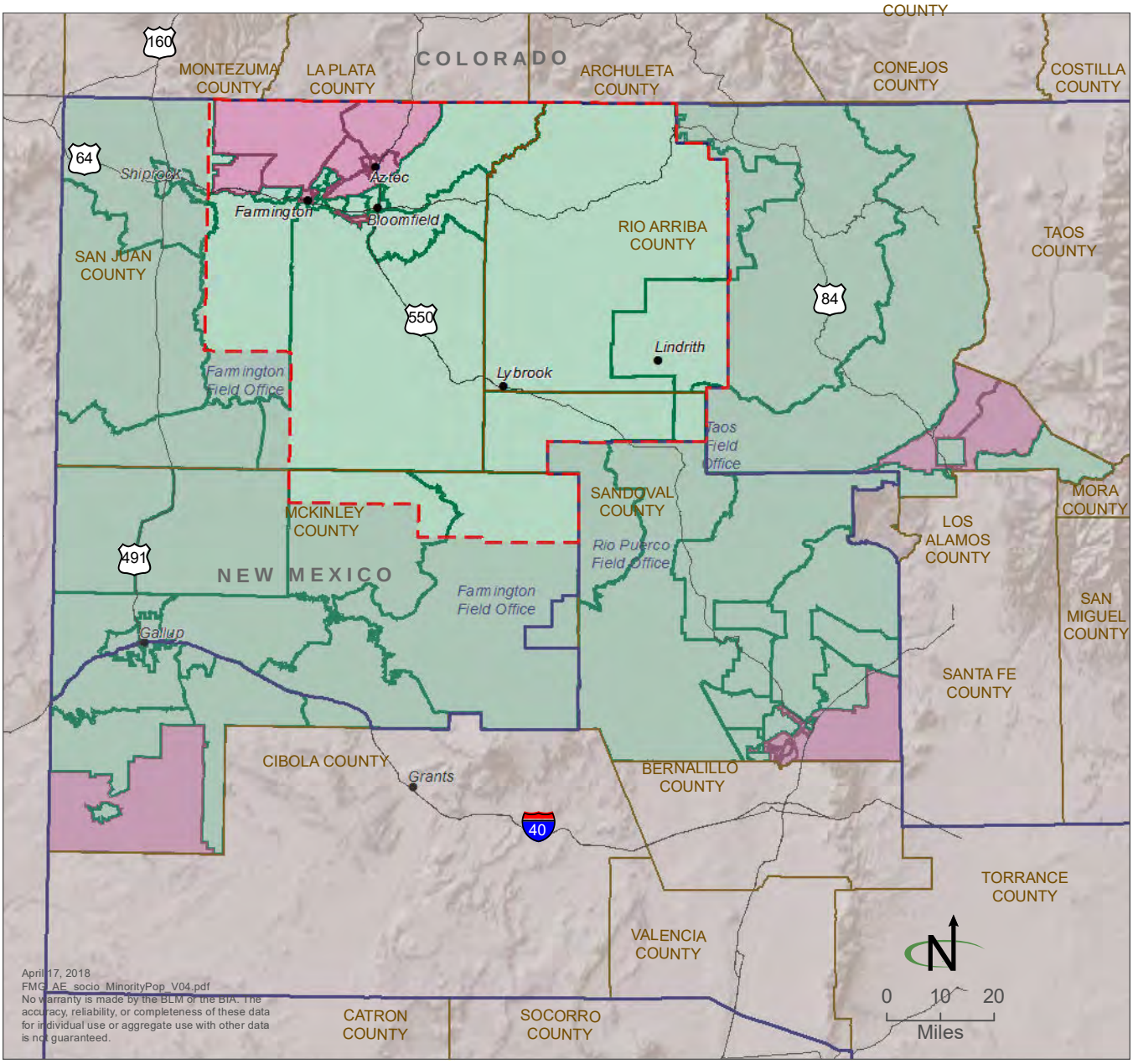
Source: US Census Bureau 2015a

Notes:
American Community Survey estimates are based on data collected over a 5-year period. The estimates represent the average characteristics of populations between January 2011 and December 2015 and do not represent a single point in time. Data for Jicarilla Apache Nation, Navajo Nation, and Ute Mountain Ute Tribe include reservation and off-reservation trust lands.

Total percent minority is calculated by counting the total population minus those identifying as white of non-Hispanic descent.

Figure AE-27
Minority Populations by Census Tract

A minority population area is defined as either an area in which the combined population of all minority groups exceeds 50 percent of the total population, or an area in which the percentage of all minority groups is meaningfully greater than the percentage of the minority population in the broader region.



