U.S. Department of the Interior
Bureau of Land Management

Pecos District Office Oil and Gas Lease Sale
Environmental Assessment
Chaves and Lea Counties, New Mexico
Quarter 1 2022 DOI-BLM-NM-P000-2021-0001-EA

U.S. Department of the Interior
Bureau of Land Management:
Pecos District Office
2909 West Second Street
Roswell, New Mexico 88201-2019
575-627-0272

The BLM's multiple-use mission is to sustain the health and productivity of the public lands for the use and enjoyment of present and future generations. The Bureau accomplishes this by managing such activities as outdoor recreation, livestock grazing, mineral development, and energy production, and by conserving natural, historical, cultural, and other resources on public lands.

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LIST OF ACRONYMS AND ABBREVIATIONS

$\mu g/m^3$	micrograms per cubic meter
ACHP	Advisory Council on Historic Preservation
AF	acre-feet
AIB	analyzed in brief
APD	Application for Permit to Drill
APE	area of potential effects
AQI	Air Quality Index
AQRV	Air Quality Related Value
ARTSD	Air Resources Technical Support Document
bbl	barrel(s)
BCR	Bird Conservation Region
BLM	Bureau of Land Management
CAA	Clean Air Act
$CaSO_4 \cdot 2H_2O$	gypsum
CCA	Candidate Conservation Agreement
CCAA	Candidate Conservation Agreements with Assurances
CCNP	Carlsbad Caverns National Park
CEQ	Council on Environmental Quality
CFO	Carlsbad Field Office
CFR	Code of Federal Regulations
CH_4	methane
CMA	Core Management Area
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COA	condition of approval
CSU	Controlled Surface Use
DAT	deposition analysis threshold
DSL	dunes sagebrush lizard
EA	Environmental Assessment
EIA	U.S. Energy Information Administration
EJ	environmental justice
EMNRD	New Mexico Energy, Minerals and Natural Resources Department
EOI	Expression of Interest
EOR	enhanced oil recovery

EPA	U.S. Environmental Protection Agency
ERMA	Extensive Recreation Management Area
ESA	Endangered Species Act
ESM	earth system model
EUR	estimated ultimate recovery
FEMA	Federal Emergency Management Agency
FLAG	Federal Land Managers' Air Quality Related Values Work Group
FLPMA	Federal Land Policy and Management Act of 1976
GHG	greenhouse gas
GHGRP	Greenhouse Gas Reporting Program
GIS	geographic information system
GMU	Game Management Unit
Gt	gigaton
GUMO	Guadalupe Mountains National Park
GWP	global warming potential
H_2S	hydrogen sulfide
HA	Habitat Area
HAP	hazardous air pollutant
HUC	hydrologic unit code
IDT	interdisciplinary team
IPA	Isolated Population Area
IPaC	Information for Planning and Consultation
IPCC	Intergovernmental Panel on Climate Change
IWG	Interagency Working Group on Social Cost of Greenhouse Gases, United States Government
kg/ha/yr	kilogram per hectare per year
km	kilometer(s)
LANDFIRE	Landscape Fire and Resource Management Planning Tools
LNB	low-NO_x burner
LOC	level of concern
LPC	lesser prairie-chicken
m	meter(s)
mcf	thousand cubic feet
MCM	Menu of Control Measures
MLA	Mineral Leasing Act of 1920
Mt	megatonnes
N/A	not applicable

N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NADP	National Atmospheric Deposition Program
NAGPRA	Native American Graves Protection and Repatriation Act
NATA	National Air Toxics Assessment
NEI	National Emissions Inventory
NEPA	National Environmental Policy Act of 1969
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NHD	National Hydrography Dataset
NHPA	National Historic Preservation Act of 1966
NMAAQS	New Mexico Ambient Air Quality Standards
NMAC	New Mexico Administrative Code
NMCRIS	New Mexico Cultural Resource Information System
NMDGF	New Mexico Department of Game and Fish
NMED	New Mexico Environment Department
NMOCD	New Mexico Oil Conservation Division
NMOSE	New Mexico Office of the State Engineer
NMPM	New Mexico Principal Meridian
NMSO	New Mexico State Office
NO_2	nitrogen dioxide
NO_x	nitrogen oxide(s)
NORM	naturally occurring radioactive material
NPS	National Park Service
NRHP	National Register of Historic Places
NSO	no surface occupancy
NSPS	New Source Performance Standards
NWI	National Wetlands Inventory
O_3	ozone
OSHA	Occupational Safety and Health Administration
Pb	lead
PBPA	Permian Basin Programmatic Agreement
PDO	Pecos District Office
PFYC	Potential Fossil Yield Classification
PL	Public Law
$PM_{2.5}$	particulate matter equal to or less than 2.5 microns in diameter
PM_{10}	particulate matter equal to or less than 10 microns in diameter
POD	plan of development

PPA	Primary Population Area
ppb	parts per billion
ppm	parts per million
PRPA	Paleontological Resources Preservation Act
PSD	prevention of significant degradation
RFD	reasonably foreseeable development
RFFA	reasonably foreseeable future action
RFO	Roswell Field Office
RMP	resource management plan
RMPA	Resource Management Plan Amendment
SCC	social cost of carbon
SCR	selective catalytic reduction
SDWA	Safe Drinking Water Act
SHPO	State Historic Preservation Office
SO	Secretarial Order
SO_2	sulfur dioxide
SOPA	Secretary's Potash Area
SRMA	Special Recreation Management Area
SSPA	Sparse and Scattered Population Area
SQI	Sky Quality Index
SWD	saltwater disposal
SWReGAP	Southwest Regional Gap Analysis Project
TCP	traditional cultural property
TRC	Texas Railroad Commission
UIC	Underground Injection Control
UNEP	United Nations Environment Programme
URS	URS Group Inc.
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VOC	volatile organic compound
VRM	Visual Resource Management
WESTAR-WRAP	Western States Air Resources Council-Western Regional Air Partnership
WIPP	Waste Isolation Pilot Plant
WO	Washington D.C. Office

CHAPTER 1. INTRODUCTION

1.1 BACKGROUND

This Environmental Assessment (EA) documents the Bureau of Land Management (BLM) Pecos District Office (PDO) (Carlsbad Field Office [CFO] and Roswell Field Office [RFO]) review of five parcels (520.8 acres) nominated for auction in the BLM PDO Quarter 1 2022 Competitive Oil and Gas Lease Sale (the Proposed Action). These lease parcels were originally nominated for the April 2021 Competitive Oil and Gas Lease Sale which was subsequently postponed by Executive Order 3395, *Temporary Suspension of Delegated Authority*, issued January 20, 2021. The nominated lease sale parcels are now incorporated into the Quarter 1 2022 Competitive Oil and Gas Lease Sale. The parcels contain federal minerals managed by the BLM. For detailed information on the leasing process, see the following website: https://www.blm.gov/programs/energy-and-minerals/oil-and-gas/leasing/parcel-nominations.

1.2 PURPOSE AND NEED

The BLM's purpose is to respond to Expressions of Interest (EOIs) to lease federal oil and gas resources through a competitive leasing process. The need for the action is established by the BLM's responsibility under the Mineral Leasing Act of 1920 (MLA), as amended, to promote the exploration and development of oil and gas on the public domain.

1.3 DECISION TO BE MADE

The BLM Authorized Officer will decide whether or not to lease the nominated lease parcels with or without constraints, in the form of lease stipulations, as provided for in the approved land use plans. If the decision is to lease, standard terms and conditions under Section 6 of the BLM Lease Form (Form 3100-11, Offer to Lease and Lease for Oil and Gas), herein referred to as standard terms and conditions, would apply. The BLM Authorized Officer also has the authority to defer the parcels, based on the analysis of potential effects presented in this EA. The Decision Record will identify whether the BLM decided to lease the nominated lease parcels and the rationale for the decision.

1.4 CONFORMANCE WITH BLM LAND USE PLANS, OTHER STATUTES, REGULATIONS, AND PLANS

1.4.1 BLM Land Use Plan Conformance

The BLM's mandate, as derived from various laws, including the MLA and the Federal Land Policy and Management Act of 1976 (FLPMA), as amended, is to promote the exploration and development of oil and gas on the public domain. Additionally, the Federal Onshore Oil and Gas Leasing Reform Act of 1987 states that lease sales shall be held for each State where eligible lands are available at least quarterly and more frequently if the Secretary of the Interior determines such sales are necessary.

Under the FLPMA, the BLM must manage public lands, resources, and resource values according to its multiple-use sustained-yield mandate in a manner that will best meet the present and future needs of the public, and in accordance with an approved land use plan or resource management plan (RMP). For split-estate lands where the mineral estate is an interest owned by the United States, the BLM has no authority over use of the surface estate; however, the BLM is required to declare how the federal mineral estate will be managed, including identification of all appropriate lease stipulations (43 Code of Federal Regulations [CFR] 3101.1 and 43 CFR 1601.0-7(b); BLM Handbook H-1601-1 and H-1624-1 [BLM 2005, 2018a]).

This Proposed Action aligns with the following RMPs:

- Carlsbad Approved RMP (BLM 1988), as amended (BLM 1997a, 2008a).
- Roswell Approved RMP and Record of Decision (BLM 1997b), as amended (BLM 2008a).

The nominated lease parcels fall within areas that are open to leasing under the RMPs indicated above, as amended, and are subject to certain stipulations. The nominated lease parcels, lease parcel surface ownership, lease parcel legal description and total acreage, and lease stipulations and notices that apply are detailed in Table 2.1. Stipulation and lease notice descriptions are detailed in Appendix B.

1.4.2 Relationship to Statutes, Regulations, Policies, and Other Plans

The BLM is currently revising the RMP for the CFO planning area. Should the BLM finalize this RMP between the lease sale and lease issuance, lease parcels in the CFO planning area would be subject to the lease stipulations adopted in the revised RMP. If new stipulations as a result of finalization of the RMP are added to the lease after the lease sale but prior to lease issuance, the successful bidder would be given the opportunity to accept the modified lease or reject it and receive a refund. If the bidder declines the lease terms due to additional or revised stipulation(s), the BLM would refund all monies, including the administrative fee, and include the parcel(s) with all the appropriate stipulations in a subsequent sale notice for future auction. In either case, the BLM would update the analysis to reflect the additional or revised stipulation(s). For more information, see *BLM Oil and Gas Adjudication for Competitive Leases*, Handbook 3120-1 (BLM 2013).

Purchasers of oil and gas lease parcels are required to comply with all applicable federal, state, and local laws and regulations, including obtaining all necessary permits prior to any lease development activities. A listing of applicable statutes, regulations, and other plans is provided in Table 1.1.

Table 1.1. Relationship to Statutes, Regulations, Policies, and Other Plans

Relevant Statute, Regulation, or Plan	Relationship to the Proposed Action
Federal Land Policy and Management Act (FLPMA)	The FLPMA established guidelines to provide for the management, protection, development, and enhancement of public lands (Public Law [PL] 94-579). Section 103(e) of FLPMA defines public lands as any lands and interest in lands owned by the United States. For split-estate lands where the mineral estate is an interest owned by the United States, the BLM has no authority over use of the surface by the surface owner; however, the BLM is required to disclose potential effects connected to the authorization to lease and develop federal mineral estate and to declare how federal mineral estate is managed in the RMP, including identification of all appropriate lease stipulations (43 CFR 3101.1 and 43 CFR 1601.0-7(b); BLM Handbook H-1601.09 and H-1624-1 [BLM 2005, 2018a]).
Mineral Leasing Act (MLA)	The MLA establishes that deposits of oil and gas owned by the United States are subject to disposition in the form and manner provided by the MLA under the rules and regulations prescribed by the Secretary of the Interior, where consistent with FLPMA, the National Environmental Policy Act of 1969, as amended (NEPA; PL 91-90, 42 United States Code [USC] Section 4321 et seq.), and other applicable laws, regulations, and policies.
43 CFR 3100	These regulations govern onshore oil and gas leasing, development, and production of federal minerals.
Federal Onshore Oil and Gas Leasing Reform Act	This act directs the BLM to conduct quarterly oil and gas lease sales whenever eligible lands are available for leasing.

Relevant Statute, Regulation, or Plan	Relationship to the Proposed Action
New Mexico Surface Owner Protection Act	This act requires operators to provide the surface owner at least 5 business days' notice prior to initial entry upon the land for activities that do not disturb the surface; and at least 30 days' notice prior to conducting actual oil and gas operations. Included in this policy is the implementation of a Notice to Lessees, a requirement of lessees and operators of onshore federal oil and gas leases within the state of New Mexico to provide the BLM with the names and addresses of the surface owners of those lands where the federal government is not the surface owner, not including lands where another federal agency manages the surface.
Endangered Species Act (ESA)	The ESA requires all federal departments and agencies to conserve threatened, endangered, and critical and sensitive species and the habitats on which they depend, as well as consult with the U.S. Fish and Wildlife Service on all actions authorized, funded, or carried out by the agency to ensure that the action will not likely jeopardize the continued existence of any threatened and endangered species or adversely modify critical habitat. See the text of stipulation WO-ESA-7 in Appendix B for details.
National Historic Preservation Act (NHPA)	Leasing is considered an undertaking pursuant to 54 USC Section 300101 et seq., commonly known as the National Historic Preservation Act of 1966, as amended (NHPA), and 54 USC Section 306108, commonly known as Section 106 of the NHPA (Section 106). Agencies may follow a phased approach to Section 106 compliance. At the leasing level, existing records reviews, and consultation drive identification of historic properties. Class III field inventories are an important part of identification at the lease-development level. See the text of stipulation WO-NHPA in Appendix B for details.
Federal Cave Resource Protection Act	Secures and protects significant caves on federal land for the benefit and enjoyment of all people and directs the Secretary of the Interior to inventory and list significant caves on federal lands. Details regarding general cave management, the significant cave nomination, evaluation, and designation process, and cave and karst resource confidentiality noted within the Federal Cave Resource Protection Act are located in 43 CFR 37 (Cave Management).

1.5 PUBLIC INVOLVEMENT AND ISSUES

1.5.1 Internal Scoping

The five nominated lease parcels were originally nominated for auction in the BLM PDO April 2021 Competitive Oil and Gas Lease Sale. As part of that planning process, the BLM PDO interdisciplinary team (IDT) conducted internal scoping to identify issues, potential alternatives, and data needs by reviewing the leasing actions within the context of the applicable RMP under the National Environmental Policy Act of 1969 (NEPA) framework. IDT meetings were held at the BLM CFO on October 5 and October 9, 2020, and at the RFO on September 23, 2020, and October 7, 2021.Weekly meetings were held with additional BLM IDT members during the parcel review process. Additionally, other resource-specific meetings with resource specialists were held to aid in refining issues related to the proposed lease sale.

1.5.2 External Scoping

A project summary page for the Pecos District Office Quarter 1 2022 Competitive Oil and Gas Lease Sale was posted on the BLM's National NEPA Register website (https://eplanning.blm.gov). The nominated lease parcel information (draft parcel list) was posted on that website for a public scoping period from August 31 to October 1, 2021.

The BLM PDO received 12 comment letters via ePlanning and eight hand-delivered submittals (including two petitions) during the scoping period for the Quarter 1 2022 Competitive Oil and Gas Lease Sale. Concerns and comments presented by the public and non-governmental organizations are summarized below:

- Concerns regarding the effects of lease sales on GHG emissions and climate change

- Concerns regarding air quality and compliance with the Clean Air Act
- Request for an extension of the public scoping period
- Concerns regarding the BLM leasing process and how it relates to Executive Order 14008 and the preliminary injunction order issued by the U.S. District Court for the Western District of Louisiana (Louisiana v. Biden, No. 2:21-cv-778-TAD-KK, 2021 WL 2446010 [W.D. La. June 15, 2021])
- Concerns regarding the adequacy of an EA for compliance with NEPA
- Concerns regarding compliance with BLM Instruction Memorandum 2021-027
- Concerns regarding archaeological sites and Native American places of significance
- Concerns regarding Tribal consultation
- Concerns regarding habitat for big game species
- Request to defer parcels in Priority Habitat Management Areas and General Habitat Management Areas for greater sage-grouse
- Concerns regarding RMP revisions and cumulative impacts of leasing
- Request to defer parcels on lands with no or low potential for oil and gas development and those that overlap inventoried lands with wilderness characteristics
- Request to incorporate climate costs and fair market value of leasing
- Request to require full-cost bonding
- Concerns regarding public health and environmental justice;
- Concerns regarding impacts to groundwater quality and quantity from hydraulic fracturing and injection wells;
- Concerns regarding impacts from leasing on surface waters
- Requests to consider and recommendations for a reasonable range of alternatives
- Request to impose climate change impacts requirements and GHG emissions mitigation on leasing
- Request for BLM to consult with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service pursuant to Section 7 of the Endangered Species Act

1.5.3 Draft EA Public Comment and Response

The draft Quarter 1 2022 Competitive Oil and Gas Lease Sale EA will be made available for a public comment period from October 29 to November 28, 2021. All comments received will be reviewed and analyzed. Substantive comments will be extracted and addressed as appropriate.

1.5.4 Public Protest Period

The Oil and Gas Lease Sale Notice will be made available for a 30-day protest period. If there are any protests, the BLM shall resolve protests prior to issuing leases.

1.5.5 Issues

The Council on Environmental Quality (CEQ) regulations at 40 CFR 1500.4(i) state that the scoping process should be used "not only to identify significant environmental issues deserving of study, but also to deemphasize insignificant issues narrowing the scope of the [NEPA] process accordingly." 40 CFR 1501.9 (f)(1) indicates the lead agency "shall identify and eliminate from detailed study the issues that are not significant or have been covered by prior environmental review(s), narrowing the discussion of these issues in the statement to a brief presentation of why they will not have a significant effect on the human environment or providing a reference to their coverage elsewhere."

Through scoping, four issues were identified for detailed analysis in this EA:

- How would future potential development of the nominated lease parcels affect air quality (particularly with respect to National Ambient Air Quality Standards [NAAQS] and volatile organic compounds [VOCs]) in the New Mexico portion of the Permian Basin?
- How would future potential development of the nominated lease parcels contribute to greenhouse gas (GHG) emissions, including social cost of carbon?
- How would future potential development of the nominated lease parcels affect surface and groundwater quantity?
- How would future potential development of the nominated lease parcels affect BLM designated special status species, specifically the dunes sagebrush lizard (*Sceloporus arenicolus*) (DSL) and lesser prairie-chicken (*Tympanuchus pallidicinctus*) (LPC)?

An additional 26 issues were identified, considered, and analyzed in brief (AIB) during review of the Proposed Action. These issues are presented in Chapter 3, Section 3.5.

Table 1.2 lists resources or concerns that were considered but determined to not warrant analysis in this EA and provides rationale for the determination.

Table 1.2. Issues Considered but not Analyzed in this EA

Resource or Concern	Rationale for not Analyzing in EA
Special designations	Special designations include Areas of Critical Environmental Concern, Lands with Wilderness Characteristics, National Trials, Research Natural Areas, Special Management Areas (SMAs), Wilderness Study Areas, and Wild and Scenic Rivers. There are no special designations located within or adjacent to the nominated lease parcels. The nearest special designation is the Poco Site SMA, which is 11.4 miles northwest of nominated lease parcel 408. Therefore, analysis of potential effects to special designations is not warranted.
Forestry and woodlands	Woodland areas within the nominated lease parcels do not occur at levels where management is implemented specifically for the woodland. Additionally, no woodland vegetation types were found to occur within the nominated lease parcels (see AIB-5).
Fuels and fire management	The potential for ignition of wildland fire from activities associated with future potential development of the nominated lease parcels would be minimized to the extent practicable through adherence to all applicable federal, state, and local fire safety requirements. No specific concerns or conflicts were identified through internal scoping relating to the effects of future potential development following lease reinstatement on fuels and fire management.
Lands and realty	Future potential development of the nominated lease parcels would be subject to existing land rights and interests (e.g., easements and water rights). Any potential land use conflicts would be resolved through other processes, such as administrative or legal proceedings, independent from this NEPA review.

CHAPTER 2. PROPOSED ACTION AND ALTERNATIVES

2.1 PROPOSED ACTION

Under the Proposed Action, the BLM would offer for lease federal minerals associated with the five nominated lease parcels. Surface management, the legal land description of the nominated lease parcels totaling 520.8 acres, and lease stipulations and notices attached to the parcels are included in Table 2.1. Appendix A contains parcel maps. Appendix B provides a summary of stipulations and lease notices. Under the Proposed Action, the BLM Authorized Officer has the authority to lease the parcels, or to defer the parcels, based on the analysis of potential effects presented in this EA.

Table 2.1. PDO Quarter 1 2022 Lease Sale Nominated Lease Parcels

Lease Parcel Number	Surface Ownership	Legal Description	Acres	Lease Notices and Stipulations
NM-2022-0396	BLM	NM T. 26 S., R. 37 E., NEW MEXICO PM (NMPM) Sec. 17 NWNW. Lea County BLM CFO 100 % US Mineral Interest EOI# NM00016631	40	**NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource **NM-13-CSU** BLM Stipulations for NMSO - CSU - Paleontological Resources **NM-14-LN** BLM Lease Notice Stipulations for NMSO - LN - Paleontological Resources **SENM-S-17-CSU** BLM Stipulations for PDO - CSU - Slopes & Fragile Soils **WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation
NM-2022-0407	Private	NM T. 25 S., R. 37 E., NMPM Sec. 21 SWNW. Lea County BLM CFO 100 % US Mineral Interest EOI# NM00016693	40	**NM-1-LN** BLM Lease Notice Stipulations for NMSO – LN – Potential, Suitable and Occupied Habitat for Special Status Plant Species **NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource **WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation
NM-2022-0408	BLM	T. 15 S., R. 29 E., NMPM Sec. 18 LOTS 1-4; Sec. 18 E2W2. Chaves County, BLM RFO 100 % US Mineral Interest EOI#NM00016697	320.8	**NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource **SENM-LN-1** BLM Lease Notice Stipulations for PDO - LN – Potential Cave or Karst Occurrent Area **SENM-S-16-CSU** BLM Stipulations for PDO - CSU - Raptor Nests and Heronries **SENM-S-19-CSU** BLM Stipulations for PDO - CSU - Playas and Alkali Lakes **SENM-S-39-CSU** BLM Stipulations for PDO - CSU - POD **WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation

Lease Parcel Number	Surface Ownership	Legal Description	Acres	Lease Notices and Stipulations
NM-2022-0409	Private	T. 25 S., R. 37 E., NMPM Sec. 27 NENW. Lea County BLM CFO 100 % US Mineral Interest EOI# NM00016821	40	**NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource **WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation
NM-2022-0410	Private	T. 25 S., R. 37 E., NMPM Sec. 27 S2NE. Lea County, BLM CFO 100 % US Mineral Interest EOI#NM00016821	80	**NM-11-LN** BLM Lease Notice Stipulations for NMSO - LN - Special Cultural Resource **WO-ESA-7** BLM Stipulations for WO - Endangered Species Act Sec 7 Consultation **WO-NHPA** BLM Stipulations for Cultural Resources and Tribal Consultation

* All acreages contained in the EA analysis were calculated using geographic information system (GIS) data sets for resources and parcels which may differ slightly from the acreages contained in legal descriptions above. Difference in total acres between parcels can vary due to geoprocessing operations where slivers of area are created when two or more data sets intersect. Any inaccuracies are negligible and do not change the overall impact analysis conclusions presented in this EA.