Source: BLM GIS 2017, US Census Bureau 2012b, 2014

Greater than 50% of the population identifies as a minority race

Less than or equal to 50% of the population identifies as a minority race

Planning area

Field office boundary

Three Tribal governments have reservations in the planning area: the Jicarilla Apache Nation, the Navajo Nation, and the Ute Mountain Ute Tribe. (**Table AE-75**, Tribal Nations with an Interest in the Planning Area, below; **Figure AE-28**, Tribal Nations, for a map of these three nations and how they intersect the Mancos-Gallup EIS planning area.)

Table AE-75
Tribal Nations with an Interest in the Planning Area

Tribe	Acres	General Location
Jicarilla Apache Nation	739,400	Most of the Jicarilla Apache Nation is in western Rio Arriba County, in the eastern portion of the planning area.
Navajo Nation	675,360	A portion of the Navajo Nation extends into western San Juan County and into the western portion of the planning area. This includes all or portions of the Nageezi, Huerfano, Counselor, Pueblo Pintado, Ojo Encino. Torreon, Whitehorse Lake, Becenti, Lake Valley, White Rock, Burnham, Upper Fruitland, Nenahnezad/San Juan, Sanostee, Newcomb, and Hogback Chapters.
Ute Mountain Ute Tribe	103,300	A portion of the Ute Mountain Ute Tribe extends into the northern portion of San Juan County, just east of the Navajo Nation, and into the northern portion of the planning area.
Navajo allotted lands	210,100	Lands in the southern portion of the planning area, under BIA jurisdiction; these are remnants of reservations broken up during the federal allotment period of the late nineteenth and early twentieth centuries.
Southern Ute Indian Tribe	N/A (next to the planning area)	North of the planning area, in Colorado.
Pueblo populations	N/A (the planning area contains ancestral lands)	Throughout New Mexico

Sources: BLM GIS 2017; US Census Bureau 2015a

The planning area overlaps the Eastern Agency of the Navajo Nation and a portion of the Shiprock Agency of the Navajo Nation. These agencies are further divided into local chapters, which may have distinct economic and cultural situations (**Figure AE-29**, Navajo Nation Chapters). The chapters likely to be most affected by the activities analyzed in this EIS in the Eastern Agency are Nageezi, Huerfano, Counselor, Pueblo Pintado, Ojo Encino, Torreon, Whitehorse Lake, Becenti, Lake Valley, White Rock, and Newcomb. Chapters in the Shiprock Agency are Burnham, Hogback, Nenahnezad/San Juan, Sanostee, and Upper Fruitland.

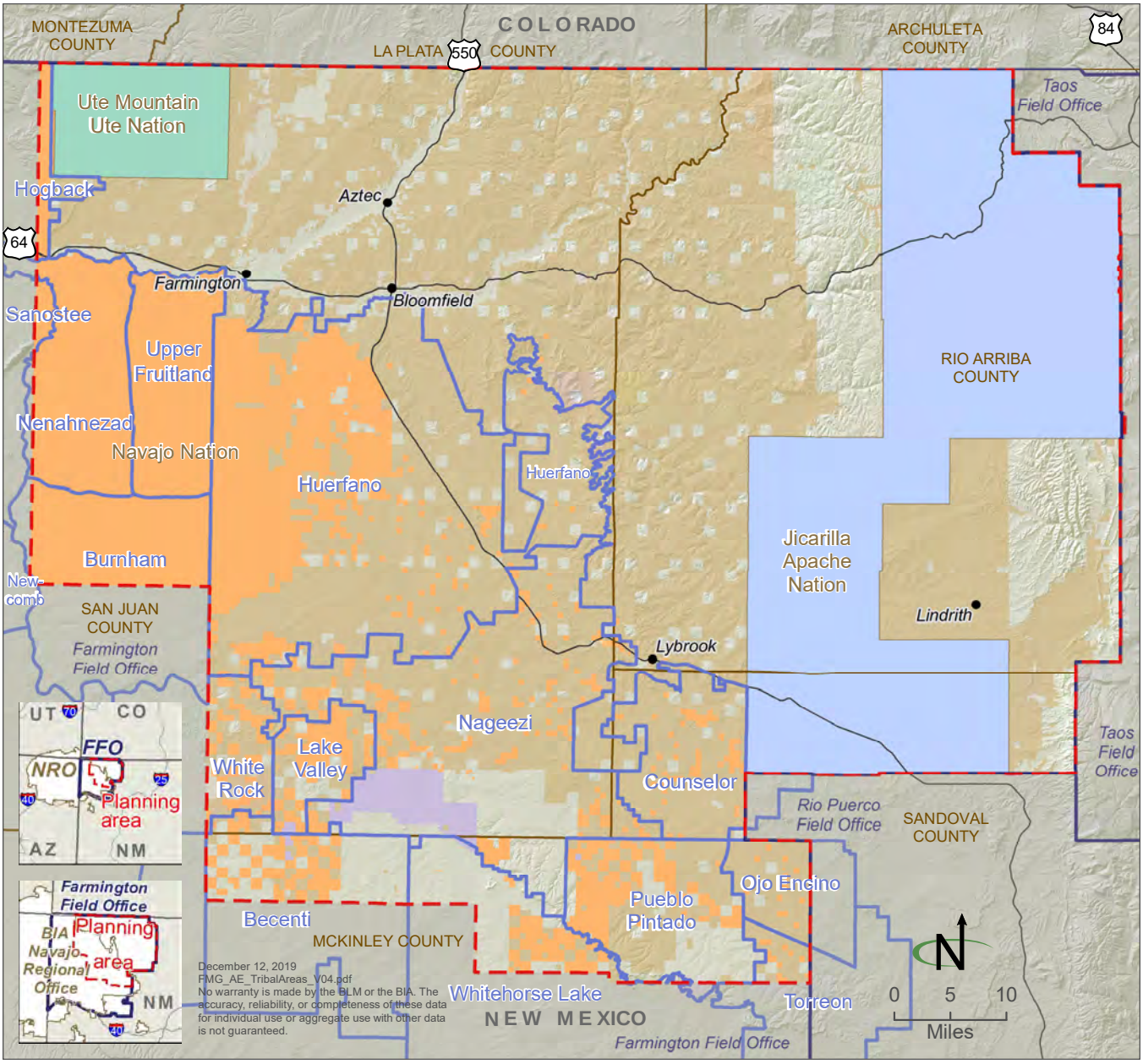
Select socioeconomic data for Navajo chapters in the area are shown in **Table AE-76**, below. Data for the Navajo Nation as a whole are provided for comparison purposes. (US Census Bureau 2016b)

Burnham, Counselor, Nagezzi, Ojo Encino, Pueblo Pintado, Sanostee, Torreon, and Whitehorse Lake chapters have higher rates of individuals in poverty than that of the Navajo Nation as a whole; all chapters qualify as low-income and minority populations, based on CEQ guidance.

Disparities in access and funding for healthcare and healthcare outcomes exist among Tribal populations. According to the San Juan County Community Health Profile, those in San Juan County have access to only 61.5 primary care physicians per 100,000 people, while New Mexicans as a whole have access to 73.7 (San Juan County 2011). Additionally, it is likely that persons in the planning area must drive further distances and spend more money travelling to access healthcare. Native Americans in rural communities experience higher rates of post-neonatal death rates and health disparities continue beyond infancy; the age-adjusted death rate for adult Native Americans exceeds the general population by nearly 40 percent (Sarche and Spicer 2009).

Figure AE-28
Tribal Nations

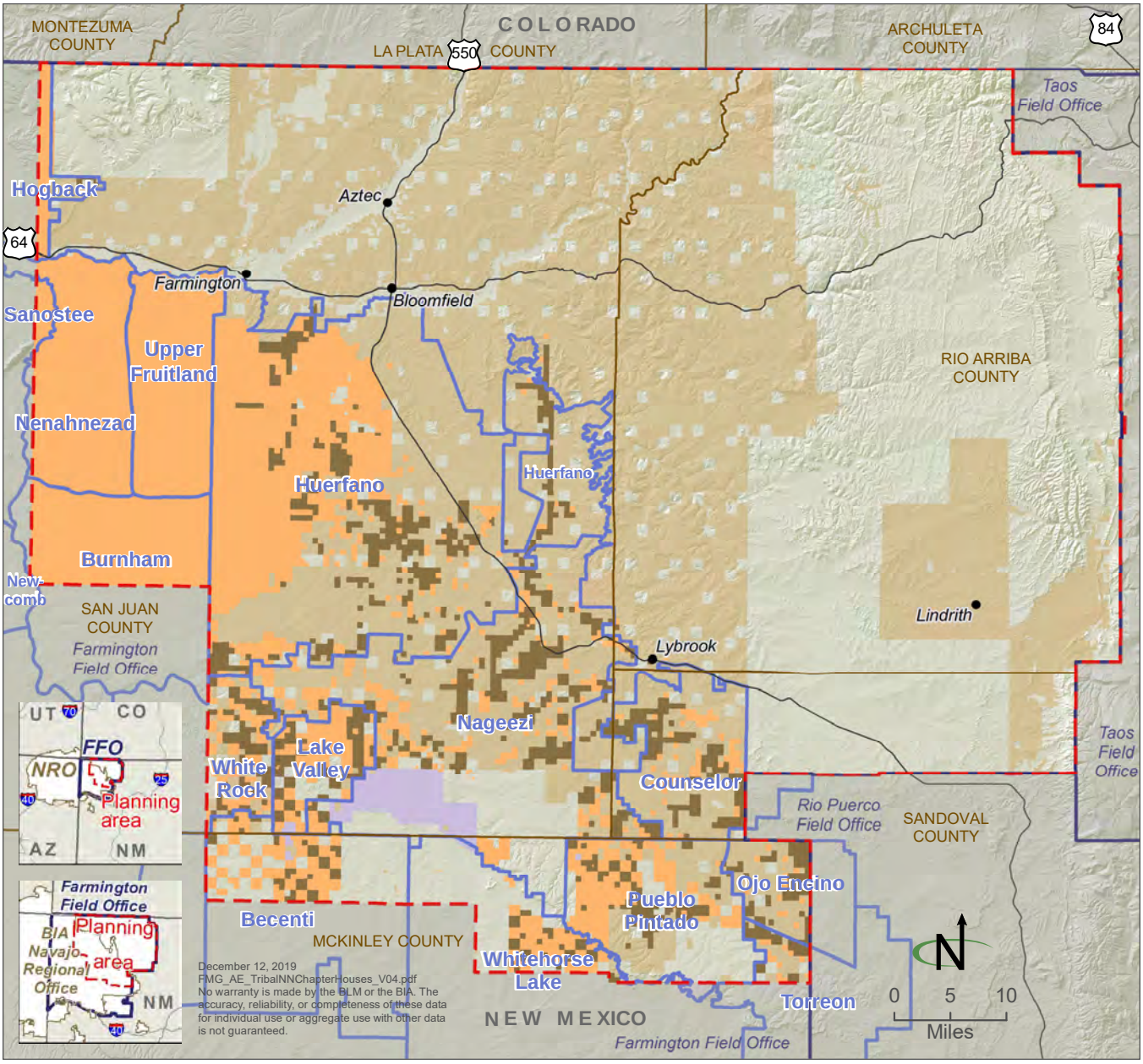
Three tribal governments have reservations in the planning area: the Jicarilla Apache Nation, the Navajo Nation, and the Ute Mountain Ute Nation.