The drilling of wells on lease parcels is not permitted until the leaseholder submits, and the BLM approves (subsequent to additional site specific NEPA analysis), a complete Application for Permit to Drill (APD) package (Form 3160-3) following the requirements specified under Onshore Oil and Gas Orders listed in 43 CFR 3162 (BLM 2017). The BLM has authority, per standard terms and conditions of the leases, to attach conditions of approval (COAs) to the APD that reduce or avoid impacts on public lands, resources, and/or resource values. Under 43 CFR 3101-1-2, such reasonable measures may include, but are not limited to, modification to siting or design of facilities, timing of operations, and specification of interim and final reclamation measures. Measures shall be deemed consistent with lease rights granted provided that they do not require relocation of proposed operations by more than 200 meters (m); require that operations be sited off the leasehold; or prohibit new surface-disturbing operations for a period in excess of 60 days in any lease year.

2.2 NO ACTION ALTERNATIVE

Under the No Action Alternative, the BLM would not offer the nominated parcels for competitive leasing in the Quarter 1 2022 Competitive Oil and Gas Lease Sale. As a result, there would not be any development of the parcels at this time. The parcels would have the potential to be nominated again for a future oil and gas lease sale.

CHAPTER 3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL EFFECTS

3.1 INTRODUCTION

Chapter 3 contains the effects analysis related to the issues. Section 3.2 describes the analysis assumptions related to future potential development of the nominated lease parcels. Section 3.3 presents an overview of reasonably foreseeable environmental trends and planned actions considered in the effects analysis. Section 3.4 describes the effects of the No Action Alternative for all issues. Section 3.5 presents the issues that are AIB. Section 3.6 presents the issues that are analyzed in detail.

3.2 ANALYSIS ASSUMPTIONS

While leasing in itself would not directly authorize any oil and gas development or production, future oil and gas development and production is a reasonable outcome of a granted lease right. Because there are currently no development proposals for the nominated lease parcels, the BLM is unable to complete an analysis that uses information related to a specific proposed project or projects. However, for the purpose of this analysis, Sections 3.2.1 and 3.2.2 outline the methodology for estimating number of wells, potential production volumes, and surface disturbance associated with the future potential development of the nominated lease parcels.

3.2.1 Methodology for Estimating Number of Oil and Gas Wells and Production Volumes

Reasonably foreseeable quantitative well development estimates were derived from the well densities identified in the BLM Pecos District Office (PDO) Reasonably Foreseeable Development (RFD) (Engler and Cather 2012, 2014; herein incorporated by reference). The projected number of wells for each nominated lease parcel is based on the horizontal and vertical well densities (in wells per acre) for each field office, as identified in the RFD. To calculate the volumes of oil, natural gas, and water expected to be produced from the parcels, the projected number of wells (calculated as described above) was multiplied by the estimated ultimate recoveries (EURs) of oil, natural gas, and produced water per well. These EURs are generated by performing decline curve analyses of existing production within the PDO.

The projected number of wells and associated oil, gas, and produced water production for the nominated lease parcels are summarized in Table 3.1Table 3.1.

Table 3.1. Estimated Well Count and Production for the Nominated Lease Parcels

Parcel Number (acres)*	Field Office	Surface Management (acres)*	Total Horizontal Wells†	Surface Disturbance (acres)	Oil Production (bbl)	Gas Production (mcf)	Produced Water Production (bbl)
396 (40)	BLM CFO	BLM / Private	1	4.5	168,000	979,600	581,400
407 (40)	BLM CFO	Private	1	4.5	168,000	979,600	581,400
408 (320.8)	BLM RFO	BLM / Private	1	4.5	168,000	979,600	581,400
409 (40)	BLM CFO	Private	1	4.5	168,000	979,600	581,400
410 (80)	BLM CFO	Private	1	4.5	168,000	979,600	581,400

Parcel Number (acres)*	Field Office	Surface Management (acres)*	Total Horizontal Wells†	Surface Disturbance (acres)	Oil Production (bbl)	Gas Production (mcf)	Produced Water Production (bbl)
Total BLM CFO (200)	–	–	**4**	**18**	**672,000**	**3,918,400**	**2,325,600**
Total BLM RFO (320.8)	–	–	**1**	**4.5**	**168,000**	**979,600**	**581,400**
Total BLM PDO (520.8)		–	**5**	**22.5**	**840,000**	**4,898,000**	**2,907,000**

Note: bbl = barrels; mcf = thousand cubic feet.

* All acreages contained in the EA analysis were calculated using geographic information system (GIS) data sets for resources and the parcels, which may differ slightly from the acreages contained in legal description here and in Table 2.1. Difference in total acres between the parcels and acres analyzed in the EA can vary slightly due to geoprocessing operations where slivers of area are created when two or more data sets intersect. Any inaccuracies are negligible and do not change the overall impact analysis conclusions presented in this EA.

† In cases where the methodology used for estimating the number of wells per nominated lease parcel resulted in a fractional value of less than one well per nominated lease parcel (because of low anticipated drilling rate), the fractional value was adjusted upward to the next whole number to represent a rational outcome of the number of potential wells that could be drilled and developed on the nominated lease parcel, as well as to provide meaningful inputs to the oil, gas, and produced water production projections.

3.2.2 Methodology for Estimating Surface Disturbance

It is unknown when, where, or to what extent subsequent well sites, roads, and associated infrastructure would be proposed in the event the BLM decides to lease the nominated lease parcels. Future potential development of the nominated lease parcels could include the following phases (Appendix C provides a summary of the phases of oil and gas development):

- Construction of new access roads or expansion of existing roads
- Pad construction
- Drilling of a well
- Hydraulically fracturing a well
- Installation of pipeline
- Production, including vehicle traffic; hauling of produced fluids such as oil or produced water; compression to move gas through pipeline systems; potential venting from storage tanks; regular well monitoring; and work-over tasks for the life of the well
- Well plugging and abandonment
- Reclamation and remediation

Based on surface disturbance values identified in the RFD (Engler and Cather 2012), supplemented by recent oil and gas development in the BLM PDO, the BLM estimates 4.5 acres of surface disturbance comprising up to two wells on one pad, an access road, and a pipeline corridor. Future potential development of the nominated lease parcels is anticipated to comprise five horizontal wells and approximately 22.5 total acres of new surface disturbance. Estimated surface disturbance from future potential development of the nominated lease parcels is provided in Table 3.1. Disturbance would remain on the landscape until final abandonment and reclamation of facilities (generally assumed to occur after 20 years). Interim/ongoing reclamation procedures would be used to limit impacts by restoring disturbed areas as soon as they are no longer required for operations.

3.3 REASONABLY FORESEEABLE ENVIRONMENTAL TRENDS AND PLANNED ACTIONS

The BLM PDO encompasses over 20 million acres within the planning area boundary. This includes 3.6 million acres of BLM surface and 7.6 million acres of federally managed minerals.

The following sections outline the reasonably foreseeable environmental trends and planned actions within the PDO planning area that are closely related to the Proposed Action and the reasonably foreseeable development of the nominated lease parcels. The BLM is able to identify and disclose reasonably foreseeable environmental trends and planned actions expected to occur over the next 20 years, as this time period is aligned with RMP and RFD scenario information available. Additional information related to environmental impacts of BLM management decisions can be found in the Carlsbad Approved RMP (BLM 1988), as amended (BLM 1997a, 2008a), and Roswell Approved RMP and Record of Decision (BLM 1997b), as amended (BLM 2008a). More information related to air resources environmental trends is available in the *Air Resources Technical Report for Oil and Gas Development in New Mexico, Oklahoma, Texas, and Kansas* (BLM 2021a); the BLM acknowledges that this document is incorporated by reference into the EA.

3.3.1 Energy Development and Other Land Uses

3.3.1.1 *Mineral and Energy Development*

The PDO planning area consists of surface topography, climate conditions, and mineral deposits that are conducive to energy development including those of both oil and gas and renewable energy sectors. These natural conditions have led to the utilization of suitable lands for various forms of energy development on federal and state managed surface as well as those privately owned. It is expected that land and mineral estates within the PDO will continue to be utilized for energy development, resulting in a trend of increased total land use and resource impacts attributed to these activities.

The PDO, analogous to the New Mexico portion of the Permian Basin, contains a mineral estate that is rich in accessible oil and gas reserves that has led to heavy development of these resources, starting in the early 1900s and resulting in the area becoming one of the most productive land-based fields in the country. The majority of the Permian Basin open to oil and gas leasing is already leased for fluid mineral development. The BLM estimates that there are currently approximately 41,006 active wells (primarily vertical wells) within the PDO, of which approximately 18,690 are federal. These numbers are based on information contained in in the BLM 2020 *Air Resources Technical Report for Oil and Gas Development in New Mexico, Oklahoma, Texas, and Kansas*, which considered Petroleum Recovery Resource Center data (BLM 2021a) (Table 3.2). The RFD scenario for oil and gas in the PDO (Engler and Cather 2012, 2014) projects that 800 oil and gas wells would be completed within the PDO each year for the 20-year scenario (2015–2035), for a total of approximately 16,000 new wells (federal and non-federal), most of which are expected to be horizontally drilled.

Additionally, the desert climate and low-slope profile topography existing across a majority proportion of the PDO lends itself to being highly suitable for renewable energy development. Over the past 20 years, the PDO has shown an increase in both solar and wind development projects along with supporting infrastructure such as transmission lines, facilities, and access roads. Also, the PDO has naturally occurring saleable and locatable mineral reserves, that have past and present development, with the understanding that development activities will continue at a similar rate. This includes but is not limited to land use and associated surface disturbance associated with seismic exploration and potash mining, such as tailings piles and mine development.

Past and planned actions of energy and mineral development within the PDO is estimated to be 427,740 acres of surface disturbance (see Section 3.3.1.3, see Table 3.2). Energy and mineral development on federal lands or mineral estate are expected to continue under the management and conditions outlined in the CFO and RFO RMPs (BLM 1988, 1997a, 1997b, 2008a). This represents a continued trend of human use of land and mineral resources. Such effects would correspond to the resources present at the location of development with contribution to landscape-level conditions and could result in landscape modifications over time, including habitat loss or degradation, changes in plant communities, fluctuating but generally increasing levels of emissions of pollutants, changes in land use patterns and the amount of landscape unaltered by human activities, changes to the visual landscape, and changes in the quantity or quality of water resources. The analyses presented in Sections 3.5 and 3.6 disclose the effects of these environmental trends and planned actions related to oil and gas development on resource issues analyzed in brief and in detail, respectively.

3.3.1.2 *Municipal and Other Land Uses*

Based on trends of past and present activity, it can be expected that PDO lands would continue to be used at current or slightly increased levels for municipal and other land uses such as urban development, grazing, recreation, off-road travel, and transmission or pipeline rights-of-ways. This includes municipal and urban development, including expanded footprints of cities such as Carlsbad, Roswell, and Artesia. Presently, livestock grazing is estimated to occur on 88% (17,600,000 acres) of the PDO planning area, and it is assumed this use will continue at existing levels. Furthermore, other land uses, such as recreation on federal lands, is expected to continue under the management and conditions of the Carlsbad Approved RMP (BLM 1988), as amended (BLM 1997a, 2008a) and Roswell Approved RMP and Record of Decision (BLM 1997b), as amended (BLM 2008a). Associated effects would correspond to the resources present at the specific development location with contribution to landscape-level conditions and could result in landscape modifications over time including habitat loss or degradation, changes in plant communities, fluctuating but generally increasing levels of emissions of pollutants, changes in land use patterns and the amount of landscape unaltered by human activities, changes to the visual landscape, and changes in the quantity or quality of water resources. The analyses presented in Sections 3.5 and 3.6 disclose the effects of these environmental trends and planned actions related to oil and gas development on resource issues analyzed in brief and in detail, respectively.

3.3.1.3 *Quantification of Landscape Disturbance*

To provide a focused and quantitative analysis of the contribution of the Proposed Action to the identified landscape-level environmental trends and planned actions, Table 3.2 summarizes the estimated acreage of landscape disturbance associated with energy and mineral development as well as other land uses within the PDO. The information provided in Table 3.2 presents a quantification of past and planned actions that are associated with surface disturbance and correlated contribution to effects and environmental trends described above. Additional information related to environmental impacts of current BLM management decisions can be found in the applicable RMP and environmental impact statement (BLM 1988, 1997a, 1997b, 2008a). More information related to air and water resources environmental trends is also available in the *Air Resources Technical Report for Oil and Gas Development in New Mexico, Oklahoma, Texas, and Kansas* (BLM 2021a) and *2020 BLM Water Support Document for Oil and Gas Development in New Mexico* (BLM 2020a); the BLM acknowledges that these documents are incorporated by reference into the EA.

Table 3.2. Estimated Landscape Disturbance Associated with Environmental Trends and Planned Actions within the PDO

Analysis Area	Number of Wells	Acreage	Percent of PDO Analysis Area (acreage)
PDO analysis area	N/A	20,000,000	-
Estimated Surface Disturbance	**Number of Wells**	**Acreage**	**-**
Past construction of gas plants, potash mines, oil and gas well pads, access roads, transmission lines, and other linear features*	41,006	317,000*	1.59%
Oil and gas RFD**	16,000	72,000	0.03%
Mining‡	N/A	2,400	-
Other linear infrastructure	N/A	4,200	-
Seismic explorations	N/A	32,000	-
Agriculture (non-grazing)	N/A	140	-
Total	**57,006**	**427,740**	**2.14%**
Contribution of surface disturbance of future potential development under the Proposed Action	5	22.5	0.0001%
Contribution of the future potential development under the Proposed Action to the oil and gas RFD	0.03%	0.03%	-
Contribution of the future potential development under the Proposed Action to total estimated landscape disturbance	0.009%	0.005% †	-

* Source: BLM (2018b). Value includes estimates of existing disturbance from past construction of gas plants, potash mines, oil and gas well pads, access roads, transmission lines, and other linear features. Of this total, and assuming an average disturbance of 4.5 acres per well, there would be approximately 184,527 acres of existing surface disturbance in the analysis area from all oil and gas well pads and related infrastructure including roads, electric lines, and pipelines (0.92% of the 20 million-acre PDO). There is no reliable estimate for past wells that are no longer in use, and were either plugged, reclaimed, and abandoned or, in some cases, abandoned without full reclamation. Note that past and present well count and estimated disturbance include some wells that are also projected in the 2012 and 2014 RFD (Engler and Cather 2012, 2014). As a result, the total well count and total disturbance figures likely include some double counting.

** Source Engler and Cather (2012, 2014). New surface disturbance from potential wells in the RFD scenario is estimated at 4.5 acres per well.

‡ BLM (2014, 2018b).This estimate includes approximately 2,400 acres of surface disturbance predicted from the proposed Ochoa Mine (BLM 2014), 4,200 acres of surface disturbance from development of transmission lines and pipelines/associated infrastructure (BLM 2018b), 140 acres of surface disturbance from land farms (BLM 2018b), and 32,000 acres of short-term disturbance from seismic exploration, with reclamation occurring within 3 years (BLM 2018b).

† The analysis contained in this EA generally provides percentage contribution rounded to two decimal points.

3.3.2 Land Restoration and Conservation Activities

A multi-faceted network of federal and state agencies as well as non-governmental organizations have, and continue to, reclaim, restore, and conserve land and resources in the PDO. The BLM New Mexico State Office (NMSO) has partnered with the State of New Mexico, ranchers, industry, and other local partners on a restoration initiative called Restore New Mexico. Since 2005, the initiative has restored over 3 million acres of grasslands, woodlands, and riparian areas across the state that had been degraded by invasive species and woodland encroachment in New Mexico (U.S. Geological Survey [USGS] 2019a). This program has also resulted in the reclamation of some oil and gas legacy well pads, roads, and caliche pits within the PDO analysis area (Carlsbad Soil and Water Conservation District 2019). Restore New Mexico's rehabilitation efforts and continued work is considered an ongoing countervailing effect to present and future impacts to landscape-level resources as legacy oil and gas development and ecosystems are gradually restored.

Additionally, BLM management decisions have a continued focus on conserving lands (habitat) for special-status species, including LPC and DSL, as disclosed in the 2008 RMPA and those managed by candidate conservation agreements (BLM 2007, 2008a, 2008b; U.S. Fish and Wildlife Service [USFWS] et al. 2008; USFWS et al. 2014; USFWS and Texas Comptroller of Public Accounts 2019). It is anticipated that the BLM, and other agencies, would also continue to treat lands within the PDO with prescribed fire, mechanical treatments, and herbicide according to the Carlsbad Approved RMP (BLM 1988), as amended (BLM 1997a, 2008a) and Roswell Approved RMP and Record of Decision (BLM 1997b), as amended (BLM 2008a).

3.3.3 Changes to Regional Environmental Conditions Related to Climate Change

Climate change, as further discussed in Section 3.6.2, is a global process that is affected by the sum total of GHGs in the Earth's atmosphere. The incremental contribution to global GHGs from land management actions cannot be accurately translated into effect on climate change globally or in the area of any site-specific or regional action. Currently, global climate models are unable to forecast local or regional effects on resources (Intergovernmental Panel on Climate Change [IPCC] 2013). However, there are general projections regarding potential effects on natural resources and plant and animal species that may be attributed to climate change from GHG emissions over time; these effects are likely to be varied, including those in the southwestern United States (Karl 2009). Current research shows a high confidence in an understanding that "changes in land conditions either from land-use or climate change, affect global and regional climate" (IPCC 2019). The PDO planning area as included in the Upper Rio Grande Basin (southern Colorado to central-southern New Mexico) and Texas-Gulf Basin (eastern New Mexico to southeastern Texas), which is expected to be affected in both the short and long term by variations in global and regional environmental conditions related to climate change in line with global trends. Details regarding observable trends in warming temperatures and associated changes to regional environmental conditions related to climate change are provided in Section 3.6.2.

3.4 NO ACTION ALTERNATIVE FOR ALL ISSUES

Under the No Action Alternative, the BLM would not lease the nominated lease parcels and the existing conditions and trends related to each issue would continue. Potential impacts associated with future potential development of the nominated lease parcels would not occur under this alternative, current land and resource uses would continue, and the federal mineral acreage would remain open to future oil and gas lease development. Oil and gas development would continue on leased land surrounding the nominated lease parcels. No natural gas or crude oil from the nominated lease parcels would be produced, and no royalties would accrue to federal or state treasuries. A choice on the part of the BLM not to lease the nominated lease parcels would eliminate one oil and gas development opportunity in the BLM PDO. Reducing total oil and gas development opportunities in the area is likely to incrementally reduce local and regional employment and revenue opportunities related to the oil and gas and service support industries over time. This is because the oil and gas sector of the economy relies on both ongoing operational activities (development of existing leases) and new development opportunities (acquisition and development of new leases) to continue to provide local and regional jobs and revenue on a sustained basis. In the 20 million-acre PDO, there are approximately 7.6 million acres of federal mineral estate. Thus, overall development of federal fluid minerals comprises approximately 38% of all potential oil and gas development activities in the PDO.

3.5 ISSUES ANALYZED IN BRIEF

Following internal and external scoping, 26 issues were identified, considered, and analyzed in brief by members of the IDT in review of the Proposed Action. Each of these issues is outlined below with a concise discussion regarding the context and intensity of the impact related to each issue. Stipulations WO-ESA, WO-NHPA, and Lease Notice NM-11-LN would apply to all nominated lease parcels, as well as standard terms and conditions as described in the lease form. For all issues analyzed in brief that follow, it is assumed that effects of reasonably foreseeable environmental trends and planned actions relevant elements of the human environment that involve landscape disturbance effects would be consistent with the acreage of the calculations presented in Table 3.2.

For the purposes of this analysis, short-term effects are considered those that cease after well construction and completion (30–60 days) or cease after interim reclamation (2–5 years); long-term effects are considered those associated with operation (for example, noise) or that otherwise extend beyond the short-term time period (for example, surface disturbance subject to interim or final reclamation). As such, some long-term effects would cease immediately upon the end of operations, whereas other long-term effects would remain until successful landscape reclamation is accomplished dependent on the nature of the effect. Note that the time frame for successful reclamation would vary by vegetation type and other facts such as the amount and timing of annual precipitation (see AIB-5 for more information).

AIB-1 Groundwater Quality

How would future potential development of the nominated lease parcels affect groundwater quality?

Leasing and future potential development of the nominated lease parcels would result in oil and gas activities, including well pad construction, drilling, and completion for an estimated five wells. The wells would be horizontal wells that would employ standard industry practices related to well completion (i.e., perforation and hydraulic fracturing). Types of chemical additives used in well completion activities may include acids, hydrocarbons, thickening agents, gelling agents, lubricants, and other additives that are operator- and location-specific. The largest components in hydraulic fracturing fluid are water and sand.

The RFD scenario projects 16,000 additional new wells over 20 years (Engler and Cather 2012, 2014) (see Section 3.3). Reasonably foreseeable well development would most likely pass through a usable groundwater aquifer currently or potentially supplying stock, residential, and/or irrigation water. If proper cementing and casing programs are not followed, there may be a loss of well integrity, surface spills, or loss of fluids in the drilling and completion process that may result in large volumes of high concentrations of chemicals reaching groundwater resources. If contamination of usable water aquifers (resulting in total dissolved solids greater than 10,000 parts per million [ppm]) from any source occurs, springs and water wells that are sourced from the affected aquifers could be subject to long-term decreases in water quality depending on the severity of the contamination event. According to New Mexico Administrative Code (NMAC) 19.15.16, operators are required to seal and isolate strata containing fresh water from oil- and gas-bearing strata (including sealing the annulus). BLM regulations (including those covered under 43 CFR 3160, Onshore Orders 1, 2, and 7; 43 CFR 3162.3-3 and 43 CFR 3162.3-5); New Mexico Oil Conservation Division (NMOCD) regulations (NMAC 19.15.26); and the state's primacy agreement under the Safe Drinking Water Act [SDWA]) include requirements for hydraulic fracturing, including casing specifications, monitoring and recording, and management of recovered fluids (wastewater or produced water). The safeguards that are in place to prevent these situations from occurring are responsibilities managed in the Inspection and Enforcement department within the BLM. The *2020 BLM Water Support Document for Oil and Gas Development in New Mexico* (BLM 2020a) (hereafter referred to as the Water Support Document and incorporated by reference)

contains a detailed summary of the regulatory program associated with hydraulic fracturing and measures to protect groundwater quality. A further list of the potential environmental effects of hydraulic fracturing can be found in the U.S. Environmental Protection Agency (EPA) report, *Hydraulic Fracturing for Oil and Gas: Impacts from the Hydraulic Fracturing Water Cycle on Drinking Water Resources in the United States* (EPA 2016a). In summary, this report examines six different scenarios in which drinking water resources may be affected by hydraulic fracturing: 1) water withdrawals during periods of low water availability; 2) spills of hydraulic fracturing fluids/chemicals and/or produced water; 3) release of hydraulic fracturing fluids from wells with inadequate casing; 4) direct injection of hydraulic fracturing fluids into groundwater; 5) discharge of insufficiently treated wastewater to surface water; and 6) contamination of groundwater from unlined storage/disposal pits.