Source: BLM GIS 2020

- Navajo Nation
- Jicarilla Apache Nation
- Ute Mountain Ute Nation
- BLM and BIA decision area
- Planning area
- National Park Service
- Field office boundary
- Navajo Nation Chapter

Figure AE-29
Navajo Nation Chapters



Source: BLM GIS 2020

- Navajo Nation Chapter
- Navajo trust land
- Navajo allotment land
- BLM and BIA decision area
- Planning area
- National Park Service
- Field office boundary

Table AE-76
Navajo Nation Chapters Overview Data

Chapter	Population (2016)	Percent Ethnic or Racial Minority (2016)	Percent of Individuals Below Poverty (2016)	Percent of Families Below Poverty (2016)	Median Household Income (2016)
Eastern Agency of the Navajo Nation					
Bencenti	479	99.4	40.9	41.3	$36,250
Counselor	762	96.2	67.7	57.0	$14,375
Huerfano	2,708	97.0	38.3	33.8	$27,500
Lake Valley	283	96.1	38.5	37.7	$20,000
Nageezi	900	99.5	52.7	50.0	$18,375
Newcomb	597	96.3	34.7	31.4	$30,250
Ojo Encino	597	99.7	55.1	50.4	$20,000
Pueblo Pintado	442	96.7	50.5	42.5	$23,750
Torreon	1,676	98.4	50.1	46.3	$25,263
Whitehorse Lake	344	100.0	50.1	37.9	$14,205
White Rock	60	100.0	33.3	20.0	$37,500
Shiprock Agency of the Navajo Nation					
Burnham	199	100.0	59.8	52.2	$13,571
Hogback	1,236	99.3	23.4	22.2	$40,125
Nenahnezad/ San Juan	1,710	99.3	34.4	31.8	$32,381
Sanostee	1,575	99.7	44.2	37.6	$19,612
Upper Fruitland	2,769	98.6	24.3	18.8	$46,771
Navajo Nation overview	64,950	98.4	41.6	37.5	$25,525

Source: US Census Bureau 2016b

Household spending patterns in Navajo Nation chapters, and the related local economy may be influenced by household characteristics. As demonstrated in **Table AE-48**, Characteristics of Occupied Housing Units (2016), households in Navajo Nation chapters, are less likely to rely on utilities for heating, and more likely to lack complete pluming as compared to state and county level populations as a whole.

In addition, limited access to retail outlets results in money earned by residents in the Navajo Nation being spent outside of the reservation, representing a leakage of secondary economic contributions. A 2010 study found that over 64 of the Navajo money is spent in off-reservation communities (Navajo Nation Division of Economic Development 2010), and the rate may be higher for some local chapters based on proximity to border towns and the degree of local economic development. In remote areas, the problem is further exacerbated by lack of transportation. As shown in **Table AE-48**, an average of 13.6 percent of households in Navajo Nation chapters do not have a car, as compared to 5.8 percent of New Mexico residents overall. Alternative transportation is often expensive or not available. Local retail, such as the Navajo Nation Shopping Centers (NNSC) enterprise, and DCI Shopping Center, Incorporated (DCISCI), have been established to promote local retail development (Navajo Nation Division of Economic Development 2010).

Almost half of the planning area is composed of Tribal lands. This includes individual Indian allotments, Tribal trust, Tribal fee, and reservation lands. Each Tribe maintains a general concern for protecting and accessing areas of traditional and religious importance and the welfare of plants, animals, air, landforms, and water on reservations and public lands. The BLM and BIA incorporate information about traditional native and native practitioner plant gathering in their analysis of the impacts of any proposed activities.

Additional Tribal nations have communities or Tribal lands near the planning area and could be affected by proposed management actions. The Southern Ute Indian Tribe has lands in Colorado just north of the planning area, but none in the planning area. The Zia and Jemez Pueblos are located just outside FFO boundaries.

Also note that additional Tribal groups with no current lands in the planning area have religious, ancestral, and cultural connections to it. In particular, contemporary Pueblo populations have connections to the area, including, but not limited to, the cultural sites of CCNHP and the Great North Road, which are in the planning area.

For Native communities, traditional uses of the land for subsistence is very important. There is a historical precedent for Native Americans to use firewood as their primary source of heat. In addition, many Native American households in the planning area are constrained by under-development and economic impoverishment, limiting access to other heating fuel sources. Firewood from BLM-managed lands or from BIA-issued permits is a primary heating source for much of the Native American population in the planning area (Rio Puerco Alliance and Hasbidito 2013).

Based on 2016 data (**Table AE-48**), use of wood as a primary fuel source for heat ranged from 38.3 percent to 90.8 percent, compared to a state rate of 6.8 percent. Similarly, data from Ojo Encino, Torreon, and Counselor chapters indicate that 93 percent of survey respondents in 1993 used wood for the primary source of heating their homes. Of this amount, approximately 60 percent was gathered from BLM-managed lands, with an additional 30 percent from unknown origin, which is also likely to include some BLM-managed lands (Rio Puerco Alliance and Hasbidito 2013).

Based on wood sources and collection methods, the average annual household cost for firewood was approximately $338 in 2012 for a household in the area surveyed (Rio Puerco Alliance and Hasbidito 2013). In addition to firewood, for some Native peoples, other vegetation, such as wild onions, berries, and pinyon-juniper nuts, on public land may provide essential subsistence.

The BLM and BIA continue to consult with potentially affected Tribal groups about resources that may be affected and issues of concern. Meetings that were conducted are summarized in **Chapter 4** of the FMG RMPA/EIS, Consultation and Coordination.

Land Grant Descendants

As discussed in the overview in **Section 5.2**, Social and Economic Uses, the Spanish and later Mexican governments issued land grants in the area to facilitate development and farming. The two major types of land grants were private ones made to individuals and communal ones made to groups for the purpose of establishing settlements. The descendants of these original landholdings have a unique tie to the planning area and the potential to be affected by proposed actions. In New Mexico, there are approximately 26 community land grants with currently active boards.

AE.5.4 Public Health and Safety

The BLM's mission to sustain public lands for the use and enjoyment of present and future generations includes minimizing and reducing threats from releases of hazardous substances. These substances could have an impact on the health, diversity, and productivity of the public lands and on the health and safety of the individuals who use and work on these lands. In addition, FLPMA requires that BLM actions comply with approved standards for public health and safety.

The BIA's mission is to enhance the quality of life, to promote economic opportunity, and to carry out the responsibility to protect and improve trust assets of American Indians and Indian Tribes. Of concern to both the BLM and the BIA in the decision area are the health and safety impacts related to energy development.

Current Conditions

Hazardous substances can be defined as any item or chemical that has the potential to harm humans, natural resources, or the environment when spilled, released, or touched. Hazardous wastes are hazardous substances that have been spilled, released, or dumped. Resource Conservation and Recovery Act (RCRA) hazardous waste in regulatory terms is a waste that appears on one of the four hazardous waste lists (40 CFR 261.31-33) and/or exhibits at least one of four characteristics: ignitability, corrosivity, reactivity, or toxicity. Hazardous waste is regulated under RCRA Subtitle C.

Energy development can include oil, gas, geothermal, wind, and solar energy sites. Oil and gas development is often associated with concerns over public health and safety. The BLM requires all oil and gas operators to comply with applicable regulations designed to protect the environment and the public, such as BLM Onshore Orders 1, 2, and 7, and with additional requirements imposed by the BLM as part of the drilling permit or lease or ROW grant.