Of the 16,000 wells identified in the RFD scenario, five wells (0.03% of the RFD scenario) would be attributable to future potential development of the nominated lease parcels (see Section 3.3). The future potential development of nominated lease parcels (22.5 acres) would comprise 0.005% of the total landscape-level surface disturbance trends (427,740 acres, see Table 3.2) identified in Section 3.3. The nominated lease parcels are within two groundwater basin aquifers: Capitan 1965 and Roswell 1993. Nominated lease parcels 396, 407, 409, and 410 are within the Lea County portion of the Capitan 1965 Basin aquifer, which has an approximate maximum thickness of 2,300 feet and occurs roughly 3,000 to 5,500 feet below ground level (Hiss 1975). Total parcel acreage (200 acres) within this groundwater basin is 0.002% of the total acreage of this groundwater basin (1,008,885.18 acres). Nominated lease parcel 408 is within the Roswell 1993 Basin aquifer, which ranges in approximate thickness from 2,000 to 3,800 feet and occurs roughly 0 to 4,000 feet below ground level (Robson and Banta 1995). Total parcel acreage (320.8 acres) within this groundwater basin is 0.02% of the total acreage of this groundwater basin (1,498,162.65 acres). The Roswell Basin aquifer has an approximate maximum thickness of 1,600 to 2,000 feet and begins approximately 0 to 200 feet below ground level (New Mexico Office of the State Engineer [NMOSE] 2004). The average oil and/or gas well depth within Chaves and Lea Counties is 4,200 feet and 9,673 feet, respectively (BLM 2020a). Based on estimated aquifer thicknesses and depths within the analysis area, future potential development of the nominated lease parcels would likely result in wells drilled beyond (deeper than) the regional aquifers. Whereas wells drilled would likely pass through these aquifers, the evidence indicates that the regulatory programs described previously would be protective of these water resources.

None of the nominated lease parcels contain groundwater wells; nominated lease parcel 407 (40 acres) is approximately 0.1 mile from one commercial water well, 0.65 mile east of one Septic System Groundwater Contamination Site (nitrate), 0.74 mile east of one petroleum tank registered site, and 1 mile east of the City of Jal Water Supply System. The closest nominated lease parcel to the Jal Water Well Field is parcel 396, which is located 5.09 miles west of parcel 396. Standard terms and conditions would apply to all leases, which allows for siting of wells to minimize potential impacts to existing groundwater wells and groundwater resources. For more information regarding livestock wells and range improvements, see AIB-13.

Protection of groundwater is enforced in concert with the State of New Mexico and any other applicable entities with jurisdiction (e.g., tribal entities or the EPA), and mitigation of any water-contaminating event would occur in addition to the enforcement of applicable regulations. If effects were to occur, lessees and operators would be obligated by the standard terms of the lease, as well as the approved APD and applicable BLM and NMOCD regulations to report, respond to, and mitigate the spill or release. Additionally, all injection wells permitted by the NMOCD (including injection wells and producing wells and all related surface facilities) are subject to a surface injection pressure limitation. Wells are required to be equipped with a pressure-limiting device, which ensures that the maximum surface injection pressure is not exceeded (NMOCD 2004). The BLM District Office inspection and enforcement personnel periodically inspect wells and surface facilities to ensure that all wells and related surface

facilities are in good repair and leak free (NMOCD 2004). The NMOCD is also responsible for oversight of hydraulic fracturing wastewater pits. NMAC 19.15.17 regulates the use of liners as well as depth restrictions to protect groundwater resources.

Finally, spill occurrences could affect groundwater on-site or during material transport. The Water Support Document (BLM 2020a) notes a total of 1,497 spills in the Permian Basin in 2019. The rate of recovery varies by spill type, but the average loss rate for all liquid spill types was approximately 79%. Spills that are not recovered are remediated, which may include removal of contaminated soil. One spill in Lea County that occurred on private land on November 8, 2019, affected groundwater (BLM 2020a). Should a spill occur, the BLM would work with the NMOCD to immediately remediate spills on BLM lands in accordance with federal and state standards, including NMAC 19.15.29.11. According to NMAC 19.15.29.11, the responsible person shall complete division-approved corrective action for releases that endanger public health or the environment in accordance with a remediation plan submitted to and approved by the division or with an abatement plan submitted in accordance with 19.15.30 NMAC. The remaining contaminates from unrecovered spills are remediated in accordance with federal and state standards. Some remediation consists of removing contaminated soil and replacement with uncontaminated soil and corresponding chemical testing. See the Water Support Document (BLM 2020a) for further information on spills.

In summary, the BLM, New Mexico Environment Department (NMED), and the NMOCD have put in place numerous requirements for oil and gas producers so that drilling fluids, hydraulic fracturing fluids, and produced water and hydrocarbons remain within the well bore and do not enter groundwater or any other formations. These include BLM regulations covered under 43 CFR 3160, Onshore Orders 1, 2, and 7, 43 CFR 3162.3-3, 43 CFR 3162.3-5, and NTL-3A; NMOCD regulations under NMAC 19.15.26; and the state's primacy agreement under the SDWA. With these requirements in place, including the use of casing and cementing measures, contamination of groundwater resources from nominated the lease parcels is highly unlikely. There have been no documented instances of groundwater contamination attributed to well drilling and completion in the Pecos District (BLM 2020a), which further supports this conclusion. In addition, the BLM has authority under standard terms and conditions to require additional measures to protect water quality if site-specific circumstances require them. Site-specific mitigation tools would be developed as appropriate for the individual circumstances, including groundwater-quality monitoring studies. The regulations at 43 CFR 3162.5-2(d) give the BLM the authority to require an operator to monitor water resources to ensure that the isolation procedures utilized to protect water and other resources are effective.

AIB-2 Surface Water Quality

How would future potential development of the nominated lease parcels affect watershed hydrology and surface water quality?

The PDO encompasses 12 watersheds, as shown by hydrologic unit codes (HUCs). Current surface disturbance of all types within the 20 million-acre analysis area is estimated at 317,000 acres (BLM 2018b), and there are approximately 41,006 active well bores of all well types (BLM 2021a). The total existing surface disturbance comprises about 1.6% of the analysis area.

Reasonably foreseeable environmental trends and planned actions within the PDO (which include the RFD scenario) would result in an estimated of 427,740 acres of estimated surface disturbance. This equates to 2.1% of the approximately 20 million-acre PDO. These actions would disturb vegetation, soils, and mineral substrate, which would create dust and increase runoff rates during precipitation events. By increasing runoff and removing vegetation, disturbed areas would become more susceptible to erosion. Soil that is carried downgradient by runoff due to upslope erosion may create sedimentation

issues in streams. Sedimentation would be most likely to occur during construction of stream crossings for access roads and flowlines, and at disturbance nearest streams; however, effects would remain until disturbed areas are restored to pre-construction conditions. Development of the RFD scenario also carries a risk of spills that could result in the delivery of contaminants to surface water depending on the proximity of development activities to surface water and the measures applied to address the possibility of spills reaching surface water bodies. However, as noted in the Water Support Document (BLM 2020a), none of the 1,497 spills in 2019 in the Permian Basin were reported as having affected surface water.

The nominated lease parcels (520.8 acres collectively) fall within two HUC-10 watersheds: Antelope Draw (parcels 396 [40 acres], 407 [40 acres], 409 [40 acres], and 410 [80 acres]) and Ishee Lake (parcel 408 [320.8 acres]), and would comprise 0.09% of the 2,61351.57 acre Antelope Draw watershed and 0.17% of the 198,211.72 acre Ishee Lake watershed. The nominated lease parcels do not contain any Clean Water Act 303(d) Impaired Waters Future potential development of the nominated lease parcels would result in approximately 22.5 acres of surface disturbance (approximately 4.32% of the total nominated lease parcel acreage). This surface disturbance would result in long-term disturbance to vegetation, soils, and mineral substrate, which in turn would increase the potential for dust, runoff, and sedimentation of nearby water bodies. Future potential development of the lease parcels also result in a small, albeit present, risk of spills. For detailed discussion of risk of spills associated oil and gas development , see Section 3.2 of the 2020 Water Support Document (BLM 2020a).

Based on desktop review analysis of the USGS's National Hydrography Dataset (NHD) (USGS 2019b) and the USFWS's National Wetlands Inventory (NWI) (USFWS 2017)[1], no surface water features are present on nominated lease parcels 396, 407, 409, and 410. Nominated lease parcel 408 contains previously mapped surface water features, including 1.16 miles of ephemeral streams and/or rivers, and 2.09 acres of riverine wetlands. Of that, 0.28 mile of ephemeral streams and/or rivers was identified by BLM biologists (BLM 2020b) that were not previously mapped by NHD or NWI. Additionally, potential playas have been identified on nominated lease parcel 408 via desktop aerial photography, the USGS NHD (USGS 2019b), Federal Emergency Management Agency (FEMA) floodplain data (FEMA 2021), USFWS NWI data (USFWS 2017), and internal communication with the BLM PDO interdisciplinary team. See AIB-22 for further information regarding playas, including applicable stipulations. None of the nominated lease parcels contain freshwater ponds, intermittent or perennial lakes and/or ponds, artificial paths[2], or FEMA Zone A mapped floodplains[3] (FEMA 2021).

Stipulation SENM-S-39-CSU, which requires a plan of development (POD) for the lease, is applied to parcel 408 (see Appendix B). Requirements for a POD with identified access to well facilities and location of well sites may facilitate avoidance of identified surface water features.

For further information on measures that may be required, see the Water Support Document (BLM 2020a). The NMOCD expressly prohibits pollution of any surface or subsurface fresh water from well completion activities, or treatment, transportation, and disposal of produced water, and provides management of hydraulic fracturing operations. Finally, NMAC 19.15.16 contains minimum casing and cementing standards. Site-specific mitigation tools would be developed as appropriate for the individual circumstances and could include surface water monitoring studies. For example, in the event that the process of hydraulic fracturing were to occur in an area that had potential to communicate with water

[1] Delineation size of surface water features varies between the NHD and NWI data sets. Site-specific analysis of the nominated lease parcels would identify aquatic features and wetlands at the time of future potential development of the nominated lease parcels.

[2] Artificial paths are used to complete the stream network through NHD water bodies and NHD areas where there is no obvious channel. Isolated NHD water body features may not contain artificial paths (USGS 2019b).

[3] Zone A floodplains represent 100-year floodplains that have a 1% change of being inundated in a given year (FEMA 2021).

resources, NMAC regulations would apply to ensure that water is not contaminated during the process by requiring the operator to test the water resource before, during, and after operations.

The BLM's authority to require additional protective measures, and the low level of surface disturbance relative to the total watersheds (22.5 acres of the total two applicable watersheds [459,563.29 acres, or less than 0.1% of the total two applicable watershed acreage]) would all serve to minimize the risk of effects on watershed hydrology and surface water quality. Should a spill occur, the BLM would work with the NMOCD to immediately remediate spills in accordance with federal and state standards, including NMAC 19.15.29.11. Per NMAC 19.15.29.11, the responsible person shall complete division-approved corrective action for releases that endanger public health or the environment in accordance with a remediation plan submitted to and approved by the division or with an abatement plan submitted in accordance with 19.15.30 NMAC. The remaining contaminates from unrecovered spills are remediated in accordance with federal and state standards. Some remediation consists of removing contaminated soil and replacement with uncontaminated soil and corresponding chemical testing. See the Water Support Document (BLM 2020a) for further information on spills.

AIB-3 Induced Seismicity

How would future potential development of the nominated lease parcels affect the potential for induced seismicity in the Permian Basin?

Leasing and future potential development of the nominated lease parcels would result in oil and gas activities within the 20 million-acre PDO, including well pad construction, drilling, and completion for an estimated one well per parcel (five wells total). Well drilling and completion activities associated with future potential development of the nominated lease parcels are not anticipated to noticeably contribute to induced seismicity in the Permian Basin. This is because hydraulic fracturing is a very minor contributor toward inducing felt earthquakes; even relatively extreme seismic events associated with hydraulic fracturing are well below the damage threshold for modern building codes (Petersen et al. 2018; USGS 2021a). However, disposal of produced water is the primary cause of anthropogenic felt earthquakes in New Mexico. Approximately 2,907,000 barrels (bbl) of produced water are projected from future potential development of the nominated lease parcels. Assuming a 20-year production time frame, this equates to an average of approximately 12,113 bbl of produced water per month across the nominated lease parcels. Produced water may be dealt with in the following ways:

- injection into enhanced oil recovery (EOR) injection wells (typically shallower wells drilled into the hydrocarbon producing zone) to enhance oil recovery in producing oil and gas wells,
- disposal in saltwater disposal (SWD) wells (typically deeper wells drilled to depths below the hydrocarbon producing zone),
- disposal in evaporation ponds, or
- reuse in the hydraulic fracturing process elsewhere.

Currently, evaporation ponds are sparingly used for disposal of produced water due to wildlife and habitat disturbance concerns. Reuse of produced water for hydraulic fracturing is also not widespread because the chemical makeup of produced water is often not compatible with hydraulic fracturing procedures. Thus, the majority of produced water ends up in EOR or SWD wells.

As of July 2020 (NMOCD 2020a),[4] 206 EOR wells and 19 active SWD wells are located within 5 miles of the nominated lease parcels. EOR and SWD wells were identified within 5 miles of the nominated lease parcels because use and disposal of produced water is likely to occur near development activity. EOR injection wells are discounted in this analysis because they are typically shallower than SWD wells and not generally associated with notable seismic events (Rubinstein and Mahani 2015).

Table 3.3 provides a summary of produced water disposal within active SWD wells within 5 miles of nominated lease parcels in 2019. As shown in the table, disposal of a total of 14,688,369 bbl of produced water into 19 active SWD wells within 5 miles of the nominated lease parcels occurred in 2019 (NMOCD 2020a). This equates to an average of 773,072 total bbl of produced water per SWD well for 2019 (or an average of 64,423 bbl per month per well). Four of these SWD wells did not receive any produced water for disposal in 2019. For the remaining SWD wells, the minimum disposal amount in 2019 was 120 bbl (API Number 30-025-09807). The maximum disposal amount in a single SWD well (API Number 30-025-09806) in 2019 was 7,256,435 bbl. The median injection volume per well in 2019 was 44,761 bbl, and the median injection volume per well per month in 2019 was 3,730 bbl.

Table 3.3. Produced Water Disposal Summary

Active SWD wells within 5 miles of nominated lease parcels in 2019	19 wells
Total injection volume within those wells in 2019	14,688,369 bbl
Lowest non-zero well injection volume within those wells in 2019	120 bbl
Highest well injection volume within those wells in 2019	7,256,435 bbl
Average injection volume per well in 2019	773,072 bbl
Average injection volume per well per month in 2019	64,423 bbl
Median injection volume per well in 2019	44,761 bbl
Median injection volume per well per month in 2019	3,730 bbl
Projected total disposal volume across all 19 active SWD wells assuming 2019 total injection volume is a constant annual disposal rate over a 20-year period	293,767,380 bbl
Total produced water projected from future potential development of the nominated lease parcels	2,907,000 bbl
Total per-well projected monthly injection volume (monthly volume from future potential development of the nominated lease parcels + average per-well per month injection volume in 2019)	65,060 bbl
Monthly produced water projected from future potential development of the nominated lease parcels assuming a 20-year development time frame	12,113 bbl
Total per-well projected monthly injection volume from future potential development of the nominated lease parcels (assuming spread between all 19 SWD wells)	638 bbl
Proportional change in monthly injection volume (in the 19 active SWD wells) projected from future potential development of the nominated lease parcels; this proportional change also describes the contribution of the potential development of the nominated lease parcels to the projected total injection volume of the 19 active SWD wells over the 20-year development time frame	0.99%
Total per-well projected daily injection volume (volume from future potential development of the nominated lease parcels + average per-well injection volume in 2019)	2,139 bbl

Assuming constant injection rates consistent with 2019 total injection volume rates, the projected total disposal volume across all active SWD wells within 5 miles of the nominated lease parcels would be 293,767,380 bbl over a 20-year time frame. Assuming all 2,907,000 bbl of produced water estimated from future potential development of the nominated lease parcels are ultimately, over time, disposed of in the active SWD wells within 5 miles of the nominated lease parcels, it would represent 0.98% of the approximated total injection of produced water over a 20-year period. Depending on the SWD well used for disposal of produced water, the monthly average of 12,113 bbl of produced water projected as a result

[4] NMOCD (2020a) data were downloaded in July 2020 and processed to obtain a full-year 2019 dataset.

of future potential development of the nominated lease parcels would result in a monthly per-SWD well increase of approximately 638 bbl (0.99%) on top of the approximated monthly average injection volumes for these wells in 2019 (64,423 bbl in total) (see Table 3.3).

The risk of induced seismicity increases with long-term and high-volume injections into deep wells carried out through SWD (Ellsworth 2013). A combination of factors is necessary to induce felt earthquakes: the injection rate and total volume injected, the presence of faults that are large enough to produce felt earthquakes, stresses that are large enough to produce earthquakes, and the presence of pathways for the fluid pressure to travel from the injection point to faults (Machette et al. 2000; USGS 2021a). High injection rates of greater than 300,000 bbl per month are much more likely to be associated with earthquakes, and any earthquake within approximately 15 kilometers (km) (9.3 miles) of an active SWD well could be associated with that well (Weingarten et al. 2015).

Depending on the site-specific circumstances, earthquakes of magnitude 2.5 or greater can be felt, whereas earthquakes of lesser magnitude are often imperceptible except with sensitive detection equipment. Within the Permian Basin, an area of increased risk of induced seismicity has been identified in the Dagger Draw Field, which has had an increase in seismic events correlated with increased injection activity (Pursley et al. 2013). Between October 2011 and October 2021, 42 earthquakes with a moment magnitude (M) (USGS 2020) of 2.5 or greater (minimum 2.5, maximum 4.0) were measured at area seismographs around the Permian Basin in New Mexico (USGS 2021b). Of these 42 earthquakes, three occurred approximately 11 km (7 miles) northeast of Jal, New Mexico, ranging from M 2.5 to M 2.7 in 2021. Over 50 SWD wells exist within 15 km (9.3 miles) of those seismicity events. Twenty-one of the aforementioned SWD wells are also within 8 km (5 miles) of the nominated lease parcels (NMOCD 2020a).

Earthquakes within or near the Dagger Draw Field (approximately 15 miles northwest of Carlsbad) are particularly notable because this is the main area of concern for induced seismicity within the Permian Basin. The Dagger Draw Field falls within the Delaware Basin portion of the Permian Basin (Snee and Zoback 2018). The New Mexico Institute of Mining and Technology catalog of earthquakes in the Dagger Draw region shows increasing seismic events with increasing injection activity (Pursley et al. 2013). A normal faulting stress field is observed throughout the Delaware Basin (Snee and Zoback 2018), giving the region a natural tendency toward seismicity. In the past, oil and gas operations have injected produced water into the basal Ellenburger carbonate reservoir, which rests unconformably on the crystalline basement (Zhang et al. 2016). In southeast New Mexico, the Ellenburger carbonate reservoir is estimated to reside between 8,760 feet and 9,110 feet below ground surface and to be approximately 400 feet thick (New Mexico Bureau of Mines 1949). High-volume deep injection of wastewater fluid can bring deep formations closer to failure. Large increases in pore pressure can leave formations that rest on the crystalline basement susceptible to faulting triggers, such as additional injection activity or shock transmitted from a remote (<300 miles distant) earthquake (Herzog 2014). SWD wells typically inject into the deepest sedimentary formations (EPA 2020a), where the proximity of fluid injection to basement rock makes this activity particularly capable of inducing earthquakes. Unlike the more viscous and ductile mantle, the earth's crust has a brittle structure where naturally occurring stress can accumulate (Ellsworth 2013). Currently within the Permian Basin, none of the active injection wells are injecting into the Ellenburger carbonate reservoir (NMOCD 2020a).

Since February 2020, six felt earthquakes of magnitude (M) 3.5 or greater have occurred in west Texas, near the New Mexico portion of the Permian Basin. These earthquakes occurred in an area of the Midland Basin from northeast Ector County to southwest Martin County known as the Gardendale Seismic Response Area. These included an M 3.7 earthquake in southwestern Martin County approximately 8 miles northwest of Midland on September 7, 2021, and two M 3.6 earthquakes northeast of Odessa in February 2020 and May 2021. In response, the Texas Railroad Commission (TRC), which regulates oil

and gas development in Texas, issued a notice to operators in September 2021 requesting a voluntarily reduction in the permitted maximum daily injection rate to 10,000 barrels per day (bpd) as a means of mitigating the recent seismic activity (TRC 2021). Additionally, between February 2020 and October 2021, 550 earthquakes of magnitude 2.5 or greater (minimum 2.5, maximum 4.5) were detected in west Texas within approximately 65 km (40 miles) of the New Mexico border. The majority of these earthquakes occurred west of Orla, approximately 17 to 33 miles south of the New Mexico border. None of the 550 earthquakes in Texas occurred within 15 km (9.3 miles) of the New Mexico border (USGS 2021b); thus, based on the area of effect estimates presented in Weingarten et al. (2015), the seismicity in Texas is unlikely to be related to oil and gas activities (such as SWD) within New Mexico.

The projected increase of SWD within the 19 SWD wells within 5 miles of the nominated lease parcels is 0.99%, increasing the total monthly per-well estimated average injection volume to 65,060 bbl/month which is well below the 300,000 bbl/month level strongly associated with induced seismicity. The projected increase of SWD within the 19 SWD wells within 5 miles of the nominated lease parcels would increase the total daily per-well estimated average injection volume to 2,139 bpd, 21.4% of the 10,000-bpd injection limit that TRC has established as a threshold of increased risk of induced seismicity.

Also, the well with the highest total SWD injection in 2019 (7,256,435 bbl [604,703 bbl per month], API Number 30-025-09806) within 5 miles of the nominated lease parcels is 83 miles (134 km) from the Dagger Draw Field (NMOCD 2020a). There are no active SWD wells in the Dagger Draw Field that are within 5 miles of any nominated lease parcels. Therefore, the associated development is not likely to contribute to injection activity associated with increased seismicity events in the New Mexico portion of the Permian Basin.

The BLM's regulations state that "for an injection well proposed on Federal or Indian leases, the operator shall obtain an Underground Injection Control (UIC) permit pursuant to 40 CFR parts 144 and 146 from the Environmental Protection Agency or the State/Tribe where the State/Tribe has achieved 'primacy'" (BLM 1993). The EPA classifies these wells as Class II injection wells, which are wells used for disposal of fluids associated with the production of oil and natural gas (hydrocarbons); to inject fluids for enhanced oil recovery; or for the storage of liquid hydrocarbons. New Mexico's UIC Program monitors and regulates the injection of fluids into the subsurface. New Mexico regulations set limits on maximum allowable injection pressures and require mechanical integrity testing of the boreholes, pressure monitoring, and reporting. All injection wells permitted by NMOCD are subject to limitations on surface-injection pressure. Wells are required to be equipped with a pressure-limiting device that ensures that the maximum surface injection pressure is not exceeded (NMOCD 2004). Compliance officers from the NMOCD periodically inspect wells and surface facilities to ensure wells and related surface equipment are in good repair and meet regulations.

Based on the New Mexico regulatory program for injection wells, the amount of produced water anticipated from future potential development of the nominated lease parcels, the volume of injection documented for injection wells within 5 miles of the nominated lease parcels, and the current risk of large-magnitude earthquakes in the Permian Basin outside of the Dagger Draw Field, leasing and future potential development of the nominated lease parcels are not expected to result in induced seismicity of magnitude 2.5 or greater.

AIB-4 Sensitive Soils

How would future potential development of the nominated lease parcels affect fragile soils and/or soil stability?