The BIA's Fluid Mineral Estate Procedural Handbook (BIA 2012) establishes the BIA's procedures for working closely with mineral owners, the lessee and operator, the BLM, and other responsible parties to ensure the safest and most efficient location for surface facilities when Tribal trust surface or Tribal allotted surface is involved.

While the BLM, not the BIA, has enforcement authority for lease compliance, the BIA can conduct inspections and identify instances of noncompliance in order to notify the BLM for enforcement actions or may take actions to cancel the lease itself (25 CFR 211.54 of Tribal Trust lands and 25 CFR 212.54 for Indian allotted lands). Unless prohibited by federal law, the BIA recognizes and complies with Tribal laws regulating the mineral estate, including Tribal laws relating to resource use, such as environmental protection, building codes, housing codes, zoning, and historic and cultural preservation.

Hazardous chemicals are used and produced by oil and gas extraction (Witter et al. 2008). Spills of oil and gas wastes or chemicals used in production can contaminate surface water, groundwater, and soil. Active wells can produce hazardous chemical emissions through control valves (e.g., venting of pressurized well gas), leaking equipment (e.g., well heads), water or condensate tanks (e.g., entrained gas can flash or evaporate), and gas compressors. Well workover operations can also release hazardous chemicals. Common hazardous materials associated with oil and gas development activities include air emissions like H_2S and methane, radioactive drill cuttings, and petroleum products like oil and diesel fuel.

Certain waste materials from oil and gas exploration and production activities have been exempted from standards created to protect health under a number of federal statutes: the Clean Air Act, the CWA, the Safe Drinking Water Act, RCRA, the Superfund Act, and the Emergency Planning and Community Right-to-Know Act (the Toxics Release Inventory; Witter et al. 2008).

These exemptions, however, do not preclude these wastes from being controlled under state regulations, under the less stringent Resource Conservation and Recovery Act Subtitle D solid waste regulations, or under other federal regulations. In addition, although these wastes are not regulated as hazardous, the exemption does not mean that they could not present a hazard to human health and the environment if improperly managed.

In general, exempted waste is that which comes from downhole (i.e., subsurface) or was brought to the surface from the well. Also exempted is waste that has otherwise been generated by contact with the oil and gas production stream during the removal of produced water or other contaminants from the product.

In addition to the regulation of waste associated with the production of oil or gas, the Navajo Nation is authorized to seek and formally request the DOI to shut-in and halt production of oil or gas on Navajo

Nation lands wherever such production is accompanied by waste or loss (Navajo Nation Code Title 18 Section 1402).

Topics of recent and growing public concern, both nationally and in the decision area, include hydraulic fracturing to enhance the recovery of natural gas and associated liquid hydrocarbons. Another topic of concern is emissions to the atmosphere of natural gas (methane) and other gaseous constituents.

Oil and gas production poses the risk of spills or accidental release of contaminants during the production and transport of natural gas, condensate, and produced water. Companies are responsible for understanding and abiding by all applicable hazardous materials transportation laws and regulations contained in 49 CFR Parts 100-180. There is a potential for a pipeline carrying natural gas, liquid condensate, or produced water to develop leaks or ruptures during natural gas extraction, transport, and processing. Data from the US Department of Transportation indicate that an average of one rupture annually should be expected for every 5,000 miles of pipeline (Office of Pipeline Safety 2005). In addition to pipelines, there is a risk of ruptures of and releases from storage tanks and barrels.

More than 50 percent of pipeline ruptures occur as a result of heavy equipment striking the pipeline. Such ruptures could cause a fire or explosion if a spark or open flame were to ignite the natural gas escaping from the pipeline. Pipeline design, materials, maintenance, and abandonment procedures are required to meet the standards set forth in US Department of Transportation regulations (49 CFR 192, Transportation of Natural Gas by Pipelines). Oil owners and operators are required to maintain and implement spill prevention, control, and countermeasure plans, including such cleanup and mitigation measures as required by the BLM or the state.

Public concern about the use of hydraulic fracturing has been focused on the potential for contamination of freshwater aquifers and impacts on domestic and municipal water wells.

An associated concern has involved the potential for mini-earthquakes caused by the creation of enough pressure in the formation to cause fractures. For decades, oil and gas companies and independent geophysicists have used state-of-the-art equipment to monitor microseismic activity—defined as a faint or very slight tremor—during hydraulic fracturing to optimize well completions and to gather information about fracture dimensions and propagation (Warpinski 2011). These data give an indication about the magnitude of seismic activity associated with hydraulic fracturing, the dimensions of resultant fractures in geologic formations, and the probability for induced fractures to extend into nearby aquifers, if present.

Research indicates that microseismic activity created by hydraulic fracturing occurs at Richter magnitude 1.0 or less (Warpinski and Zimmer 2012). In comparison, a magnitude 3.0 earthquake is the threshold that can be felt at the ground surface. The Richter magnitude scale is base-10 logarithmic, meaning that a magnitude 1.0 tremor is 1/10th the energy of a magnitude 2.0 tremor.

The National Academy of Sciences reviewed more than 100,000 oil and gas wells and wastewater disposal wells around the world and concluded that "incidences of felt induced seismicity appear to be very rare," with only one such documented occurrence (NAS [National Academy of Sciences] 2012).

In addition to vertical separation of several thousand feet between the upper extent of fractures and freshwater aquifers, the BLM imposes requirements for proper casing and cementing of wellbores to isolate the aquifers penetrated by a wellbore. The BLM requires that the surface casing be set from 800 to 1,500 feet deep, based on a geological review of the formations, aquifers, and groundwater. Cement is then pumped into the space between the casing and surrounding rock to prevent fluids from moving up the wellbore and casing annulus and coming in contact with shallow rock layers, including freshwater aquifers.

BLM petroleum engineers review well and cement design and final drilling and cementing logs to ensure that the cement has been properly placed. When penetration of groundwater and freshwater aquifers is anticipated, BLM inspectors may witness the cementing of surface casing and subsequent pressure testing to ensure that the annular space between the casing and borehole wall is properly sealed.

No single list of chemicals currently used in hydraulic fracturing exists for the planning area, and the exact combinations and ratios used by operators are considered proprietary; however, the general types of compounds and relative amounts used are well known and relatively consistent (**Table AE-77**). Since fracture jobs are tailored to the downhole environment and companies are aware of the concerns involving hydraulic fracturing, the chemicals listed in **Table AE-77** may or may not be used, and the information is provided solely as general information.

Table AE-77
Typical Hydrofracturing Chemical Additives

Additive Type[1]	Typical Example[1]	Percent by Volume[2]	Function[1]	Common Use of Example Compound
Acid	Hydrochloric acid	0.123	Dissolves minerals and initiates cracks in the rock	Swimming pool chemical and cleaner
Biocide	Glutaraldehyde	0.001	Eliminates bacteria in the water that produces corrosive by-products	Disinfectant; sterilizer for medical and dental equipment
Breaker	Ammonium persulfate	0.010	Allows delayed breakdown of the gel	Used in hair coloring, as a disinfectant, and in manufacture of household plastics
Clay stabilizer	Potassium chloride	0.060	Creates a brine carrier fluid that prohibits fluid interaction with formation clays	Used in low-sodium table salt substitutes, medicines, and intravenous fluids
Corrosion inhibitor	Formic acid	0.002	Prevents corrosion of the pipe	Used as a preservative in livestock feed and as a lime remover in toilet bowl cleaners
Crosslinker	Borate salts	0.007	Maintains fluid viscosity as temperature increases	Used in laundry detergents, hand soaps, and cosmetics
Friction reducer	Polyacrylamide	0.088	"Slicks" the water to minimize friction	Used as a flocculent in water treatment and manufacture of paper
Gelling agent	Guar gum	0.056	Thickens the water to help suspend the sand	Used as a thickener, binder, or stabilizer in foods
Iron control	Citric acid	0.004	Prevents precipitation of metal oxides	Used as flavoring agent or preservative in foods
Surfactant	Lauryl sulfate	0.085	Increases the viscosity of the fracture fluid	Used in soaps, shampoos, and detergents and as a foaming agent

Additive Type[1]	Typical Example[1]	Percent by Volume[2]	Function[1]	Common Use of Example Compound
pH adjusting agent	Sodium hydroxide, acetic acid	0.011	Adjusts pH of fluid to maintain the effectiveness of other components, such as crosslinkers	Sodium hydroxide used in soaps and drain cleaners; acetic acid used as a chemical reagent and main ingredient of vinegar
Scale inhibitor	Sodium polycarboxylate	0.043	Prevents scale deposits in the pipe	Used in dishwashing liquids and other cleaners
Winterizing agent	Ethanol, isopropyl alcohol, methanol	—	Added as a stabilizer, drier, and anti-freezing agent	Various cosmetic, medicinal, and industrial uses
Total Additives	–	**0.49**	–	–
Total Water and Sand	–	**99.51**	–	–

Sources: [1]FracFocus Chemical Disclosure Registry, fracfocus.org/chemical-use/what-chemicals-are-used; [2]US DOE 2009

Although a variety of chemical additives is used in hydraulic fracturing,[27] the vast bulk of fluid injected into the formation during the process is water, mixed with sand. This represents 99.51 percent of the total by volume in the typical mixture shown in **Table AE-77**. The sand is used as a propping agent to help keep the newly formed fractures from closing.