Soil movement disrupts the existing structure of the soil horizons to the depth of disturbance. Soil-forming processes are halted, and compaction of underlying horizons and loss or degradation of soil microbes may occur. These issues are compounded when fragile and/or sensitive soils are present. Fragile soils are soil types that are easily damaged by use or disturbance and/or are those that are difficult to reclaim to pre-disturbance condition.

Additionally, sensitive soils may include those that have components that can be characterized as susceptible to compaction or other mechanical damage and/or are highly erodible when disturbed. Surface disturbance of fragile and/or sensitive soils occurring on increased slope profiles has the potential to effect soil stability and may lead to accelerated soil erosion and potential sedimentation to proximal water bodies (see AIB-2 for more information).

Within the BLM PDO, examples of managed fragile soils include soils with gypsiferous components ("gypsum soils"), biological soil crusts, active sand dunes, and those on slopes greater than 30 percent. Gypsum soils are scattered throughout the analysis area and comprise approximately 156,479 acres, or 0.78% of the 20 million-acre PDO (BLM 2020a). The potential for adverse effects on fragile and/or sensitive soils would depend on site-specific locations. Soil effects are generally considered long term due to the amount of time it takes for soil to be rebuilt through deposition. Reasonably foreseeable environmental trends and planned actions within the PDO would result in a total of 110,740 acres of new surface disturbance for a total of 427,740 acres of landscape-level surface disturbance. Future potential development of the nominated lease parcels would affect the physical and biological integrity of soils within the area of surface disturbance. Surface disturbance associated with future potential development of the nominated lease parcels (22.5 acres) would comprise 0.005% of total landscape-level surface disturbance (427,740 acres; see Table 3.2) associated with reasonably foreseeable environmental trends and planned actions and 4.32% of the total nominated lease parcels acreage of 520.8 acres. These actions would result in long-term disturbance to soils, with related reductions of soil-forming processes and compaction of underlying horizons, and potential loss or degradation of soil microbe communities.

The nominated lease parcels do not contain any mapped units of gypsiferous "gypsum" soils (a limited and fragile soil type that is difficult to reclaim to pre-disturbance condition) or slopes greater than 30% (Natural Resources Conservation Service 2021). Active dune fragile soils are found within nominated lease parcel 396 (16.21 acres, 40.44% of total parcel acreage). Stipulation SENM-S-17-CSU is applied to nominated lease parcel 396 to prevent potential impacts to slopes and active dune fragile soils. This stipulation would not allow surface disturbance on slopes 30 percent or greater, and occupancy or use of fragile soils would be considered on a case-by-case basis (see Appendix B). Site-specific analysis would occur at the lease development level, and the lessee would be required to follow applicable COAs and reclamation measures as determined by the BLM. These may include measures such as topsoil stockpiling and pad placement in respect to topography and other factors to further mitigate effects on the physical and biological integrity of soils during the development of a lease.

AIB-5 Vegetation

How would future potential development of the nominated lease parcels affect vegetation?

Surface disturbance associated with reasonably foreseeable environmental trends and planned actions within the 20 million-acre PDO would remove surface vegetation, altering the plant community

composition, increasing potential for erosion and soil compaction, and increasing the likelihood for the introduction of noxious weeds (see AIB-6). In these arid plant communities, low rainfall (13 inches per year) combined with limited soil organic matter contributes to communities with low disturbance level thresholds and lack of resilience (BLM 2018c). Removal of vegetation may leave segmented plant communities that would not recover to pre-disturbance levels without reclamation measures, which may take years to achieve (BLM 2018b). Consequently, this would be a long-term effect. Vegetation resources may also be subject to increased fragmentation of vegetative types, the introduction of invasive species, and the potential for monocultures to develop. Many of the adverse effects on landscape vegetation density and type resulting from surface disturbances would also be long term. At the landscape level, vegetation rehabilitation efforts such as Restore New Mexico (USGS 2019a) would continue, existing and active wells would be plugged and reclaimed to former vegetative conditions, and a countervailing impact to vegetation would also occur.

Reasonably foreseeable environmental trends and planned actions within the PDO would result in a total of 110,740 acres of new surface disturbance for a total of 427,740 acres of total landscape-level surface disturbance, of which the future potential development of the nominated lease parcels would comprise approximately 22.5 acres (0.005% of total landscape-level surface disturbance associated with reasonably foreseeable environmental trends and planned actions, and approximately 0.00001% of the 20 million-acre PDO) (see Table 3.2). This surface disturbance may contribute to landscape-level variations in plant communities dependent on success of reclamation activities and concurrent effects of climate change.

Using land cover vegetation type data from Landscape Fire and Resource Management Planning Tools (LANDFIRE) (2019), the nominated lease parcels are covered by the vegetation types listed in Table 3.4.

Table 3.4. Vegetation Types within the Nominated Lease Parcels

Land Cover Vegetation Types*	Total Area of Vegetation Type Intersected by Parcels (acres)	Parcel within Vegetation Types* (percent of parcel containing vegetation type)
Apacherian-Chihuahuan Semi-Desert Grassland†	11.6	408 (3.4%), 409 (0.5%)
Apacherian-Chihuahuan Semi-Desert Shrub-Steppe†	278.1	396 (0.1%), 407 (6.2%), 408 (82.3%), 409 (3.5%)
Chihuahuan Creosotebush Desert Scrub	37.5	396 (1.1%), 408 (10.7%), 410 (1.7%)
Chihuahuan Loamy Plains Desert Grassland†	3.8	407 (1.5%), 408 (1.0%)
Chihuahuan Mixed Desert and Thornscrub	36.0	396 (2.3%), 407 (23.0%), 408 (0.7%), 409 (41.4%), 410 (8.6%)
Chihuahuan Mixed Salt Desert Scrub	8.6	396 (1.7%), 407 (18.7%), 409 (0.9%)
Chihuahuan Sandy Plains Semi-Desert Grassland†	0.2	409 (0.6%)
Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub	0.8	396 (2.0%)
Chihuahuan-Sonoran Desert Bottomland and Swale Grassland†	0.4	408 (0.1%)
Interior West Ruderal Riparian Scrub†	1.0	408 (0.3%)
North American Warm Desert Active and Stabilized Dune	0.2	396 (0.4%)
North American Warm Desert Riparian Herbaceous†	0.2	408 (0.1%)

Land Cover Vegetation Types*	**Total Area of Vegetation Type Intersected by Parcels (acres)**	**Parcel within Vegetation Types* (percent of parcel containing vegetation type)**
North American Warm Desert Riparian Shrubland†	0.7	408 (0.2%)
North American Warm Desert Ruderal & Planted Scrub	139.0	396 (67.4%), 407 (42.4%), 408 (1.1%), 409 (50.8%), 410 (88.6%)
Quarries-Strip Mines-Gravel Pits-Well and Wind Pads	4.9	407 (7.8%), 409 (2.2%), 410 (1.1%)
Western Great Plains Sandhill Steppe†	10.0	396 (25.0%)
Western Warm Temperate Developed Ruderal Shrubland†	0.1	407 (0.3%)
Total	**533.1**‡	-

* Source: LANDFIRE (2019).

Note: The analysis contained in this EA generally provides percentage contribution rounded to two decimal points. As such, percentages may not always sum to 100 due to rounding.

† Indicates rare and unique vegetation types. Rare and unique vegetation types are based on existing vegetation types that encompass 1% or less of the 20 million-acre analysis area (LANDFIRE 2019; Sandbom 2020).

‡ All acreages contained in the EA analysis were calculated using geographic information system (GIS) data sets for resources and the parcels, which may differ slightly from the acreages contained in legal description here and in Table 2.1. Difference in total acres between the parcels and acres analyzed in the EA can vary slightly due to geoprocessing operations where slivers of area are created when two or more data sets intersect. Any inaccuracies are negligible and do not change the overall effect analysis conclusions presented in this EA.

Nominated lease parcel 408 contains 11.4 acres (82.3% of total parcel acreage) of Apacherian-Chihuahuan Semi-Desert Shrub-Steppe vegetation type, which is considered a rare and unique vegetation type (see Table 3.4). It is likely, based on the composition of vegetation types in nominated lease parcel 408, that this rare and unique vegetation type would be impacted by surface disturbance during development of the lease parcel. This vegetation type is categorized as rare and unique due to the availability of the vegetation community composition within the analysis area (less than 1% of present vegetation. However, this vegetation type is fairly common outside of the BLM PDO management area, with a range extending west to Arizona, north up the Rio Grande Valley to central New Mexico and east into the Chihuahuan Desert (NatureServe 2021). Therefore, impacts to this vegetation type from development of the nominated lease parcel would not have an impact to the overall integrity or distribution of the vegetation type. Standard lease terms and conditions provide the BLM with the authority to determine site-specific vegetation management strategies, including relocating wells up to 656 feet (200 m), at the lease development stage for any future actions within the lease parcels to determine whether effects on rare and unique or otherwise sensitive vegetation would occur. Under standard terms and conditions, which would apply to the nominated lease parcels, pre-disturbance surveys would be required at the time of the proposed lease development. The surveys would identify occurrence of rare or unique vegetation types, special status plant species, and/or vegetation providing habitat for special status wildlife species for avoidance during project siting and construction (see AIB-8 for more information). Avoidance, minimization, and/or mitigation measures would also be determined at that time.

Rare and unique vegetation types comprise less than 8.0% of the total parcel acreage of nominated lease parcels 396, 407, 409 and 410; therefore, it is expected that rare and unique vegetation types are less likely to be impacted during lease development. Additionally, the protections to slopes and fragile soils applied to the nominated lease parcel 396 may provide protections to rare and unique vegetation types found on the nominated lease parcel where they intersect these ecological features. In the unlikely event that all surface disturbance associated with development of nominated lease parcels 396, 407, 409 and 410 were to occur in a single common vegetation type, the level of estimated disturbance would not result in a substantial change to the overall characteristics or availability of the said vegetation type across the

analysis area. This surface disturbance may contribute to landscape-level variations in plant communities dependent on success of reclamation activities and concurrent effects of climate change, such as warmer temperatures, changes in rainfall and runoff, and the resulting shifts in vegetation communities. Note that the time frame for successful reclamation would vary by vegetation type and other factors such as the amount and timing of annual precipitation. Thus, the estimated level of disturbance would not pose a threat to the viability of species composing these communities or ecoregions, nor to any species utilizing common vegetation for habitat.

AIB-6 Invasive Species (Noxious Weeds)

How would future potential development of the nominated lease parcels affect the introduction and/or spread of noxious weeds and invasive plants?

The 20 million-acre PDO has observed an increase in noxious weed/invasive plant populations in recent years, and there appears to be a direct correlation between development and associated disturbed areas and the establishment and spread of noxious and/or invasive plants. African rue (*Peganum harmala*), a perennial deep-rooted noxious weed, has proven especially difficult to control because it colonizes every soil type and easily outcompetes native plants for soil nutrients and available water (BLM 2018b).

Invasive and noxious weeds invade disturbed sites, spread into adjacent areas, compete with and potentially displace native vegetation, and can contribute to the degradation of soil health by overutilizing soil nutrients. Surface disturbance, construction equipment, and source materials brought on-site (e.g., caliche, gravel) associated with reasonably foreseeable environmental trends and planned actions within the PDO (427,740 acres of surface disturbance) would likely increase the spread and density of invasive plants and noxious weeds over the long term. Additionally, livestock grazing may potentially spread noxious, invasive, or non-native species through equipment, feed products, and on livestock themselves (BLM 2018b). On a landscape level, the Carlsbad and Chaves Soil and Water Conservation Districts have operated a joint county venture (Chaves, Eddy, and Lea Counties) to target certain species for eradication (Carlsbad Soil and Water Conservation District 2019; Chaves Soil and Water Conservation District 2019).

Reasonably foreseeable environmental trends and planned actions within the PDO would result in a total of 110,740 acres of new surface disturbance for a total of 427,740 acres of total landscape-level surface disturbance, of which the future potential development of the nominated lease parcels would comprise approximately 22.5 acres (0.005% of total landscape-level surface disturbance; see Table 3.2). This would also result in a concomitant increase in risk of establishment of noxious weeds. All disturbed acreage would be vulnerable to the long-term establishment and spread of noxious weeds/invasive plants until successful reclamation. A review of the BLM PDO spatial data of known noxious weed treatment acres concluded that there are known noxious weed occurrences of African rue within nominated lease parcels 409 and 410, and Malta starthistle (*Centaurea melitensis*) within nominated lease parcel 409.

Within the BLM PDO, there are ongoing efforts to reduce the presence and spread of these unwanted species by way of prevention and treatment. The most common treatment method is the application of herbicides. In general, the effectiveness of treatments is variable depending on location, species, treatment type, timing of treatment, and size of population. In the event that noxious weeds are discovered at any time during future potential development, standard lease terms and conditions hold the operator responsible for weed treatment and prevention activities, such as herbicide application and washing vehicles coming from areas with known weed populations.

Reclamation is intended to restore previously disturbed sites to a properly functioning natural ecological state. The effectiveness of reclamation efforts varies based upon a number of factors such as soil type, precipitation, herbicide treatments, and additional disturbance. Once physical reclamation of the site has taken place, seeding of native species is intended to reestablish the native plant community and protect the disturbed area from potential establishment of noxious weeds. While reclamation has been shown to increase and restore the health of disturbed sites, the complete eradication of noxious weed species is challenging, and initiation of large-scale control efforts is not feasible at this time (BLM 2018b).

Together with the standard lease terms and conditions, site-specific approval requirements that require permit holders to treat weeds provide a countervailing effect that limits the spread of noxious weeds across Chaves, Eddy, and Lea Counties and contributes to controlling the spread on a landscape level. Some of the adverse effects from development remain, including potential introduction of new species. These remaining effects would be long term if full eradication of certain introduced species is not achieved.

AIB-7 Threatened and Endangered Species

How would future potential development of the nominated lease parcels affect threatened and endangered (T&E) species?

Analysis of potential for occurrence of ESA-listed threatened and endangered species within the 20 million-acre BLM PDO was conducted in a desktop review format utilizing best available data to assess the potential for habitat to be present within the nominated lease parcels coinciding with known habitat requirements of the species listed in Table 3.5. Desktop analysis included review of aerial mapped vegetation communities (LANDFIRE 2019), NHD data (USGS 2019b) (see AIB-2 for further information), USFWS NWI data (USFWS 2017), USFWS descriptions of species habitat requirements and current mapped critical habitat (USFWS 2021a), and BLM-mapped potential habitat for special status plant species (BLM 2021b. Surface disturbance associated with reasonably foreseeable environmental trends and planned actions within the PDO (427,740 acres of surface disturbance) may contribute to reduction of suitable habitat and increased fragmentation, which could affect ESA-listed species occurring within the planning area, including those listed in Table 3.5. At the landscape level, implementation of land restoration and conservation activities listed in Section 3.3.2 would continue, with a result of countervailing beneficial impacts to habitat dependent on the site-specific success of restoration activities and concurrent effects of climate change.

According to the USFWS Information for Planning and Consultation (IPaC) system (USFWS 2021b), 11 species—two bird species: northern aplomado falcon *(Falco femoralis septentrionalis*) and piping plover (*Charadrius melodus*); two fish species: Pecos bluntnose shiner (*Notropis simus pecosensis*) and Pecos gambusia (*Gambusia nobilis*); three snail species: Koster's springsnail (*Juturnia kosteri*), Pecos assiminea snail (*Assiminea pecos*), and Roswell springsnail (*Pyrgulopsis roswellensis*); one crustacean species: Noel's amphipod (*Gammarus desperatus*); and three plant species: Kuenzler hedgehog cactus (*Echinocereus fendleri* var. *kuenzleri*), Pecos sunflower (*Helianthus paradoxus*) and Wright's marsh thistle (*Cirsium wrightii*)—were evaluated for the potential to occur within the nominated lease parcels (see Section 4.1 for additional information). Based on desktop analysis, three ESA-listed species were determined to have the potential to occur within the nominated lease parcels based on present suitable habitat and species distribution information (see Table 3.5).

Table 3.5. USFWS IPaC System ESA-listed Threatened and Endangered Species with Suitable Habitat on or in the Vicinity of the Nominated Lease Parcels

Species (*Scientific Name*) (Status)*	Suitable Habitat within Nominated Lease Parcels	Discussion†, ‡
Birds		
Piping plover (*Charadrius melodus*) (T)	Y	The nominated lease parcels are outside of critical habitat for this species (USFWS 2021b). Nominated lease parcel 408 contains 1.9 acres (0.6% of the parcel acreage) of riparian habitat (see AIB-5). Ephemeral streams and/or rivers and riverine wetlands have also been identified within nominated lease parcel 408 (see AIB-2). Additionally, playas have been identified on nominated lease parcel 408 (see AIB-22), which, along with the surface water features, may provide wetland and shoreline habitat for this species. Stipulations SENM-S-19-CSU‡, (preventing surface disturbance within 200 m of playa features) and SENM-S-39-CSU (requiring a POD prior to development) are applied to parcel 408, which provide secondary protection to associated potential habitat for this species. Standard terms and conditions also provide the BLM with the authority to move future potential development to avoid surface water features and playas within any lease; this, in turn, protects shoreline habitat that may be utilized by this species.
Plants		
Pecos sunflower (*Helianthus paradoxus*) (T)	Y	The nominated lease parcels are outside of critical habitat for this species (USFWS 2021b). Nominated lease parcel 408 contains 1.9 acres (0.6% of the parcel acreage) of riparian habitat (see AIB-5). Ephemeral streams and/or rivers and riverine wetlands have been identified within nominated lease parcel 408 (see AIB-2). Additionally, playas have been identified on nominated lease parcel 408, which, along with the surface water features, may provide wetland and shoreline habitat for this species. Stipulations SENM-S-19-CSU‡, (preventing surface disturbance within 200 m of playa features) and SENM-S-39-CSU (requiring a POD prior to development) are applied to parcel 408. Lease Notice NM-1-LN, which notifies the lessee that the lease parcels contain potential, suitable, and/or occupied habitat, is applied to nominated lease parcel 407. These stipulations and the lease notice would provide secondary protection to associated potential habitat for this species. Standard terms and conditions also provide the BLM with the authority to move future potential development to avoid surface water features and playas within any lease; this, in turn, protects shoreline habitat that may be utilized by this species.
Wright's marsh thistle (*Cirsium wrightii*) (C)	Y	No critical habitat has been designated for this species (USFWS 2021b). Nominated lease parcel 408 contains 1.9 acres (0.6% of the parcel acreage) of riparian habitat (see AIB-5), which is the preferred habitat of this species (USFWS 2021b). Ephemeral streams and/or rivers and riverine wetlands have been identified within nominated lease parcel 408 (see AIB-2). Additionally, playas have been identified on nominated lease parcel 408 (see AIB-22), which, along with the surface water features, may provide wetland and shoreline habitat for this species. Stipulations SENM-S-19-CSU‡, (preventing surface disturbance within 200 m of playa features) and SENM-S-39-CSU (requiring a POD prior to development) are applied to parcel 408. Lease Notice NM-1-LN, which notifies the lessee that the lease parcels contain potential, suitable, and/or occupied habitat, is applied to nominated lease parcel 407. These stipulations and the lease notice would provide secondary protection to associated potential habitat for this species. Standard terms and conditions also provide the BLM with the authority to move future potential development to avoid surface water features and playas within any lease.

C = Candidate species undergoing USFWS review; E = Endangered; EX = Experimental Population, Non-Essential; T = Threatened

† The nominated lease parcels are not within species-specific critical habitat.

‡ See Appendix B for summaries of stipulations and lease notices.

According to Stipulation WO-ESA-7, which is applied to the nominated lease parcels, the BLM will not approve any ground-disturbing activity that may affect species or critical habitat until it completes its obligations under applicable requirements of the ESA. In addition, the BLM may require modifications to or disapprove proposed activity that is likely to result in jeopardy to the continued existence of a proposed or listed threatened or endangered species, or result in the destruction or adverse modification of a designated or proposed critical habitat (see Table 2.1 and Appendix B). Section 4.1 further discusses how the Proposed Action would comply with threatened and endangered species management guidelines outlined in the 1988 CFO RMP (BLM 1988), as amended in 1997 (BLM 1997a), and the 2008 BLM PDO Special Status Species RMPA (BLM 2008a), as well as Endangered Species Act (ESA) Section 7 consultation requirements.

The ESA-listed species with the potential to occur within nominated lease parcel 408 are all riparian obligate species with suitable habitat occurring on approximately 1.9 acres (0.6%) of the nominated lease parcel. Based on review of aerial imagery, the present habitat is marginally suitable but lacks the presence of perennial wetland and shoreline habitat, which are more common characteristics of habitat occupied by these species. Therefore, the likelihood of adverse impacts to or removal of available habitat by development of nominated lease parcel 408 is relatively low. Additionally, future potential development is not anticipated to create short- or long-term adverse effects for the following reasons: 1) stipulations and lease notices facilitate the reduction or avoidance of effects, 2) site-specific analysis at the lease development stage provides an additional opportunity to evaluate effects and develop measures to reduce or avoid effects, and 3) the standard lease terms and conditions that apply to the nominated lease parcels provide the BLM with the authority to require reasonable measures that reduce or avoid effects.

AIB-8 Sensitive Species

How would future potential development of the nominated lease parcels affect sensitive species?

Analysis of potential for occurrence of sensitive species within the 20 million-acre BLM PDO was conducted in a desktop review format utilizing best available data to assess the potential for habitat to be present within the nominated lease parcels coinciding with known habitat requirements of the sensitive species. Desktop analysis included review of aerial mapped vegetation communities (LANDFIRE 2019, see AIB-5), NHD (USGS 2019b, see AIB-2), published descriptions of species habitat requirements (New Mexico Department of Game and Fish [NMDGF] 2021), as well as USFWS mapped critical habitat (USFWS 2021a).

Surface disturbance associated with reasonably foreseeable environmental trends and planned actions within the PDO (110,740 acres of new surface disturbance for a total of 427,740 acres of total landscape-level surface disturbance) is not anticipated to create adverse effects. Depending on the proximity of ground disturbance and development activity to sensitive species habitat and/or populations, there may be short-term effects (i.e., temporary displacement from habitat due to noise and construction) or long-term effects on sensitive species and the ecological processes that sustain them related to changes in the following habitat conditions: ground cover, soil nutrient flows and processes, hydrological flows and processes, solar exposure, thermal cover, fugitive dust loads, non-native species dispersal, habitat connectivity, noise levels and human activity, light pollution, forage availability, and pollinator and dispersal agents' visitation behaviors. If detected and avoided, actual impacts to special status plant species would be less than the potential effects estimated in this analysis. It is not certain that detected occupied habitat could be avoided, given valid existing lease rights and other resource conflicts in the vicinity of proposed development locations. Effects may also be lower than the estimated potential when single pads host multiple wells. Methods to minimize impacts on individuals and habitats would be applied into the future for foreseeable environmental trends and planned actions as well, and the resulting impacts from landscape-wide development would be minimized or restricted from protected habitat.

The remaining impacts from landscape-level development lead to long-term habitat loss and fragmentation. The resulting acreage effects across the landscape would contribute to additional potential for habitat loss and fragmentation that could affect sensitive species. At the landscape level, implementation of land restoration and conservation activities listed in Section 3.3.2 would continue, and a countervailing impact to habitat would also occur dependent on the success of restoration activities and concurrent effects of climate change.

Potential habitat has been identified within the nominated lease parcels for 11 sensitive species (Table 3.6); therefore, sensitive species have the potential to occur within the nominated lease parcels. No additional sensitive species are known to occur on, or in the vicinity of, the nominated lease parcels, though parcel-specific data are limited. Site selection of the 22.5 acres of potential surface disturbance associated with the development of the nominated lease parcels would occur after pre-disturbance biological surveys and additional analysis and disclosure of potential effects on sensitive species at the time of lease development. For more information regarding general wildlife, including game species and the New Mexico State Wildlife Action Plan, see AIB-15. Detailed analysis of potential impacts to the DSL and LPC and/or their habitats can be found in Section 3.6.4.

BLM biologists have identified swales within nominated lease parcel 408 that may provide mesquite habitat and, therefore, potential nesting habitat for raptor species (BLM 2020b). Stipulation SENM-S-16-CSU is applied to nominated lease parcel 408 for raptor nests and heronries and would provide protections to these species. Stipulation SENM-S-19-CSU (playas and alkali lakes) is also applied to parcel 408 (see Appendices A and B), which may provide protections to sensitives species that utilize this habitat. Additionally, SENM-S-39-CSU (POD requirement) is applied to parcel 408 (see Appendices A and B) and may also provide protections to sensitive species within this parcel because the POD will include site-specific evaluations of the entire parcel. Standard terms and conditions would apply to all nominated lease parcels, including a requirement of pre-disturbance surveys at the time of proposed lease development. The surveys would identify occurrences of special status plant species and special status wildlife habitat for avoidance during project siting and construction. The BLM would conduct site-specific evaluations at the lease development stage for any reasonably foreseeable environmental trends and planned actions within the lease parcels to determine whether effects on sensitive species would occur. Avoidance, minimization, and/or mitigation measures would also be determined at that time. The BLM is working with other land management agencies to restrict and manage development through establishment of management protocols to identify and map potential and occupied habitat, requiring species-specific inventories and studies, as well other requirements, ahead of locating well pads and infrastructure.

Table 3.6. Potential Sensitive Species Habitat within Nominated Lease Parcels

Species (*Scientific Name*)	Potential Habitat	Parcel Number (total parcel acreage)	Discussion
Birds			
Baird's sparrow (*Ammodramus bairdii*)	Y	407 (40), 408 (320.8)	This species is a winter resident in New Mexico. It generally prefers dense, extensive grasslands with few shrubs, and avoids heavily grazed areas. The nominated lease parcels contain semi-desert grassland habitat, which may indicate potential habitat for this species (see AIB-5).
Bald eagle (*Haliaeetus leucocephalus*)	Y	407 (40), 408 (320.8)	Occurs in New Mexico year-round. Breeding is restricted to a few areas mainly in the northern part of the state along or near lakes. In migration and during winter months, the species is found chiefly along or near rivers and streams and in grasslands associated with large prairie dog (Cynomys sp.) colonies. Typically perches in trees. The nominated lease parcels contain potential prairie dog habitat, which indicates potential foraging habitat for bald eagle (see AIB-5). Stipulation SENM-S-16-CSU is applied to nominated lease parcel 408 and would provide protections to raptor nests if these species were found within the nominated lease parcel.
Chestnut-collared longspur (*Calcarius ornatus*)	Y	407 (40), 408 (320.8)	This species migrates and winters in the eastern part of New Mexico and migrates westward locally to the vicinity of the Rio Grande valley, and occasionally farther in the Southwest. This species is considered uncommon to abundant and is most numerous in the southernmost area of the Rio Grande valley and is regular in the Mogollon Plateau (Hubbard 1978). Chestnut-collared longspurs were often seen within, or in association with, open grassland habitats. The sites that were used most often were dominated by desert saltgrass (*Distichlis spicata*), with occasional clumps of fourwing saltbush (*Atriplex canescens*) interspersed. Adjacent sites having an even greater shrub component were also occasionally used (Baltosser 1991). The nominated lease parcels contain semi-desert grassland habitat, which may indicate potential habitat for this species (see AIB-5).
McCown's longspur (*Calcarius mccownii*)	Y	396 (40), 407 (40), 408 (320.8), 409 (40), 410 (80)	This species is found in Sonoran desertscrub, Chihuahuan desertscrub, annual grassland, farms, and mountain and alpine meadows. It is associated with open to dense vegetation of shrubs, low trees, and succulents, dominated by paloverde (*Cercidium microphyllum*), pricklypear (*Opuntia* sp.), and giant saguaro (*Cereus giganteus*) (U.S. Department of Agriculture 1991). The nominated lease parcels contain Chihuahuan desertscrub and semi-desert grassland habitat, which may indicate potential habitat for this species (see AIB-5).
Sprague's pipit (*Anthus spragueii*)	Y	407 (40), 408 (320.8)	This species occurs in New Mexico only as a sporadic winter resident. It is associated with southern desert grasslands of the state. The species as a whole prefers dry, open grasslands. The nominated lease parcels contain semi-desert grassland habitat, which may indicate potential habitat for this species (see AIB-5).
Western burrowing owl (*Athene cunicularia hypugaea*)	Y	407 (40), 408 (320.8)	This species is found in grasslands, especially in association with prairie dog colonies, in desertscrub, and in agricultural and semi-urban environments. The nominated lease parcels contain several suitable vegetation communities as well as potential habitat for black-tailed prairie dog (*Cynomys ludovicianus*), which may indicate potential habitat for this species (see AIB-5).

Species (*Scientific Name*)	**Potential Habitat**	**Parcel Number (total parcel acreage)**	**Discussion**
Mammals			
Black-tailed prairie dog (*Cynomys ludovicianus arizonensis*)	Y	407 (40), 408 (320.8)	This species prefers grasslands, including short- and mixed-grass prairie, sagebrush steppe, and desert grasslands. It is also known to occur in mesquite–creosote bush, grama–needlegrass, tarbush–creosote bush, and burrograss–cholla type habitats. The nominated lease parcels contains several suitable vegetation communities, which may indicate potential habitat for this species (see AIB-5).
Least shrew (*Cryptotis parva*)	Y	408 (320.8)	In New Mexico, this species is found in mesic grassland and wetland habitats characterized by dense grass cover, often along the borders of streams or lakes within otherwise relatively arid habitats. Most active at night. Vulnerable to habitat loss from drought, water diversion, agriculture, and grazing. The nominated lease parcels contain riverine wetlands, which may indicate potential habitat for this species (see AIB-2).
Spotted bat (*Euderma maculatum*)	Y	408 (320.8), 409 (40), 410 (80)	In New Mexico, spotted bats have been known to inhabit areas near cliffs, including piñon-juniper woodlands and from streams or water holes within ponderosa pine or mixed coniferous forest. They have also taken over cattle tanks in a meadow surrounded by mixed coniferous forest and near a ridge with cliffs and limestone outcroppings. Spotted bats are usually observed around water sources, including desert pools or cattle tanks. They also may use rivers or desert washes as travel corridors. The nominated lease parcels contain surface water features, which may indicate potential habitat for this species (see AIB-2).
Reptiles and Amphibians			
Desert massasauga (*Sistrurus tergeminus*)	Y	407 (40), 408 (320.8)	This species primarily inhabits desert grasslands or shortgrass prairies with sandy soil in valleys, on low sloping alluvial fans, and on rolling grass-covered hills within semidesert grassland habitats. The nominated lease parcels contain semi-desert grassland habitat, which may indicate potential habitat for this species (see AIB-5).
Plants			
Wind Mountain rock-cress (*Boechera zephyra*)	Unknown	410 (80)	This species has potential to occur within the BLM CFO, specifically Eddy County, New Mexico (BLM 2018c; New Mexico Rare Plant Technical Council 1999) and is also within the “Guadalupe Mountains and Foothills” suite of species. This species can be found on rocky syenite, limestone, or basaltic scoria slopes, and primarily occurs in the upper margins of Chihuahuan desertscrub and occasionally occurs in juniper savanna or oak-juniper woodlands. The nominated lease parcels contain desertscrub habitat, which may indicate potential habitat for this species (see AIB-5).

AIB-9 Migratory Birds

How would future potential development of the nominated lease parcels affect migratory birds?

Habitat fragmentation, alteration, and/or loss within the 20 million-acre PDO has changed how birds move through landscapes and use the remaining habitat. Loss, alteration, and fragmentation of habitat are among the main reasons why biodiversity is decreasing in many places worldwide. The primary drivers of habitat loss and fragmentation within this area are oil and gas development, livestock grazing, and mining.

Reasonably foreseeable environmental trends and planned actions within the 20 million-acre PDO would result in a total of 110,740 acres of new surface disturbance (0.55% of the 20 million-acre PDO), for a total of 427,740 acres of total landscape-level surface disturbance (2.1% of the 20 million-acre PDO) (see Table 3.2). This landscape-level disturbance would further contribute to migratory bird habitat loss and fragmentation. Additionally, land restoration and conservation projects (outlined in Section 3.3) have improved habitat, in which migratory birds have benefitted from the improved herbaceous cover associated with these activities. Future restoration projects would likely produce similar effects where they are implemented.

Habitat loss, alteration, or fragmentation that occurs outside of the PDO can also contribute to population declines in respective migratory bird populations within PDO. Taylor and Stutchbury (2015) state "that habitat loss in one region can effect sub-populations in regions that are not directly connected." Habitat loss on wintering grounds south of the United States border and local drought conditions can contribute to population declines in migratory birds that occur within the PDO. This regional habitat continues to provide for the life cycles of these birds notwithstanding known drivers of habitat loss as described above.

Most of the effects associated with reasonably foreseeable environmental trends and planned actions within the PDO would occur at the initial stages of lease development. These disturbances include construction and drilling, human presence, traffic, heavy equipment, and noise associated with lease development activities. Bird species not tolerant of these activities may leave and avoid the area altogether for the duration of construction or move into nearby undisturbed habitat patches. Habitat loss effects would be long term, and, in some cases, reclamation would not fully rehabilitate migratory bird habitat to pre-development conditions. For more information regarding general wildlife, including game species, and the New Mexico State Wildlife Action Plan, see AIB-15.

Nominated lease parcels 396, 407, 409 and 410 fall within the North American Bird Conservation Initiative Bird Conservation Region (BCR) 18 (Shortgrass Prairie) and nominated lease parcel 408 falls within BCR 35 (Chihuahuan Desert) (Partners in Flight 2021a; USFWS 2021b). The New Mexico Avian Conservation Partners developed two species conservation lists of the highest conservation concern in New Mexico (Level 1 and Level 2) based on distribution, threats, global population size, New Mexico population trend, and importance of New Mexico to breeding or wintering (Partners in Flight 2021a, 2021b). Some of the continent's highest-priority birds of conservation concern breed in BCR 18 and include the mountain plover (*Charadrius montanus*), long-billed curlew (*Numenius americanu*s), ferruginous hawk (*Buteo regalis*), and LPC (New Mexico Avian Conservation Partners 2016). Playa lakes habitat consists of numerous shallow wetlands that support many wintering ducks, migrant shorebirds, and some breeding species, such as snowy plover (*Charadrius nivosus*) (New Mexico Avian Conservation Partners 2016). Species of highest conservation concern found in BCR 35, which require desertscrub and grassland habitats, include aplomado falcon, prairie falcon (*Falco mexicanus*), scaled quail (*Callipepla squamata*), Bendire's thrasher (*Toxostoma bendirei*), wintering Sprague's pipit, and wintering McCown's longspur (New Mexico Avian Conservation Partners 2016). In riparian areas, species of highest concern include southwestern willow flycatcher (*Empidonax traillii extimus*), Bell's

vireo (*Vireo bellii*), and Lucy's warbler (*Oreothlypis luciae*) (New Mexico Avian Conservation Partners 2016).

Future potential development of the nominated lease parcels would result in approximately 22.5 acres of total surface disturbance (0.005% of total landscape-level surface disturbance; 427,740 acres). Future potential development of nominated lease parcels 396, 407, 409 and 410 and would result in 18 acres (0.00002%) of surface disturbance for BCR 18 (95,063,465.03 acres) and future potential development of nominated lease parcel 408 would result in 4.5 acres (0.0000003%) of surface disturbance for BCR 35 (141,738,865.81 acres). This surface disturbance could result in long-term habitat loss and fragmentation, depending on the proximity of disturbance to migratory bird habitat. Stipulation SENM-S-16-CSU is applied to nominated lease parcel 408, which would provide protections to raptor nests if these species were found within the nominated lease parcel. Additionally, Stipulation SENM-S-39-CSU is also applied to nominated lease parcel 408 which requires a POD for the lease and may provide protections to migratory birds. Lastly, Stipulation SENM -S-19-CSU is also applied to nominated lease parcel 408, which provides protections to playa features (see AIB-22), and may also provide protections to migratory birds.

Compliance with the Migratory Bird Treaty Act would be required for any future potential developments and would follow the BLM PDO Migratory Bird Policy, which could include timing limitation constraints on developments within the nominated lease parcels during migration and nesting seasons, or requirements for netting over open water containing fluids that are harmful to migratory birds. The BLM's authority under standard terms and conditions would result in the application of measures to mitigate effects on migratory birds at the lease development level. Developmental constraints during spring and fall migrations and nesting seasons, as well as nest surveys, may be required prior to implementation of lease development activities. Some of these include the application of netting over open tanks, raptor-safe power line construction standards, and sound mufflers. In addition, avoidance of active avian nests and burrows or delays of development activities may be required.

AIB-10 Paleontological Resources

How would future potential development of the nominated lease parcels affect paleontological resources?

The Potential Fossil Yield Classification (PFYC) is a tool that allows the 20 million-acre BLM PDO to predict the likelihood of a geologic unit to contain paleontological resources. The PFYC is based on a numeric system of 1–5. An area identified as PFYC 1 has very low likelihood of containing paleontological resources, whereas an area identified as PFYC 5 is a geologic unit that has a very high likelihood to contain scientifically significant paleontological resources. Within areas identified as PFYC 2 or 3, paleontological resource management concern is generally low to moderate because the likelihood of encountering scientifically significant fossils is relatively low to moderate. Within areas identified as PFYC 4, paleontological resource management concerns are moderate to high, as the probability of affecting scientifically significant paleontological resources is generally moderate to high.

Surface disturbance and risk of effects on paleontological resources associated with reasonably foreseeable environmental trends and planned actions within the PDO (110,740 acres of new surface disturbance, added to 317,000 acres of previous surface disturbance for a total of 427,740 acres of total landscape-level surface disturbance; see Table 3.2) would depend on the locations of proposed disturbance relative to PFYC class. As currently mapped, almost all of the PDO analysis area is PFYC 2 and 3, and there are no PFYC 5 areas identified in the area (BLM 2019). As such, the risk would be low to moderate, and the same measures for minimizing effects at the site-specific level as described above would be followed for resources associated with reasonably foreseeable environmental trends. Effects

would result in the immediate physical loss of fossils and their contextual data. Ground disturbance could also subject fossils to long-term damage or destruction from erosion and create improved access to the public and increased visibility, potentially resulting in unauthorized collection or vandalism. Ground disturbance can also reveal scientifically significant fossils that would otherwise remain buried and unavailable for scientific study. Such fossils can be collected properly and curated into the museum collection of a qualified repository, making them available for scientific study and education. Future potential development of the nominated lease parcels would be analyzed further through separate NEPA processes, as directed by regulations and current policy.

Utilizing currently available geological mapping at 1:500,000 scale, all five of the nominated lease parcels are in areas mapped as Quaternary piedmont deposits with a PFYC 2 designation. However, spread throughout the PDO are smaller outcrops of late-Pleistocene deposits associated with ancient lakes that have produced scientifically important paleontological resources, such as the Hackberry Lake fossil area to the southwest and the Jal fossil area to the southeast (Morgan and Harris 2015). At this scale, many of these smaller outcrops that do contain scientifically important fossils are not represented in the map data. With refined geologic mapping, these smaller outcrops, which are often partially covered by younger eolian dunes, would be assigned a PFYC 4 or U (unknown).

There are no known paleontological localities within the nominated lease parcels, However, one lease parcel (396) is immediately adjacent to the important Jal fossil area (Morgan and Harris 2015), and while this lease parcel is mapped as PFYC Class 2 Quaternary pediment deposits, it could contain deposits similar to those containing fossils at Hackberry Lake or Jal. Future potential development of this nominated lease parcel would include 4.5 acres of surface disturbance.

Effects on paleontological resources can be mitigated by standard terms and conditions, which require a lessee to conduct inventories or special studies at the discretion of the BLM. Site-specific projects that would cause surface disturbance in areas with unknown or moderate to high potential may require a paleontological survey and/or monitoring conducted at time of proposed lease development in accordance with NEPA, Paleontological Resources Preservation Act (PRPA), and FLPMA. Specifically, stipulation NM-13-CSU, in which surface occupancy or use would be subject to special operating constraints, and Lease Notice NM-14-LN, in which lease development would be subject to compliance with PRPA, NEPA, and FLPMA (see Appendix B), are applied to the nominated lease parcel 396. Additional mitigation measures may be applied as COAs based on the results of the survey. If, during operations within the nominated lease parcels, paleontological resources are discovered and a permitted paleontological monitor is not on-site, the lessee must cease any operations that would result in the destruction of such specimens and contact the BLM Authorized Officer. Scientifically significant paleontological resources discovered through surveys or monitoring would be collected by a permitted paleontologist and curated at an appropriate repository. These same measures for minimizing effects at the site-specific level would be followed for resources associated with reasonably foreseeable environmental trends and planned actions. With consideration of these protections, potential effects on paleontological resources of scientific interest would be avoided or mitigated.

AIB-11 Fluid Minerals

How would future potential development of the nominated lease parcels affect fluid minerals and energy production?

There are currently 2,362,024.14 acres leased within the BLM PDO. Current annual production within the analysis area is estimated to be 363,847,626 bbl of oil and 1,411,539,112 mcf of gas (NMOCD 2020b). Reasonably foreseeable environmental trends and planned actions (which includes the RFD scenario) would result in potential for development of 16,000 wells in addition to other mineral development.

Development of all 16,000 wells would produce 1,817,700,000 bbl of oil and 6,981,800,000 thousand cubic feet (mcf) of gas over 20 years. As with the future potential development of the nominated lease parcels, development of the RFD scenario is consistent with laws mandating development of mineral resources on public lands. Oil and gas development associated with reasonably foreseeable environmental trends and planned actions, including development of the nominated lease parcels, is consistent with various laws, including FLPMA (43 United States Code [USC] Section 1701 et seq.), that mandate that the BLM administer for the exploration and development of these mineral resources on public lands for the benefit of the citizens of the United States.

Future potential development of the nominated lease parcels would include 22.5 acres of surface disturbance and would add 520.8 acres (a 0.003% increase) to the total amount of the 20 million-acre PDO analysis area that is leased. The total future estimated production from the nominated lease parcels is 840,000 bbl of oil and 4,898,000 mcf of gas (see Table 3.1) and would contribute an additional 0.23% oil and 0.35% gas production within the analysis area. Future potential development of the nominated lease parcels would comprise 0.009% of all past and reasonably foreseeable future oil and gas development (57,000 wells) and depending on the success of oil and gas well drilling, non-renewable natural gas and/or oil would be extracted and delivered to market. Four of the nominated lease parcels contain oil and gas wells: parcel 407 contains six oil and/or gas wells, parcels 408 and 409 contain one oil or gas well each, and parcel 410 contains two oil and/or gas wells. However, none of the aforementioned oil and/or gas wells are currently active.

AIB-12 Potash, Solid, and Leasable Minerals

How would future potential development of the nominated lease parcels impact solid and other leasable minerals, such as potash?

Potash resources in southeast New Mexico are located in an area governed by the rules of the Secretary of the Interior's 2012 Order dated December 4, 2012. This area is commonly called the Secretary's Potash Area (SOPA). The Secretary's 2012 Order was written to establish rules for concurrent operations in prospecting for, development of, and production of oil and gas and potash deposits owned by the United States within the designated Potash Area. The SOPA completely encompasses the Known Potash Leasing Area, which was established for the administration of potassium leasing. The SOPA is composed of four classifications respective to the density of core holes or geophysical inference: Measured Ore (Potash Enclave), Indicated Ore, Inferred Ore, and Barren of Potash Ore. Oil and gas development within Measured Ore (Potash Enclave) reserves would affect economical potash resources. Development in areas that are Indicated, or Inferred Ore may affect economical potash reserves or resources. Oil and gas development in areas that are barren of potash reserves would not affect economical potash reserves or resources.

Reasonably foreseeable environmental trends and planned actions (which includes the RFD scenario) would result in potential development of 16,000 wells over 20 years (Engler and Cather 2012, 2014; see Section 3.3) in addition to other mineral development. Of the 16,000 wells identified in the RFD scenario, five wells would be attributable to future potential development of the nominated lease parcels. This is 0.03% of the RFD scenario (see Section 3.3). While it is assumed that some portion of development associated with the RFD would occur in the SOPA, the five wells associated with the nominated lease parcels would occur outside the SOPA and not result in reductions of available potash resources Impacts of the RFD scenario would vary depending on the area of the SOPA in which the reasonably foreseeable future wells would be developed. Potential impacts would be examined at the site-specific development stage.

None of the nominated lease parcels are within the SOPA. The nearest nominated lease parcel to the boundary of the SOPA is nominated lease parcel 408, which is located 16.97 miles north of the SOPA. No solid or leasable mineral resources were identified within the nominated lease parcels; nominated lease parcel 407 is approximately 0.94 mile south of the Portable Number 5 Jal Active Mining open-pit mine (aggregate and/or caliche). Future potential development of these nominated lease parcels is not expected to interfere with operations of the open-pit mine, and these facilities would remain open for use.

AIB-13 Livestock Grazing

How would future potential development of the nominated lease parcels impact livestock grazing?

There are currently 8,727,888 acres of livestock grazing allotments (644 allotments) within the 20 million-acre PDO. Surface disturbance associated with reasonably foreseeable environmental trends and planned actions within the 20 million-acre PDO would involve vegetation removal and changes in forage conditions, altering the grazing availability for livestock, and alterations to existing range improvements are also possible. Consequently, this would be a long-term effect.

Reasonably foreseeable environmental trends and planned actions within the PDO would result in a total of 110,740 acres of new surface disturbance for a total of 427,740 acres of total landscape-level surface disturbance (see Table 3.2). Two nominated lease parcels (396 and 408) are located within grazing allotments (Table 3.7). The future potential development of these two nominated lease parcels would comprise approximately 9 acres (0.0002% of total landscape-level surface disturbance within the PDO). This surface disturbance may contribute to landscape-level variations in plant communities in which livestock grazing success is dependent on. None of the nominated lease parcels contain or are within 656 feet (200 m) of livestock watering wells (see AIB-1 for more information) or are within 656 feet (200 m) of livestock water tanks or troughs. Surface disturbance for future potential development of each nominated lease parcel would affect between 0.002% and 0.051% of the allotments.

Table 3.7. Grazing Allotments by Parcel

Grazing Allotment(s)	Parcel Number(s) (parcel acreage within grazing allotment)	Estimated Area of Surface Disturbance (acres)	Percent of Grazing Allotment that would be Disturbed
North Turkey Track No. 65075 256,178.83 acres	408 (320.8 acres)	4.5	0.002%
Tobosa Flats No. 76042 8,892.44 acres	396 (40 acres)	4.5	0.051%

Note: The analysis contained in this EA generally provides percentage contribution rounded to two decimal points. As such, percentages may not always sum to 100 due to rounding.