Following completion of fracturing activities, the pressure differential between the formation and the borehole (a result of the weight of thousands of feet of rock above the formation) causes most of the injected fluids to flow toward the borehole. Then it flows upward to the surface, along with the hydrocarbon fluids released from the formation. The composition of this mixture, called flowback water, gradually shifts over several days to a few months, as injected fluids that have not yet migrated back to the wellbore or reacted with the native rock are carried out of the formation.

Although public awareness of hydraulic fracturing has heightened public concern about contaminating freshwater aquifers and water wells, similar concerns have been expressed more generally in relation to oil and gas developments. A white paper by Witter et al. (2008; not peer reviewed) addressed the chemicals used or produced during oil and gas development but made little reference to health or environmental statistics; however, the authors did note two situations relative to environmental exposures.

One was the reported occurrence of detectable levels of methane in 135 of 184 water wells, springs, seeps, ponds, and rivers sampled during a groundwater investigation conducted for Garfield County, Colorado, in 2006 (Papadopoulos 2007). That study noted that methane may have been present due to natural levels in some of the bedrock formations penetrated by the water wells or recharging the seeps, springs, and surface water, and that it may also be generated by a natural (bacterial) process in the water wells. Witter et al. (2008) could not identify the sources of methane; because of this, they were unable to conclude whether any of the methane in wells and natural water bodies sampled by Papadopoulos (2007) resulted from oil and gas-related activities or from secondary generation of methane by natural bacterial processes unrelated to oil and gas.

Measures that the BLM currently requires for protecting groundwater aquifers, water wells, and surface waters include isolating deeper, hydrocarbon-producing horizons from shallower bedrock and alluvial layers that communicate with surface waters and within which freshwater wells are completed. Examples are to require the following:

[27] The examples in the table are drawn from a total of 59 listed on the FracFocus website.

- That casings be set to a depth below the deepest freshwater aquifer encountered and water wells in the vicinity
- That the casing be cemented to prevent flow of saline waters, natural gas, and associated fluids moving up the borehole from coming in contact with the freshwater zones

In general, the BLM requires surface casing to be deeper than the deepest water wells in the area.

During the scoping phase of the FMG RMPA/EIS, commenters raised concerns about increased vehicular traffic associated with energy development in the planning area. Vehicles traveling to well sites during construction and operation share public roads with passenger vehicles and school buses and cause additional wear on road surface bridges.

Table AE-78, below, displays crash data for the counties in the planning area. Currently, heavy vehicles comprise a relatively small portion of the vehicles in crashes.

Table AE-78
Vehicle Crashes by Vehicle Type (2012–2016 5-Year Average)

Vehicle Type	San Juan County	Rio Arriba County	McKinley County	Sandoval County
Bus	1	4	4	10
Motorcycle	5	21	19	56
Passenger	175	484	860	1,536
Pedal cyclist	1	1	5	11
Pedestrian	3	5	33	11
Pickup	140	242	555	492
Semi	18	28	151	69
Van/SUV/4WD	77	170	387	592
Other vehicle	3	13	29	52
Missing data	61	104	184	180
Total vehicles	484	1,072	2,227	3,009

Source: NMDOT 2017a, 2017b, 2017c, and 2017d

Commenters also raised concerns regarding the damage increased vehicular traffic associated with energy development can have on roads. **Table AE-79**, Frequency of Contributing Factors in Vehicle Crashes (2016), displays the distribution of contributing factors by county in 2016. Compared to certain other contributing factors, especially human factors, road defects were identified as a contributing factor in vehicle crashes in a relatively small number of instances.

Table AE-79
Frequency of Contributing Factors in Vehicle Crashes (2016)

Contributing Factor	San Juan County	Rio Arriba County	McKinley County	Sandoval County
Human	2,698	1,142	2,045	2,667
Vehicle defect	46	21	48	47
Environment	0	7	1	0
Road defect	4	5	14	8
Other	1,615	626	997	1,612

Source: NMDOT 2017a, 2017b, 2017c, and 2017d
Note: Multiple contributing factors may be reported for any vehicle in a crash.

Population changes related to energy and mineral development may result in changes to crime rate. Public safety concerns related to crime rates are discussed in **Section AE.5.2**, Social and Economic Uses.

Trends

Public health and safety concerns associated with energy development are expected to continue to increase. Horizontal drilling in the planning area has occurred sporadically since 1980 but began to increase sharply as a share of overall drilling in the mid-2000s. Horizontal drilling first accounted for greater than 10 percent of total drilling in the planning area in 2010. It peaked in 2014, with 120 horizontal wells drilled. In 2017, horizontal drilling made up 77 percent of total development (**Appendix I**).

Between 2007 and 2016, the trend in total number of vehicle crashes per year was as follows:

- San Juan County—downward (-101 crashes per year)
- Rio Arriba County—upward (+11 crashes per year)
- McKinley County—upward (+9 crashes per year)
- Sandoval County—downward (-36 crashes per year)

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