* Acreages contained in the table above were calculated using geographic information system (GIS) data sets for resources and parcels which may differ slightly from the acreages contained in the parcel acreage within grazing allotments. Difference in total acres between parcels can vary due to geoprocessing operations where slivers of area are created when two or more data sets intersect. Any inaccuracies are negligible and do not change the overall impact analysis conclusions presented in this EA.

The BLM's authority under standard lease terms and conditions would allow for the application of measures, including relocating wells up to 656 feet (200 m), to mitigate livestock grazing–related impacts. The reasonably foreseeable environmental trends and planned actions described in Section 3.3 provides a quantitative overview of these actions within PDO. These actions described in Section 3.3 would result in a cumulative loss of forage across the allotments within the analysis area. Proposed

vegetation treatments and reclamation projects would ultimately contribute to cumulatively long-term countervailing impacts as new forage for livestock grazing is made available through revegetation.

AIB-14 Recreation

How would future potential development of the nominated lease parcels affect dispersed public recreation?

Recreation activities within the 20 million-acre PDO include camping, hiking, hunting and shooting, fishing, nature viewing, sightseeing, horseback riding, mountain biking, and motorized recreation including off-highway travel (on existing maintained or primitive roads), and off-road travel (cross-country, off existing roads). Off-highway vehicle use has increased in popularity as more versatile vehicles have become affordable and available. Noted recreation attractions within the PDO include Carlsbad Caverns National Park (CCNP), which attract tourists from New Mexico and beyond.

Oil and gas–related and other surface disturbances have the potential to modify recreation opportunities and the recreation experience over the long term, primarily as a result of changes in the landscape (viewshed), soundscape (noise), habitat loss, and presence of oil and gas development–related activities (construction, traffic, etc.). Within the PDO, reasonably foreseeable environmental trends and planned actions would add to past and present disturbance, resulting in a total of 427,740 acres of surface disturbance over the next 20 years. This comprises 2.14% of the PDO. Some of the past impacts have been mitigated through vegetation restoration projects and surface reclamation of well pads, roads, and facility sites.

It is estimated that 22.5 acres would be disturbed as a result of future potential development of the nominated lease parcels (which comprises 0.005% of total landscape-level surface disturbance; see Table 3.2) associated with reasonably foreseeable environmental trends and planned actions. There are no Special Recreation Management Areas (SRMAs)[5] within any of the nominated lease parcels, however, nominated lease parcels 396 and 408 are within an Extensive Recreation Management Area (ERMA).[6] Management of recreation within ERMAs is commensurate with the management of other resources and resource uses. Future potential development of the nominated lease parcels would result in approximately 9 acres of surface disturbance within the ERMA (less than 0.0002% of the 4.5 million acres of public lands in the PDO available for dispersed recreation). Oil and gas development–related equipment and structures would be present in the areas of development. This disturbance is unlikely to change overall dispersed recreation opportunities or the experience of dispersed recreation within the ERMA because of the limited scale of the proposed development and the presence of substantial existing oil and gas development (see Table 3.1). There may be some small increases in access for dispersed recreation due to new roads.

The nearest nominated lease parcel (408) is 58.63 miles southeast of the boundary of CCNP, and 90.89 miles east of the boundary of Guadalupe Mountains National Park (GUMO). As such, future potential development of the nominated lease parcels is not expected to impact access, dispersed recreation, or noise for CCNP or GUMO beyond existing conditions. See AIB-16, AIB-17, and AIB-24 for more information regarding visual impacts and economic activity impacts to CCNP and recreation.

[5] The BLM's land use plans may designate SRMAs to provide specific for recreational opportunities, such as developing trailhead areas for hikers, mountain bikers, or off-road vehicle users (BLM 2020d).

[6] An ERMA is an area where recreation is unstructured and dispersed, and where minimal recreation-related investments are required. All BLM lands not designated as a SRMA are considered an ERMA in the 1997 Carlsbad Approved RMP, as amended (BLM 1997a) and Roswell Approved RMP (BLM 1997b). This does not apply to private or state lands.

The nominated lease parcels would comprise 520.8 acres of GMU 31 (which totals 5,340,536.21 acres). Hunting opportunities based on the NMDGF permit system and the supporting business section contributes to the economy within Eddy and Lea County. A 2014 analysis conducted for the NMDGF on the economic benefit of fishing, hunting, and trapping in 2013 (Southwick Associates 2014) reported a total of 5,679 and 3,022 hunters in Eddy and Lea Counties, respectively. Hunting activities were reported as resulting in 118 and 106 jobs and total hunter spending of approximately 11 and 9 million dollars within each county, respectively (Southwick Associates 2014). Future potential development of the nominated lease parcels is anticipated to impact approximately 22.5 acres (0.0004%) of GMU 31. Given the amount of the GMU present within the nominated lease parcels and that existing GMU-hunting opportunities and hunting-related economic benefits in Eddy and Lea Counties occur amidst a landscape of existing oil and gas development (41,006 existing wells and 317,000 acres of surface disturbance within the PDO; see Section 3.1), impacts to hunting opportunities and the hunting sector of the economy are not anticipated from future potential development of the lease parcels. Information on Game Management Units (GMUs) managed by the NMDGF are discussed in AIB-15.

AIB-15 General Wildlife and Game Species

How would future potential development of the nominated lease parcels affect wildlife, including game and non-game species?

The 20 million-acre BLM PDO contains populations of big-game species, including mule deer (*Odocoileus hemionus*) and pronghorn (*Antilocapra americana*), as well as a multitude of other non-game species. Carnivores include bobcat (*Lynx rufus*), coyote (*Canis latrans*), badger (*Meles meles*), swift fox (*Vulpes velox*), and striped skunk (*Mephitis mephitis*). Two upland game bird species, mourning dove (*Zenaida macroura*) and scaled quail (*Callipepla squamata*), are prevalent throughout the area as well. Disturbance from future potential development of the nominated lease parcels can result in the long-term loss of vegetation, burrows, and nests, and could also cause habitat loss and fragmentation and mortalities. Future potential development may also have effects on pronghorn and mule deer, such as in avoidance of areas within and near the nominated lease parcels. The BLM PDO also contains year-round habitat for big-game species including mule deer and pronghorn.

Reasonably foreseeable environmental trends and planned actions within the PDO would add to past and present disturbance, resulting in 427,740 acres of total landscape-level surface disturbance, which would impact wildlife habitat of varying levels. Past, present, and future vegetation restoration projects (outlined in Section 3.3), which include herbicide treatments and surface reclamation of well pads, roads, and caliche pits, have improved habitat availability for wildlife and big-game species. The aforementioned reclamation activities improve nesting cover for ground nesting birds, improve fawning habitat for pronghorn and mule deer, and restore proper hydrological functionality by increasing ground cover, slowing water movement across the surface, and increasing percolation where applicable. Migratory birds have also benefitted from the improved herbaceous cover associated with these vegetative treatments. It is assumed that future vegetative restoration will produce similar effects where they are implemented. Additionally, the BLM has installed many wildlife habitat improvements including numerous watering developments and playa enclosures within the analysis area since 1990. These habitat improvements have been implemented through the Habitat Stamp Program funding, which is generated through the sale of a $5.00 stamp or authorization associated with hunting and fishing licenses. The BLM has also funded many of these projects through their annual budget.

Overall, the landscape habitat fragmentation and human presence could be considered long-term effects for wildlife, and a potential exists for the decline in species numbers and/or use of the analysis area. Where implemented, restoration projects (outlined in Section 3.3.) would have countervailing impacts on

aggregate disturbance to wildlife habitat. Additionally, new wildlife watering developments and playa exclosures would have beneficial impacts related to water availability for wildlife species.

Surface disturbance associated with future potential development of the nominated lease parcels would result in approximately 22.5 acres of surface disturbance (0.0001% of the acreage in the approximately 20 million-acre PDO). Currently, there are no mapped migration corridors within the BLM PDO (NMDGF 2019). In accordance with SO 3362, the NMDGF has identified priority areas for further research within their New Mexico State Action Plan (NMDGF 2019), and these priority areas were based on big game units. The NMDGF is currently conducting research on movement routes and/or defined wintering areas for mule deer and pronghorn. In coordination with NMDGF, the BLM PDO is completing fence modification and grassland restoration efforts for pronghorn. The only mapped migration corridor in New Mexico is within the Farmington Field Office (reflected in the NMDGF New Mexico State Action Plan [NMDGF 2019]), which is outside of the analysis area (NMDGF 2019). Additionally, one special status bat species (see AIB-8) and non-listed species have the potential to occur within the nominated lease parcels due to suitable foraging habitat; these species are only active during crepuscular foraging periods. Additionally, stipulation SENM-S-39-CSU is applied entirely to nominated lease parcel 408 (see Appendices A and B) that may provide protection to general wildlife and game species.

GMUs are subdivisions used to manage big game species in the state. These GMUs are designated and mapped by the NMDGF and are readily available through its annual hunting proclamation and website (http://www.wildlife.state.nm.us/hunting/maps/big-game-unit-maps-pdfs/). The NMDGF has provided a set of guidelines that are useful to guide oil and gas development statewide. Specifically, these guidelines can be applied in areas where potential conflicts occur between development and the various wildlife species present (NMDGF 2007). The nominated lease parcels (520.8 acres collectively) are located within GMU 31 (5,340,513.08 acres). Future potential development of the nominated lease parcels is anticipated to affect approximately 22.5 acres (0.0004%) of GMU 31.

Pre-disturbance surveys would be required at the time of proposed lease development in accordance with standard terms and conditions of the lease. The surveys would analyze potential effects on game and non-game species habitat. Avoidance, minimization, and/or mitigation measures would also be determined at that time. The BLM has the authority under standard terms and conditions to attach COAs at the site-specific level to minimize adverse effects on resource values at the time operations are proposed. Examples of potential mitigation measures include design modifications to avoid or minimize effects to sensitive habitats; limiting the number of well pads under simultaneous construction; seasonal restrictions; limiting the number of proposed roads; reclaiming old and/or unnecessary roads; minimizing truck traffic; noise-buffering measures; pre-development surveys; or use of special construction techniques to minimize surface disturbance to sensitive areas.

AIB-16 Visual Resources

How would the visual landscape, including areas adjacent to Carlsbad Caverns National Park, be affected by future potential development of the nominated lease parcels?

Reasonably foreseeable environmental trends and planned actions within the 20 million-acre PDO would create surface disturbances and visual contrasts with the surrounding landscape and adversely contribute to the existing scenic quality effects on the analysis area's landscapes. The degree of effect would depend upon the location of proposed infrastructure relative to sensitive viewsheds and areas already highly modified in character. At the landscape level, vegetation rehabilitation efforts such as Restore New Mexico would continue, existing and active wells would be plugged and reclaimed to former visual condition, and a countervailing effect on visual resources would also occur. Visual resources on BLM lands are managed using four Visual Resource Management (VRM) classes: VRM Class I, II, III, and IV

(BLM 1986). Oil and gas development is not compatible with VRM Class I designated areas, is often not compatible with VRM Class II designated areas, is generally compatible with VRM Class III designated areas, and is compatible with VRM Class IV designated areas (BLM 1986).

The nominated lease parcels (520.8 acres collectively) are all located within VRM IV. Within this VRM class, the level of change to the characteristic landscape can be high (BLM 1986). These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the effect of these activities through careful location, minimal disturbance, and repeating the basic elements (BLM 1986).

Future potential development of the nominated lease parcels would result in approximately 22.5 acres (0.4% of total parcel acreage) of surface disturbance, and approximately five wells. This disturbance comprises 0.02% of new surface disturbance (110,740 acres) associated within the PDO, and 0.00001% of the total landscape-level surface disturbance (427,740 acres) associated with reasonably foreseeable environmental trends and planned actions within the PDO (see Table 3.3). The BLM PDO reviewed aerial photography and records of existing oil and gas development to evaluate the nature and extent of visual effects as a result of future potential development of the nominated lease parcels and found that the nominated lease parcels are adjacent to lands with a high degree of oil and gas development. Future potential development of an estimated five wells on the nominated lease parcels (1 well each) would lead to a new visual element and modification of the landscape, resulting in long-term visual impacts associated with the nominated parcels, however, this would be visually consistent with the surrounding landscape, which is already highly modified in character. The three nearest nominated lease parcels to CCNP and GUMO are approximately 60.95 miles northeast (parcel 408), 73.64 miles east (parcel 396), and 74.15 miles east of CCNP, and 92.22 miles northeast (parcel 408), 104.91 miles east (parcel 396), and 105.42 miles east of GUMO. Future potential development within these nominated lease parcels is not expected be visible from portions of CCNP or GUMO.

It is assumed that development of the nominated lease parcels could be visible from some or all of the residences located within proximity the nominated lease parcels and immediately adjacent areas (see AIB-25). The presence of oil and gas development–related equipment and structures on the nominated parcels is unlikely to change the visual landscape of adjacent surface because of the limited scale of the proposed development (see Table 3.2), and the presence of existing oil and gas development in adjacent and surrounding areas.

Standard terms and conditions allow the BLM to consider further mitigation for visual resources at the time of proposed lease development. Measures could include siting of well sites, roads, and associated infrastructure to follow the contour of the landform and mimicking the lines in vegetation to screen and hide locations. In addition, per Onshore Order 1 (OO1 – XII. Abandonment, B. Reclamation), interim reclamation (reclamation of surface disturbance not necessary for production) and final reclamation (reclamation following well plugging and abandonment) is required within 6 months of well completion and well plugging, respectively.

AIB-17 Night Skies at Carlsbad Caverns National Park

How would future potential development of the lease parcels affect the quality of night skies at the Carlsbad Caverns National Park?

The darkness of the night sky is a valuable aspect of CCNP. Those who visit the park often seek an experience of solitude and the wilderness experience that dark night skies provide. Sky glow is the result of scattered artificial light in the atmosphere; it raises night sky luminance and creates the most visible negative effect of light pollution. The Sky Quality Index (SQI) is an index of light pollution from sky

glow with a range of 0 to 100, where 100 is a sky free from artificial sky glow. Using the best available data, the National Park Service's (NPS's) Night Sky Monitoring Reports from 2008 indicate the SQI for the CCNP monitoring station within CCNP is between 89 and 91 (NPS 2016a). These values show that skies in the analysis area retain their natural characteristics throughout most of the sky. The SQI data have limitations that "bright unshielded lights in the land portion of the mosaic will not be accurately measured for two reasons: they commonly are so bright their recorded luminescence exceeds the dynamic range of the detector so they become clipped or saturated at the maximum ADU value, and the median filter will remove most of the light from these sources since they resemble stars or point sources" (NPS 2016a). The limitations of the SQI data indicate that point source lights from oil and gas development may not be completely accounted for.

The main sources of sky glow in the analysis area are the following: the communities of Artesia, Carlsbad, Roswell, Dexter, Hagerman, and Hobbs; artificial lighting associated with areas of consolidated oil and gas development (particularly at Loco Hills); and infrastructure lighting, flaring, and traffic. At present, there are approximately 41,006 active well bores of all well types in the PDO (BLM 2021a). Surface disturbance associated with reasonably foreseeable environmental trends and planned actions within the PDO (110,740 acres of new surface disturbance, for a total of 427,740 acres of total landscape-level surface disturbance) would likely contribute to sky glow over the long term with an incremental increase as wells are developed. Past and reasonably foreseeable environmental trends and planned actions would result in a total of 57,006 wells. While NPS monitoring data indicate that dark sky conditions in the area currently retain their natural characteristics, SQI ratings could be affected by sky glow associated with community and urban growth, as well as up to 16,000 wells over 20 years associated with reasonably foreseeable environmental trends and planned actions.

Future potential development of the nominated lease parcels would result in 22.5 acres of surface disturbance and five wells, which would represent 0.009% of the 57,006 wells associated with past and reasonably foreseeable environmental trends and planned actions (see Table 3.2). Future potential development of the nominated lease parcels could introduce additional artificial lighting that would contribute to sky glow over the short and long term. The degree to which artificial lighting contributes to sky glow would be generally temporary and transient in nature and would vary based on conditions such as cloud cover, weather, and wind speed or direction. For example, most artificial lighting would be short term and would occur during the drilling, completion, and potential flaring of a well, which could last for approximately 30 to 60 days. Long-term lighting from oil and gas development and production include those associated with vehicle traffic as well as safety lighting required at night. There is wide variability in both type of lighting and potential impacts of that lighting on night skies that are dependent on environmental factors best understood at the site-specific development stage. Because site-specific information such as the average number of lumens per well or proposed lighting plans for each proposed development is not known at the leasing stage, the number of proposed wells and anticipated new surface disturbance is used as the proxy for determining the change in oil and gas-related lighting from existing conditions (currently estimated at 41,006 active wells and 317,000 acres of related surface disturbance; see Section 3.1). Given that the NPS reports that the primary sources that contribute to an increase in night sky effects (sky glow) are cities (NPS 2016b), contributions to sky glow from future potential development of the nominated lease parcels would be a small contribution to the existing sources (a 0.01% increase over current number of wells and a 0.007% increase in oil and gas–related surface disturbance). Parcel 408 is 60.95 miles northeast of, and most proximal to, the CCNP monitoring site and is 58.98 miles northeast of the CCNP park boundary (NPS 2016a).

Under standard terms and conditions, the BLM has the authority to require mitigation measures to reasonably reduce resource effects at the lease development level. The BLM may require mitigation measures that specify flare shields, the type of lighting (limited to downcast lighting with covers for safety purposes only), and project alignment.

AIB-18 Air Quality Related Values at Carlsbad Caverns National Park

How would future potential development of the nominated lease parcels affect air quality related values (visibility and deposition) at CCNP?

The analysis for this issue examines the Class I areas within the BLM CFO planning area. This area was chosen because these areas are afforded a higher level of protection under the Clean Air Act (CAA). The analysis considers oil and gas development within the CFO planning area as well as other sources outside of the planning area that might affect these Class I Air Quality Related Values (AQRVs).

AQRVs are resources sensitive to air quality and can include a wide variety of atmospheric chemistry–related indicators. Monitoring and modeling of AQRVs help to provide a level of protection to sensitive areas such as Class I park and wilderness areas. For purposes of this analysis, the following AQRVs have been considered: visibility, nitrogen deposition, and sulfur deposition.

Congress established certain national parks and wilderness areas as mandatory Class I areas where only a small amount of air quality degradation is allowed. Defined by the CAA, Class I areas include national parks greater than 6,000 acres, wilderness areas and national memorial parks greater than 5,000 acres, and international parks. These areas must have been in existence at the time the CAA was passed by Congress in August 1977. There are three Class I areas in or near the analysis area: CCNP, GUMO, and Salt Creek Wilderness. The most closely watched Class I areas near the analysis area are CCNP and GUMO. GUMO has monitoring data representative of the CCNP. The NPS is responsible for managing the CCNP and the GUMO. The three nearest nominated lease parcels are 60.95 miles northeast (parcel 408), 73.64 miles east (parcel 396), and 74.15 miles east of CCNP, and 92.22 miles northeast (parcel 408), 104.91 miles east (parcel 396), and 105.42 miles east of GUMO.

Visibility[7] modeling was performed using the BLM CFO RFD potential oil and gas well development scenario and with mitigation using EPA's on-the-books emission controls and additional management controls. This analysis tiers to the modeling that was performed in the Air Resources Technical Support Document (ARTSD) (URS Group Inc. [URS] 2013) for the BLM CFO for results of visibility impairment, indicating that, for the Carlsbad region, visibility effects on CCNP at the project level are minimal and not expected to be of concern (Engler and Cather 2012, 2014; URS 2013). The visibility screening analysis followed the recommendations in the Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report – Revised Guidelines (FLAG 2010). The analysis relies on a 0.5 and 1.0 delta-deciview (change in visibility) threshold, calculated for base year 2008, base case 2017, and future RFD years. Non-project, aggregate emissions are driving the overall visibility effects. A refinement of the aggregate emissions would reduce the number of days of total visibility effects and would likely be closer to baseline and future visibility effects. Any refinement down to a smaller scope of development or project-specific level would likely reduce the number of days of total visibility effects that would be likely, closer to matching actual base and future visibility effects/baseline conditions (URS 2013). Further refinement of the URS 2013 visibility modeled results was performed to show relative effects. The results indicate that there are no days in which the threshold is exceeded at the project level for the CCNP.

[7] Visibility impairment is a result of regional haze that is caused by the accumulation of pollutants from multiple sources in a region. Emissions from industrial and natural sources may undergo chemical changes in the atmosphere to form particles of a size that scatter or absorb light and result in reductions in visibility.

Deposition[8] modeling was performed using the BLM CFO RFD potential oil and gas well development scenario and with mitigation using EPA's on-the-books emission controls and additional management controls. Regional modeling was performed to determine the potential effects of emissions increases within the CFO RFD to nitrogen and sulfur deposition impairment at nearby federal Class I areas (Engler and Cather 2012; URS 2013). To assess potential nitrogen and sulfur deposition effects in the planning area, deposition effects were compared with the NPS screening deposition analysis thresholds (DATs), which are defined as 0.005 kilogram per hectare per year (kg/ha/yr) in the western United States for both nitrogen and sulfur. A DAT is the additional amount of nitrogen or sulfur deposition within a Class I area below which estimated effects from a proposed new or modified source are considered to be insignificant. The DAT is a screening threshold that was developed primarily to assess effects from a single stationary source (FLAG 2008, 2010). Modeling results showing deposition greater than a DAT do not strictly indicate the need for mitigation. If a DAT is exceeded, modeling may be required to demonstrate that deposition is below the level of concern (LOC). The LOC is the rate of deposition below which there are believed to be no adverse effects. The LOC for the nitrogen and sulfur deposition values, defined by the NPS and U.S. Forest Service, are 3 kg/ha/yr for nitrogen and 5 kg/ha/yr for sulfur (Fox et al. 1989). Results of analysis showed that the maximum annual nitrogen DAT at the RFD level was exceeded for CCNP but may be below the LOC at specific receptors. The contribution of CFO RFD development was found to be below the LOC for nitrogen of 3 kg/ha/yr for CCNP (URS 2013). Based on modeled contributions from the CFO RFD development, the maximum modeled effects to sulfur deposition were below the DAT and LOC thresholds for CCNP. It is important to note that the nitrogen and sulfur deposition benchmarks that have recently been established by the NPS for CCNP are lower than the LOC values noted in the ARTSD. To maintain the highest level of protection, the maximum of the 5-year average range (2013–2017) is used to set the benchmark. Normally, the most recently available 2017 values of 1.9 kg/ha/yr for nitrogen and 1.1 kg/ha/yr for sulfur would indicate fair condition. However, the condition has been reduced to poor because the ecosystems at CCNP may be more sensitive to acidification effects relative to other ecosystems (NPS 2019).

Modeling to determine effects to deposition at Class I areas is included in the ARTSD (URS 2013). To assess potential effects to AQRVs, the air quality assessment considers emissions and potential impacts of expected growth oil and gas development for nearby oil and gas basins as well as the Permian Basin, including the Raton Basin, San Juan Basin, Denver-Julesburg Basin, White River Field Office, Colorado River Valley Field Office, Utah Vernal Field Office, and Oklahoma, Kansas, and Texas Oil and Gas Basins (URS 2013). Appendix R and Appendix S of the ARTSD provide detailed nitrogen and sulfur deposition results (URS 2013), which model results above for the LOC for CCNP. It should be noted that for a large aggregate project that includes thousands of sources (such as oil and gas development in the BLM CFO), deposition greater than the DAT as well as LOC is typical based on the uncertainty in the model parameters, and more refined modeling studies are often required to better understand potential effects. Future potential development of the lease parcels could result in degradation of air quality related to nitrogen deposition, depending on the number of sources present during development and any mitigation applied. Appropriate mitigation would be determined following further analysis at the site-specific APD stage that allows for refined modeling analysis (as appropriate), which incorporates project-specific information that is not available at the leasing stage.

[8] Deposition of pollutants through direct or dry atmospheric transport and precipitation can result in acidification of water and soil resources in areas far removed from the source of the pollution, as well as in harm to terrestrial and aquatic species. The Acid Rain Program has resulted in greatly reduced levels of the most damaging pollutants. There are currently four wet deposition monitors in New Mexico: Gila Cliff Dwellings, Mayhill, Bandelier National Monument, and Capulin Volcano National Monument. Deposition data for nitrogen and sulfur deposition can be accessed through the National Atmospheric Deposition Program (NADP) website (NADP 2019).

For instance, as part of a master development plan for development of 436 oil and gas wells on more than 106 well pads, Chevron conducted additional analysis extending the URS (2013) modeling that was performed in support of the CFO RMP effort. The refined emission inventory for the modeling study reflected emission control measures implemented by the applicant to reduce nitrogen oxide(s) (NO_x) emissions in the project area. The results of acid deposition monitoring showed incremental exceedances of the nitrogen DAT of 0.005 kg/ha/yr in the CCNP would occur during drilling operations but would be well below the DAT once drilling is completed (BLM 2016). Similar results of AQRVs can be expected for other large well development projects in the CFO. With consideration of these project-specific modeling results, future potential development of the proposed lease (two wells) would not be expected to show exceedances of the nitrogen DAT and, therefore, would not be likely to contribute significantly to degradation of deposition benchmark values at CCNP.

In addition, various regulations to protect Class I areas from effects to AQRV degradation have been promulgated. A further summary of the regulations meant to protect AQRVs at Class I areas is discussed in Section 3.6.1.1.

AIB-19 Cultural Resources

How would future potential development of the nominated lease parcels affect cultural resources?

There are 427,740 acres of surface disturbance associated with reasonably foreseeable environmental trends and planned actions within the PDO. Surface disturbance associated with reasonably foreseeable environmental trends and planned actions within the PDO would likely impact cultural resources. Such impacts may include, but are not limited to, loss of or damage to cultural resources or contextual information (such as redistribution of cultural resources) due to the development of oil and gas facilities and related industrial development, increased vehicular traffic, unauthorized ground disturbances, inadvertent oil and produced water spills, erosion, unauthorized collection, and new audible and visual impacts. The magnitude of impacts associated with reasonably foreseeable environmental trends and planned actions would generally depend upon the location of reasonably foreseeable development relative to the location of cultural resources and the degree to which the setting has already been affected. Effects from reasonably foreseeable development on federal lands or with a federal nexus would require separate National Historic Preservation Act (NHPA) processes to avoid, minimize, and/or mitigate effects on cultural resources.

The BLM CFO and RFO conducted reviews of the New Mexico Cultural Resource Information System (NMCRIS), internal BLM data sources, and General Land Office record for the lease parcels to identify historic properties, traditional cultural properties (TCPs), sacred sites, and traditional use areas within the area of potential effects (APE) for the lease sale. The APE for physical effects is the physical footprint of the proposed lease parcel boundaries (520.8 acres collectively). This is to account for any potential development that may occur within the parcels at the APD stage. The proposed undertaking will not authorize any ground-disturbing activities; therefore, the APE for audible and visual effects is the same as the physical effects APE.

Approximately 10.51 acres (5.0%) of the 200 acres of the nominated lease parcels within the CFO have been previously surveyed for cultural resources. The records search identified no cultural resources within the nominated lease parcel APE. However, three cultural resources are located within a 0.25-mile radius of the nominated parcels within the CFO. All three cultural resources were determined not eligible for listing to the National Register of Historic Places (NRHP). Approximately 22.48 acres (7.0%) of the 320.8 acres of the nominated lease parcel in the RFO have been previously surveyed for cultural resources. The review found no previously recorded cultural resources documented within the nominated lease parcel in the RFO; however, a historic road and windmill are depicted on the 1951 King Camp map.

These historic-age features are also visible on current satellite imagery. The historic road still exists today and is currently in use for mineral extraction and ranching activities. The probability of discovering previously unrecorded historic properties in this area is high. There are no known TCPs within or near the proposed parcels within the PDO.

Due to low archaeological survey coverage and minimal overall ground disturbance from development within the nominated lease parcels (a total of 5 wells and 22.5 acres of new surface disturbance), there is potential for identifying previously unrecorded sites. However, the nominated lease parcels would be subject to additional cultural resource analysis through NEPA and Section 106 of the NHPA.

The nominated lease parcels assessed within this EA have been assigned the National WO-NHPA Lease Stipulation, which requires additional cultural resources analyses pursuant to Section 106 of the NHPA, to include identification, effects assessment, consultation, and if necessary, resolution of adverse effects, prior to the authorization of any ground-disturbing activities associated with the oil and gas lease. Additionally, the nominated lease parcels assessed within this EA has also been assigned Lease Notice NM-11-LN, which requires compliance with Section 106 of the NHPA and Executive Order 13007 (see Appendix B). In effect, this lease notice notifies lessees that the BLM could require intensive cultural resource inventories, Native American consultation, and mitigation measures to avoid adverse effects—the costs for which would be borne by the lessee—and that the BLM may require modifications to or fail to authorize activities that are likely to adversely affect TCPs or sacred sites for which no mitigation measures are possible. Such measures could include the development of COAs to protect cultural resources. The BLM would work with consulting parties, including any Tribes or Pueblos that might attach religious, and cultural significance to properties within the area of potential effects, to identify additional historic properties when an APD is received and may develop COAs to mitigate physical, audible, or visual impacts to sensitive cultural resources. The processing of lease development applications constitute separate undertakings that would be analyzed through the NHPA Section 106 process at that time.

Because the proposed oil and gas lease sale does not directly authorize ground disturbance and future oil and gas development would constitute a new undertaking that would require a separate analysis under Section 106 of the NHPA, the CFO and RFO cultural heritage resources specialists determined that there would be *no adverse effect* to historic properties as defined in 36 CFR 800.5(b) as a result of the proposed lease sale. Additionally, the CFO and RFO sent letters notifying the New Mexico State Historic Preservation Office (SHPO) of their intent to use the State Protocol Appendix C.I.a. on October 21, 2020, and November 11, 2021, respectively (i.e., during the BLM PDO April 2021 Competitive Oil and Gas Lease Sale planning process), and again on September 8, 2021, and MONTH DAY, 2021 as part of the BLM PDO Quarter 1 2022 Competitive Oil and Gas Lease Sale planning process. Please refer to Section 4.3 for additional details.

AIB-20 Native American Concerns

How would future potential development on the nominated lease parcels impact Native American traditional cultural and religious concerns?

There are 427,740 acres of surface disturbance associated with reasonably foreseeable environmental trends and planned actions within the PDO. Surface disturbance associated with reasonably foreseeable environmental trends and planned oil and gas operations within the PDO have the potential to adversely impact traditional cultural and religious properties located within the vicinity. Such impacts may include, but are not limited to, temporary or long-term loss of or damage to Native American religious use or gathering areas, or loss of access to these areas due to the development of oil and gas facilities and related industrial development, increased vehicular traffic, unauthorized ground disturbances, inadvertent oil and

produced water spills, or erosion. The magnitude of impacts associated with reasonably foreseeable environmental trends and planned actions would generally depend upon the location of reasonably foreseeable development relative to areas of concern to Native American Tribes. Reasonably foreseeable development on federal lands or with a federal nexus would undergo the same type of consultation process discussed above. In addition, the BLM could apply COAs to protect such properties, which may affect or limit oil and gas development. Through tribal consultation, such measures may include COAs to mitigate audible and visual impacts to sensitive TCPs. The processing of lease development applications is a separate undertaking that would be analyzed through the Section 106 process at that time, as directed in law, regulation and policy, including the use of the PBPA (as applicable).

As described in Section 1.1of this EA, the five nominated lease parcels were originally nominated for auction in the BLM PDO April 2021 Competitive Oil and Gas Lease Sale. As part of that planning process, the BLM CFO and RFO initiated government-to-government consultation under NEPA and NHPA on September 16, 2020, and October 13, 2020, respectively, with the Apache Tribe of Oklahoma, Comanche Nation, Hopi Tribe, Kiowa Tribe of Oklahoma, Mescalero Apache Tribe, Pueblo of Isleta, and Ysleta del Sur Pueblo. No specific Native American traditional cultural and religious concerns have been identified on the subject lease parcels. The BLM CFO and RFO re-initiated government-to-government consultation under NEPA and NHPA for the same leases as part of the BLM PDO Quarter 1 2022 Competitive Oil and Gas Lease Sale planning process on September 8, 2021, and MONTH DAY, 2021, with the same tribes. No specific Native American traditional cultural and religious concerns have been identified on the subject lease parcels; however, this consultation is considered ongoing. If the nominated parcels are leased, future potential development would go through separate NEPA and NHPA processes as directed by regulation and current policy.

AIB-21 Cave and Karst

How would the future potential development of the nominated lease parcels affect cave and karst resources?

Karst is a landscape produced by the dissolution of soluble rock types such as limestone, dolomite, marble, gypsum, or salt. Features associated with karst terrains include sinkholes or closed depressions, caves, dry valleys, sinking streams, and resurgences or springs. Sinkholes leading to underground voids and drainages are common. These features, as well as fissures and discontinuities in the bedrock, may serve as direct conduits leading to groundwater. Thus, surface, and subsurface contaminants have the potential to be quickly transported into subterranean water systems and freshwater aquifers without filtration as a result of the development of oil and gas lease parcels. In addition, contaminants spilled or leaked into or onto karst zone surfaces and sub-surfaces may lead to the disruption and displacement of cave species and critical biological processes. Changes in geologic formation integrity, runoff quantity/quality, drainage course, rainfall percolation factors, vegetation, surface contour, and other surface factors can negatively impact cave ecosystems and aquifer recharge processes. Heavy vibrations and focusing of surface drainages can lead to slow subsidence, collapse of subsurface voids, and/or cave ecosystem damage. The BLM categorizes all areas within the PDO as having either low, medium, or high karst potential occurrence based on geology, occurrence of known caves, and density of known karst features (BLM 1997a, 2018b). Effects to cave and karst resources would depend on the locations of proposed disturbance relative to existing subsurface cave and/or karst features as described above.

Effects from reasonably foreseeable environmental trends and planned actions are anticipated to be the same as the effects documented above. Reasonably foreseeable environmental trends and planned actions would result in a total of 427,740 acres of total landscape-level surface disturbance, of which future potential development of the nominated lease parcels would comprise approximately 22.5 acres (0.002% of total landscape-level surface disturbance; see Table 3.2).

Four of the nominated lease parcels (396, 407, 409, and 410) are located within the CFO's mapped low cave potential zone. Nominated lease parcel 408 is within RFO's mapped medium (50%) and high (50%) karst potential zones (BLM 2020b). Generally, the karst features in the area proximal to Parcel 408 are overlain by Piedmont alluvial deposits, therefore karst features are not generally observed on the surface but may be occur within subsurface formations (BLM 2020c). There are known karst features within a two-mile radius of this parcel (BLM 2020b). Lease notice SENM-LN-1 has been applied to nominated lease parcel 408 for potential cave or karst occurrent areas (see Appendices A and B). Additionally, stipulation SENM-S-39-CSU is applied to parcel 408 (see Appendices A and B), which requires a POD prior to development, and may also provide protections to cave and karst resources.

While there is a low likelihood of encountering karst features within the low karst occurrence zone, past oil and gas development in high and medium karst occurrence zones have resulted in the intersection of subterranean voids during construction, resulting in damage to equipment, loss of infrastructure, bit drops, and losses of drilling medium and cement during drilling and casing, respectively. Losses of circulation during drilling and cementing introduces foreign materials into the subterranean environment, while the opening of subterranean voids could change airflow patterns within a cave system that negatively impact the cave ecosystem and compromise the structural integrity of the cave passage. In the past year, the BLM CFO has received eight reports of subsurface voids opening during construction (power line, pipeline, and facility pad) and exploration activities (two seismic surveys) in areas where there were no previously known sinkholes or caves. None of these events resulted in reported contamination events of groundwater and the features impacted did not meet the criteria of a "significant cave;" thus, development remained in conformance with the Cave Resource Protection Act of 1988, and attendant regulations.

All future potential development within medium and high karst occurrence zones on the nominated lease parcels would be further reviewed and mitigated at the time of proposed lease development, or during other proposed ground-disturbing activities, per standard terms and conditions of the lease. While several mitigation measures can be implemented to mitigate many impacts, it is still possible for impacts to occur from containment failures, well blowouts, accidents, spills, and structural collapses. It is therefore necessary to implement long-term monitoring studies to determine if current mitigation measures are sufficient to prevent long-term or short-term impacts on cave/karst resources. Mitigation measures could include changes in drilling operations, special casing and cementing programs, installation of leak detection and automatic shut-off systems, and modifications in surface activities. A complete list of mitigation measures can be found in Appendix 3, Practices for Oil and Gas Drilling and Production in Cave and Karst Areas, within the Carlsbad RMP (BLM 1997a). Therefore, although cave/karst resources may experience impacts, the degree and extent of impacts are not expected to exceed a threshold of significance and the Proposed Action is expected to remain in conformance with the Cave Resource Protection Act of 1988, and attendant regulations.

AIB-22 Playas

How would future potential development of the parcels affect function of playa features in these locations?

Playas are relatively small, round, shallow depressions. Their basins are lined with clay soil, which collects and holds water from rainfall and runoff, creating temporary lakes. Properly functioning playas have intact clay basins, are encompassed by grassy buffer strips or prairie, and collect water runoff from the surrounding area after large rain events. Despite their small size and relatively simple structure, playas are relevant to the landscape because they provide important ecological and hydrological functions. In the 20 million-acre PDO, playas are the main source of water and are the center of biodiversity on the plains—supporting 185 bird species, 450 plant species, 13 amphibian species, and 37 mammal species at some point in their life cycle (Smith 2003); playas are also a water source for migratory and wintering

shorebirds, waterfowl, and other game and nongame wildlife, and contribute to groundwater recharge. Past development in southeast New Mexico has resulted in disturbance to one-third of wetlands (Fretwell et al. 1996).

Culturally accelerated dust and sediment accumulation, which is the result of increased transport of dust and sediments from the upland through airborne particles and water erosion, could degrade function of the playa features. Land disturbances near a playa exacerbate the accelerated sedimentation problem: 1) through movement of sediments into the playa basin, and 2) through mixing of sediments with the underlying clay layer. The additional sediments may interfere with the shrinking and swelling of the clay layer, which is vital to aquifer recharge, and reduce playa volume, which in turn decreases the hydroperiod. (i.e., the length of time and portion of the year the playa holds ponded water). Hydroperiod reduction greatly alters the plant and wildlife community supported by the playa (LaGrange et al. 2011). Oil and gas operations could result in land disturbance within the drainage basin that would introduce sediments through erosion from heavy rains or wind. Additional sediments can fill the playa, preventing water from pooling and reducing the capacity of the playa to recharge an aquifer (Gurdak and Roe 2009). Spills can occur as a result of development (see Water Support Document [BLM 2020a] for discussion of spills) resulting in degraded playa function. There are no methods for remediation that would not disrupt the hydrologic connectivity, natural hydrology, and benefits that playas provide to wildlife within the planning area. Surface disturbance associated with reasonably foreseeable environmental trends and planned actions within the PDO (427,740 acres of surface disturbance) would likely occur in leases that include or are in close proximity to playas.

Based on desktop aerial photography, the USGS NHD (USGS 2019b), FEMA floodplain data (FEMA 2021), USFWS NWI data (USFWS 2017), and internal communication with the BLM PDO interdisciplinary team, 408 contains 5.41 acres of potential playa features (1.68% of the 320.8-acre parcel). Playas have also been identified within 656 feet (200 m) of the boundary of this parcel. Stipulation SENM-S-19, which provides protections to playas and does not allow surface disturbance within 200 m of these areas, has been applied to nominated lease parcel 408 (see Table 2.1 and Appendix B). The BLM also has the authority under standard terms and conditions to attach COAs at the site-specific level to minimize adverse effects on resource values at the time operations are proposed. Standard terms and conditions would allow for measures to avoid and mitigate accelerated soil erosion and sedimentation to water bodies. With consideration of standard terms and conditions, stipulation SENM-S-19, and COAs as determined by the BLM Authorized Officer, all permanent effects from surface occupancy to any playa features identified at the site-specific level would be avoided.

AIB-23 Human Health and Safety

How would future potential development of the nominated lease parcels contribute risks to human health and safety?

Within the 20 million-acre PDO, there are 41,006 existing active well bores of all well types across all land jurisdictions (BLM 2021a). This level of development has resulted in the following public health and safety–related risks: occasional fire starts; spills of hazardous materials, hydrocarbons, produced water, or hydraulic fracturing fluid (see Appendix C) and corresponding potential contamination of air, soil, or water; traffic congestion and collisions from commercial vehicles and heavy use, especially south and east of Carlsbad along NM State Road 128 and U.S. Route 285; infrequent industrial accidents; presence of hydrogen sulfide (H_2S); or increased levels of fugitive dust (PM_{10} and $PM_{2.5}$), other criteria pollutants, VOCs, and hazardous air pollutants (HAPs).

While no formal human health risk assessments have been conducted specific to past and present development in the PDO, results of EPA's 2014 National Air Toxics Assessment (NATA) indicate that cancer, neurological risks, and respiratory risks in the analysis area are generally lower than national levels (EPA 2018; see Section 3.6.1.1). In addition to fugitive dust, see the air quality analysis in Section 3.6.1 for projected levels of criteria pollutants, HAPs, GHG emissions, and VOC and NO_x emissions that contribute to O_3 formation, as well as NAAQS. Human health risk assessments cannot be performed until project-specific details are known so that frequency, timing, and levels of contact with potential stressors may be identified (EPA 2021a). However, each of the reasonably foreseeable environmental trends and planned actions have been, or will be, subject to relevant rules and regulations regarding public health and safety. Ongoing and future potential development would continue to present aggregate risks to human health as detailed above. When wells reach the end of their useful life and are properly plugged and reclaimed, they would no longer contribute to these effects.

The U.S. Department of Energy's Waste Isolation Pilot Plant (WIPP) fenced property boundary is approximately 37.24 miles southwest of the nearest nominated lease parcel (407). Given this distance, no impacts to the WIPP are expected from future potential development of the nominated lease parcels. The WIPP is insulated by a 16-section minerals withdrawal. The waste storage area is in the center of the withdrawal, and waste is encapsulated prior to transport and storage. In most areas around the WIPP, oil and gas wells would not directionally drill beneath the WIPP, as minerals are withdrawn in this area. On the southwest corner of the WIPP, existing oil and gas leases are located in areas where minerals have not been withdrawn and hydraulic fracturing has taken place within the WIPP boundary. The WIPP has multiple seismicity, waterflow, and air monitors on-site to detect adverse impacts related to oil and gas development near the WIPP, and no impacts have been detected. Additionally, the salt beds in which the WIPP is located are tied to existing potash mining, and lease parcels are buffered to ensure future potential development of the nominated lease parcels does not interfere with existing potash mining, which indirectly protects the WIPP. Finally, the BLM is required to notify the WIPP if an oil and gas well is to be located within 1 mile of the WIPP boundary and coordinate application of COAs. As a result of these protective measures, no impacts to the WIPP are expected from the Proposed Action.

Future potential development on the nominated lease parcels is estimated to be five new wells for this lease sale. This is a 0.012% increase in addition to the 41,006 existing active wells. When authorizing development, federal and state laws, regulations, and policy are applied to reduce effects or respond to incidents. These include the following:

- Federal, state, county, and municipal fire managers shall coordinate on fire response and mitigation.
- Developers who install and operate oil and gas wells, facilities, and pipelines are responsible for complying with the applicable laws and regulations governing hazardous materials and for following all hazardous spill response plans and stipulations. The NMOCD requires similar spill response measures after release of hydrocarbons, produced water, or hydraulic fracturing fluids (see the Water Support Document [BLM 2020a] for further information on spills).
- All well pads, vehicles, and other workplaces must comply with worker safety laws as stipulated by the Occupational Safety and Health Administration (OSHA).
- Vehicular traffic and pipelines are regulated according to safety laws as stipulated by the Department of Transportation.
- Measures to lower risks related to H_2S exposure include flaring or venting gas and the use of stock tank vapor recovery systems.

Fugitive dust is concentrated in the short term during construction but may occur to a lesser degree in the long term due to increased vehicle use and ground disturbance. In addition to fugitive dust, see the air quality analysis in Section 3.6.1 for potential health effects of other air pollutants, including criteria pollutants, VOCs, and HAPs. See AIB-1 and AIB-2 for further information regarding potential surface and groundwater effects and relevant regulations, stipulations, and lease notices offering protections to groundwater and surface water quality.

AIB-24 Economic Activity

What are the potential effects from oil and gas leasing and future potential development on economic activity?

The oil and gas industry has been a substantial contributor to the social setting and economic basis of the BLM PDO for decades. The oil and gas sector of the economy relies on both ongoing operational activities (development of existing leases) and new development opportunities (acquisition and development of new leases) to continue to provide local and regional jobs and revenue on a sustained basis. In the 20 million-acre PDO, there are approximately 7.6 million acres of federal mineral estate. Overall development of federal fluid minerals comprises approximately 38% of total oil and gas development activities in the PDO.

While the act of leasing federal minerals itself would not result in social effects, subsequent development of a lease may generate impacts on communities and individuals in the vicinity of the lease. At the lease sale stage, it is unknown where, or if, development would occur in any given nominated lease parcels; however, in general, acquisition and development of new leases provide short-term local and regional jobs and long-term revenue on a sustained basis. These may include employment opportunities related to the oil and gas and service support industries in the region, as well as federal, state, and county government revenue related to taxes, royalty payments, and other revenue streams. For example, the revenue collected from the lease sale auction is split between the U.S. Treasury and the state in which the auction is held and can be used for improvements to transportation networks and education systems. As specific types and locations of development are proposed, their effects would be analyzed and addressed at the time of proposed lease development.

Oil and gas lease sales may contribute to employment for area residents, continued demand for oil and gas industry–related goods and services, and continued demand for support goods and services. This continued demand may contribute to stability in employment in sectors outside of the oil and gas industry. To the extent that additional oil and gas development affect recreational and tourism opportunities in the area of the nominated lease parcels, there may be related effects in these economic sectors. Continued expansion of the oil and gas industry may be perceived as having a negative effect on quality-of-life considerations for people who value undeveloped landscapes, opportunities for isolation, and activities such as wildlife viewing and cattle ranching. The BLM uses a number of stipulations and lease notices applied to the nominated lease parcels in the current sale that may mitigate potential effects on wildlife (see AIBs-7, 8, 9, and 15) and other resources that in turn may mitigate effects on related recreation (see AIB-14) and quality-of-life (see AIB-25) concerns (see Table 2.1 and Appendix B for specific stipulations and lease notices applied to the nominated lease parcels, and individual stipulation and lease notice summaries).

AIB-25 Quality of Life

How would future potential development of the nominated lease parcels affect quality of life and residences within and adjacent to the nominated lease parcels?

The 20 million-acre PDO contains 427,740 acres of total landscape-level surface disturbance associated with reasonably foreseeable environmental trends and planned actions (see Table 3.2), which includes activities that generate increased human activity, traffic, noise, dust, odor, light pollution, and visual effects (see summary of the phases of oil and gas development in Appendix C). All of these activities have potential to affect quality of life of nearby residences, depending on the intensity of development activities and proximity to residences. Collective effects from noise, dust, odor, and light disturbance associated with reasonably foreseeable environmental trends and planned actions would affect the quality of life for residence and livestock facilities within or adjacent to the parcels.

Future potential development of the nominated lease parcels would comprise approximately 22.5 acres of surface disturbance (0.005% of the total landscape-level surface disturbance associated with reasonably foreseeable environmental trends and planned actions) and five wells. Table 3.8 identifies residences nearest to the nominated lease parcels. While the majority of the effects to the nearest residences would be short term and would cease during operations (e.g., increased human activity, traffic, noise, dust, and odor during drilling and completion phases), the residences would continue to experience long-term visual or other effects that have potential to affect quality of life if they are located in areas in which oil and gas development is not currently nearby or visible.

Table 3.8. Residential Areas in and near the Nominated Lease Parcels

Parcel Number (total parcel acreage)	Parcel Distance and Direction to Nearest Residence*	Parcel Closest to Nearest Municipality	Discussion*
407 (40)	0.33 mile, northwest	Adjacent to the town of Jal, NM.	Lands west of parcel 407 are densely populated, mostly developed, and also include light industrial development. Lands to the north, south, and east are rural, sparsely populated, and primarily consist of moderately concentrated oil and gas development. Parcel 407 is 0.95 mile southwest of the Lea County-Jal Airport.
409 (40)	0.95 mile, north-northwest	1.24 miles east of the town of Jal, NM.	Lands surrounding nominated lease parcel 409 are rural, sparsely populated, and include moderately concentrated oil and gas development. Parcel 409 is 1.16 miles south of the Lea County-Jal Airport.
396 (40)	1.13 miles, northwest	1.54 miles southwest of the town of Bennett, NM.	Lands north, south, east, and west of nominated lease parcel 396 are rural, sparsely populated, and include sporadically concentrated oil and gas development.
410 (80)	1.22 miles, north	1.48 miles east of the town of Jal, NM.	Lands north, south, east, and west of nominated lease parcel 410 are rural, sparsely populated, and include moderately to sporadically concentrated oil and gas development. Parcel 410 is 1.46 miles south of the Lea County-Jal Airport.
408 (320.8)	8.45 miles, west-northwest	15.6 miles southeast of the town of Hagerman, NM.	Lands north, south, east, and west of nominated lease parcel 408 are rural, sparsely populated, and include moderately concentrated oil and gas development. Parcel 408 is 3.05 miles south of New Mexico State Road 126.

* Source: Google Earth (2021). For surface ownership of the parcels listed above, see Table 2.1 or Appendix A.

With consideration of total lease acreage, topography, and other resources issues present within the nominated lease parcels, there are opportunities for future potential development to reasonably be placed in portions of the nominated lease parcels that are less proximal to the residences to minimize quality of life issues. Under the authority granted in standard terms and conditions attached to each lease, measures to reduce effects on or avoid resource values, land uses, or users would be attached as COAs to the APD. Site-specific avoidance, minimization, and/or mitigation measures would be determined at the time of proposed lease development. This could include measures to reduce noise, dust, odor, and light effects during construction and operations. As with reasonably foreseeable environmental trends and planned actions, effects to quality of life from these trends and actions would be examined at the APD level with consideration of site-specific locational information and development of COAs to reduce effect as needed.

AIB-26 Environmental Justice

What are the potential effects from oil and gas leasing and future potential development on environmental justice (EJ) populations?

Environmental Justice (EJ) 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 (CEQ 1997). Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* requires federal agencies to determine if proposed actions would have disproportionately high and adverse environmental impacts on minority, low-income, and American Indian populations of concern. BLM policy, as contained in BLM Land Use Planning Handbook H-1601-1 (BLM 2005) Appendix C, provides direction on how to fulfill agency responsibilities for Executive Order 12898.

The CEQ has developed guidance to assist federal agencies with their NEPA procedures so that EJ concerns are effectively identified and addressed. The guidance focuses on identifying communities of concern (e.g., minority and low-income populations) using census data. Low-income populations are defined as those living below the poverty threshold (see Federal Interagency Working Group on Environmental Justice and NEPA Committee 2016), as identified by the U.S. Census Bureau. Minority populations include the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic (CEQ 1997). A minority population is identified as a community of concern if either 1) the minority population of the area of analysis exceeds 50% of the population, or 2) the minority population percentage of the area of analysis is meaningfully greater than the minority or low-income population percentage in the general population or other appropriate unit of geographic analysis (CEQ 1997:25). 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” (CEQ 1997:26). The BLM generally defines “meaningfully greater” as 10 percentage points above the population size of the comparison geography. A low-income population is present everywhere where the percentage of the population in poverty is the same or greater than that of the reference area and therefore would be considered a community of concern (see Federal Interagency Working Group on Environmental Justice and NEPA Committee 2016).

The nominated lease parcels are located in Chaves and Lea Counties, New Mexico (see Table 2.1). Because socioeconomic and census data are typically available at the county level, population data for these counties is used as the area of analysis for identifying communities of concern. The State of New Mexico is then used as a comparison population for determining whether low-income or minority populations in Chaves and Lea Counties exceed the thresholds described by CEQ for consideration as communities of concern (Table 3.9).

Table 3.9. Minority and Low-Income Populations in Area of Analysis

	Analysis Area		
	Chaves County	**Lea County**	**New Mexico**
Total Population	65,1445	70,277	2,092,454
Minority Populations	**Percent of Minority Populations in Analysis Area**		
Hispanic or Latino (of any race)‡	56.7	58.7	49.3
Black or African American – one race	2.1	4.8	2.9
American Indian and Alaska Native – one race	2.5	1.6	10.8
Asian – one race	1.2	0.7	2.3
Native Hawaiian and Other Pacific Islander – one race	0.1	0.1	0.2
Some other race – one race	7.1	4.8	9.8
Two or more races	2.4	1.7	3.3
Total minority population	10.5	10.2	22.5
Poverty Prevalence	**Percent of Population Below Poverty Line in Analysis Area**		
All individuals below poverty line	19.4	15.8	19.1
Families below poverty line	15.0	12.4	14.5

Data Source: U.S. Census Bureau (2020).

‡ Hispanic refers to ethnicity and is derived from the total population, not as a separate race, i.e., it is calculated differently than the other columns in this table. Therefore, it is considered separately in this analysis.§ All individuals includes those below the poverty line, regardless of whether they are included as such due to being below the individual income or family income poverty line.

After examination of the most recently available data on minority and low-income populations for the area of analysis (U.S. Census Bureau 2020), the BLM has determined that there are communities of concern present in the analysis area. The communities of concern present include people of Hispanic or Latino origin for Chaves and Lea Counties, which comprises more than 50% of the county population and would therefore be considered a community of concern (U.S. Census Bureau 2020) (see Table 3.9). In addition, the population in poverty for Chaves County is greater than that of the State of New Mexico and therefore is also considered a community of concern.

While the determination of potential adverse and disproportionate effects from specific actions may initially be the assessment of the BLM. This assessment should not be assumed to be the position of specific, potentially affected communities of concern. The BLM realizes that additional adverse impacts may be identified by local communities as specific development locations and types are proposed. Therefore, identified communities of concern would be provided opportunities to identify any perceived adverse environmental impacts at the time of site-specific analysis during the APD stage. As a result, the following discussion assesses only the effects for the issues identified by the BLM during scoping. The BLM would continue to work with potentially affected communities of concern to identify and address additional EJ issues as they arise.

The federal government cannot dictate where oil and gas reserves may exist. Consequently, there may be instances where oil and gas exploration activities disproportionately and adversely affect communities of concern due to proximity and other factors.

Oil and gas exploration activities can be active for variable amounts of time. For example, a typical horizontal well averages from 30 to 60 days from start of drilling to completion (see Appendix C) and may have a greater effect (increased dust, traffic, etc.) on resident populations in close proximity to such drilling operations while the drilling operations are ongoing. These types of exploration activities may result in impacts that are adverse to communities of concern if the populations of concern are located near the drilling operations; however, the BLM does not know exactly where drilling operations may take place until lease development is proposed if a nominated lease parcel is developed at all.

The BLM PDO uses stipulations and COAs to minimize effects to nearby populations, including communities of concern, during construction and operations, to the extent practicable. For purposes of the leasing action, Table 3.10 provides a summary of the effect conclusions associated with the issues analyzed in detail. Those conclusions were then assessed by the BLM relative to whether the projected impacts to communities of concern may be adverse and disproportionate. As described in AIB-25, none of the nominated lease parcels contain residences, and one of the nominated lease parcels (407) has one residence approximately 0.33 mile from the parcel boundary. Note that any residence, community facilities or gathering spaces in an area with a community of concern has the chance of being significant to that community; however, none have been identified within the nominated lease parcels. In addition, there were no other resources of significance identified during public scoping. Additionally, no specific Native American resource concerns have been identified on the subject lease parcels; however, this consultation is considered ongoing. Therefore, impacts to communities of concern are more likely to be indirect and may incrementally contribute to impacts associated with reasonably foreseeable environmental trends and planned actions. Note that while the determination of potential adverse and disproportionate impacts from specific actions may initially be the assessment of the BLM, this assessment should not be assumed to be the position of specific, potentially impacted, communities of concern. The BLM realizes that additional impacts may be identified by local communities as specific development locations and types are proposed.

Additional analysis would be conducted at the time of proposed lease development. Standard terms and conditions attached as COAs to the APD could include measures to reduce effects on nearby communities of concern. Under the Oil and Gas Leasing Regulation for Surface Use Rights (43 CFR 3101-1-2), such reasonable measures may include modification to siting or design of facilities, including relocation of proposed operations up to 656 feet (200 m). These measures would minimize potential effects that could be adverse and disproportionate to members of communities of concern.

Table 3.10. Summary Comparison of Conclusions from Analysis of Other Issues to Environmental Justice

Issues Analyzed	Summary of Potential Adverse Effects	Are potential effects disproportionate to environmental justice populations?
Air Quality (Issue 1, Section 3.6.1)	Criteria pollutants, VOC, and HAP emissions would increase as shown in Section 3.6.1.1 (Table 3.14). Future potential development of the lease parcels would result in short-term local area increases of pollutant emissions, particularly fugitive dust ($PM_{2.5}$ or PM_{10}), lasting an average of 30 to 60 days.	Potential for disproportionate impacts to communities of concern. Fugitive dust and diesel exhaust emissions from construction would result in criteria pollutant, VOC, and HAP emissions. These emissions would be short-term (30–60 days) and would have the greatest impact at locations near the construction activities. Therefore, residents near the construction activities, would experience greater levels of impacts due to project construction. Additional analysis would be conducted at the time of proposed lease development if development occurs; standard design features and project-specific COAs would help to minimize potential effects that could be adverse and disproportionate to communities of concern.

Issues Analyzed	Summary of Potential Adverse Effects	Are potential effects disproportionate to environmental justice populations?
Greenhouse Gases and Climate Change (Issue 2, Section 3.6.2)	Based on a 100-year global warming potential, future potential development of the nominated lease parcels is estimated to result in 21,551 metric tons of carbon dioxide equivalent (CO_2e) from construction and operation and 631,238 metric tons of CO_2e from downstream GHG emissions. All GHG emissions would contribute to global GHG emissions. GHG emissions are associated with documented ongoing and reasonably foreseeable climate-related effects. For the Upper Rio Grande Basin (southern Colorado to central-southern New Mexico), these may include increased temperatures, decreases in overall water availability, and increases in frequency, intensity, and duration of both droughts and floods (BLM 2021b).	Yes. While any climate change–related effect from the future potential development of the parcels themselves would be minimal, climate change is the result of collective and global actions. Any climate change–related impact would be regional in nature but may disproportionately affect communities of concern.in the analysis area who are unable to relocate or take other actions to address higher temperatures and decreased overall water availability or increased flooding.
Water Use and Quantity (AIB-1, AIB-2, and Issue 3, Section 3.6.3)	Future potential development may require 156 AF of water (over 20 years) or 7.8 AF of water per year, which would increase the annual demand for surface and groundwater in the tri-county analysis area by 0.01% at current usage rates. With consideration of design features and regulatory requirements, no effects to groundwater or surface water quality are expected from well drilling and completion. Spills affecting groundwater or surface waters could occur.	Potential for disproportionate impacts to communities of concern. While groundwater resources are regional in nature and water withdrawals are not anticipated to affect domestic water sources, any impacts on local water wells (for example, a spill that affects groundwater) could force residents to find other means of supplying water for domestic use. Best management practices and COAs would help to minimize this risk. Should a spill occur, the BLM would work with the NMOCD to immediately remediate spills in accordance with federal and state standards, including 19.15.29.11 NMAC.
Quality of Life (AIB-25)	Future potential development of the nominated lease parcels could result in localized air, noise, visual resources, and traffic and safety effects that could affect quality of life for local residences and EJ populations, particularly during construction. Continued expansion of the oil and gas industry can have a negative effect on quality of life for people who value undeveloped landscapes.	Potential for disproportionate impacts to communities of concern. In general, quality of life impacts would be greater for the residents in close proximity to future potential development. When evaluating placement of wells at the lease development stage, standard design features and project-specific COAs would be applied to reduce effects that could be adverse and disproportionate to communities of concern.

* The AIBs in Section 3.5 generally disclose adverse effects associated with these issues, some of which may be disproportionate to communities of concern based on where site-specific development occurs.

3.6 ISSUES ANALYZED IN DETAIL

The issues identified for detailed analysis in this EA were developed in accordance with CEQ regulations and the guidelines set forth in the BLM NEPA Handbook H-1790-1 (BLM 2008c) using input from internal and external scoping. Issues were retained for detailed analysis if that analysis is necessary to make a reasoned choice between alternatives; to determine significance; if there is disagreement about the best way to use a resource; or if there is conflict between resource impacts or uses.

3.6.1 Issue 1: Air Quality

How would future potential development of the nominated lease parcels affect air quality (particularly National Ambient Air Quality Standards and volatile organic compounds) in the analysis area?

Air quality is determined by the quantity and chemistry of atmospheric pollutants in consideration of meteorological factors (i.e., weather patterns) and topography, both of which influence the dispersion

and concentration of those pollutants. The presence of air pollutants is due to a number of different and widespread sources of emissions. The analysis area for this issue is the entirety of Lea, Eddy, and Chaves Counties (tri-county analysis area). This spatial scope of analysis was identified based on the regional nature of air pollution and to facilitate analysis using the best available air quality data, which are generally provided at the county level. For the purposes of this analysis, short-term effects to air quality are considered those that cease after well construction and completion (30–60 days); long-term effects are considered those associated with operation. Long-term effects would cease after well operation.

Much of the information in this section is incorporated from the *BLM Air Resources Technical Report for Oil and Gas Development in New Mexico, Oklahoma, Texas and Kansas* (herein referred to as Air Resources Technical Report and incorporated into this EA by reference) (BLM 2021a).

3.6.1.1 *Affected Environment*

The CAA requires the EPA to set NAAQS for pollutants considered harmful to public health and the environment. *Primary standards* provide public health protection, and *secondary standards* provide for public welfare, including protection against degraded visibility and damage to animals, crops, vegetation, and buildings (EPA 2021b) The primary NAAQS are set at a level to protect public health, including the health of at-risk populations, with an adequate margin of safety (EPA 2021b).

The EPA has set NAAQS for six principal pollutants ("criteria" air pollutants): carbon monoxide (CO); nitrogen dioxide (NO_2); ozone (O_3); particulate matter equal to or less than 10 microns in diameter (PM_{10}) and particulate matter equal to or less than 2.5 microns in diameter ($PM_{2.5}$); sulfur dioxide (SO_2); and lead (Pb) (EPA 2021b). The EPA has delegated the responsibility of regulation and enforcement of the NAAQS to the state level and has approved the New Mexico State Implementation Plan (SIP), which allows the State to enforce both the New Mexico Ambient Air Quality Standards (NMAAQS) and the NAAQS on all public and private lands with the exception of tribal lands and lands within Bernalillo County.[9] The NMED Air Quality Bureau is responsible for implementation of the SIP and enforcement of air quality standards (BLM 2021a).

Various federal and state-level permitting programs ensure protectiveness of the NAAQS and reduce effects to AQRVs at Class I areas. New major emitting facilities or significant modifications to major emitting facilities are required to undergo prevention of significant degradation (PSD) pre-construction review. PSD review requires an air quality analysis to assess the project's potential contribution to the NAAQS and PSD increments (maximum allowable increases in air quality over baseline concentrations), a Best Available Control Technology Analysis, and an additional effects analysis (to assess potential effects to soils, vegetation, and visibility) (EPA 2020b). Complete PSD applications are generally forwarded to the NPS Air Quality Division for review to ensure protectiveness of AQRVs at Class I areas. Additional state-level permitting requirements have been adopted by NMED such as New Source Review permitting requirements or de-minimis emission thresholds (10 pounds per hour or 25 tons per year of any criteria pollutant) that must be met in lieu of completing the construction permitting process are also enforced within the analysis area in order to ensure protectiveness of the NAAQS (NMED 2001). Construction permitting requirements are listed in NMAC 20.2.72 (NMED 2001).

CRITERIA POLLUTANT CONCENTRATIONS

Concentrations of air pollutants are measured at air monitoring sites and expressed in ppm, parts per billion (ppb), or micrograms per cubic meter ($\mu g/m^3$) depending on the unit of measure for a specific standard. The EPA and State of New Mexico periodically analyze and review air monitor locations and will discontinue monitoring where pollutant concentrations have been well below standards or may add

[9] Under the CAA and the Tribal Authority Rule, tribes have express authority to manage air quality on tribal lands. Air quality in Bernalillo County is regulated by the City of Albuquerque/Bernalillo Air Quality Division.

monitors in areas where concentrations may be suspected of approaching the NAAQS or the NMAAQS (BLM 2021a).

Design values are the concentrations of air pollution at a specific monitoring site that can be compared with the NAAQS. The most recent design values for criteria pollutants within Lea and Eddy Counties are listed in Table 3.11 (EPA 2021c). These counties do not have monitoring data for CO, Pb, and PM_{10} concentrations, but because the counties are relatively rural, it is likely that these pollutants are not elevated.

Table 3.11. 2020 Design Values in Eddy and Lea Counties

Pollutant	2019 Design Values	Averaging Time	NAAQS	NMAAQS
O_3	0.078 ppm (Eddy County), 0.068 ppm (Lea County)	8-hour	0.070 ppm*	–
NO_2	5 ppb (Eddy County), 5 ppb (Lea County)	Annual	53 ppb†	50 ppb
NO_2	29 ppb (Eddy County), 35 ppb (Lea County)	1-hour	100 ppb‡	–
$PM_{2.5}$§	7.0 µg/m^3 (Lea County)	Annual	12 µg/m^3 §	–
$PM_{2.5}$§	17 µg/m^3 (Lea County)	24-hour	35 µg/m^3 ‡	–

Source: EPA (2021c).

Notes: NMAAQS = New Mexico Ambient Air Quality Standards; ppm = parts per million; ppb = parts per billion; µg/m^3 = micrograms per cubic meter. While there are no NAAQS for H_2S, New Mexico has set half-hour standards for H_2S at 0.100 ppm within Pecos-Permian Air Quality Control Region and 0.030 ppm, for municipal boundaries and within 5 miles of municipalities with populations greater than 20,000 in the Pecos-Permian Air Quality Control Region (BLM 2021a). The NMAAQS standard for total suspended particulates, which was used as a comparison for PM_{10} and $PM_{2.5}$, was repealed as of November 30, 2018.

* Annual fourth-highest daily maximum 8-hour concentration averaged over 3 years.

† Not to be exceeded during the year.

‡ 98th percentile, averaged over 3 years.

§ Annual mean, averaged over 3 years.

O_3 is the criteria pollutant that is of most concern for the tri-county analysis area. As a secondary pollutant, O_3 is not a direct emission pollutant (that is, it is not emitted directly into the air), but it is the result of chemical reactions between a group of highly reactive gases called NO_x and VOCs (which are organic compounds that vaporize [i.e., become a gas] at room temperature) when exposed to sunlight (EPA 2021d). O_3 and NO_2 are criteria air pollutants and are regulated under the NAAQS and NMAAQS. VOCs are not criteria pollutants, however, because O_3 is not a direct emission; emissions of NO_x (particularly NO_2, which is used as an indicator for the larger group of gases), and VOCs are used as a proxy for determining potential levels of secondary formation of O_3.

O_3 is most likely to reach unhealthy levels on hot, sunny days in urban environments and can be transported long distances by wind into rural areas (EPA 2021d). Breathing O_3 can have human health effects, particularly for sensitive groups (children, the elderly, and those with chronic lung conditions like bronchitis, emphysema, and asthma) as well as sensitive vegetation (NMED 2021a). Major sources of both NO_x and VOCs emissions include industrial facilities like power plants and motor vehicle exhaust (including off-road equipment). Biogenic sources, such as trees and plants, can also represent a substantial portion of NO_x and VOC emissions in an area, including New Mexico (BLM 2021a).

In May 2021, the EPA published new design values for NAAQS for various counties throughout the United States. The 2811 Holland Street monitoring station in Eddy County reported 8-hour O_3 exceedances of 78 ppb (EPA 2021c). NMED is required by State Statute to plan for O_3 mitigation in areas where monitors indicate O3 levels within 95% of the O3 standard. The area discussed above in Carlsbad, New Mexico, has not been formally declared nonattainment by the EPA through the state's recommendation.

The Ozone Attainment Initiative is a project authorized by State Statute, 74-2-5.3 New Mexico Statutes Annotated 1978. This statute directs the NMED to develop plans that may include regulations more stringent than federal rules for areas of the state in which ambient monitoring shows O_3 levels at or above 95% of the NAAQS (BLM 2021a).

NO_x is primarily emitted through fossil fuel combustion in electric utilities, high-temperature operations at other industrial sources, and the operation of motor vehicles (BLM 2021a). NO_x can also react with other chemicals in the air to form particulate matter, contributing to haze (BLM 2021a). VOCs are also emitted from burning fuels (gasoline, wood, coal, or natural gas) and are associated with refineries, oil and gas production equipment, and other industrial processes. The upstream sources of VOCs that are produced during the production of oil and gas are during the separation of gases from liquids and the storage process. Such emissions are generally controlled with the use of enclosed combustion devices, such as flares. Leaks and ineffective control systems are also a source of VOC emissions. In the event that VOCs are produced from incomplete combustion, they become more highly reactive O_3 precursors (Matichuk et al. 2016).

Particulate matter (also known as particle pollution) is a mixture of solid particles and liquid droplets in the air. Particulate matter varies in size: PM_{10} refers to particulate matter 10 micrometers or less in diameter (commonly considered "dust"). $PM_{2.5}$ refers to particulate matter that measures 2.5 micrometers or less (i.e., fine particles), which are the main cause of reduced visibility (haze) in the United States (EPA 2021e). The EPA regulates particulate matter 10 micrometers in diameter or smaller (PM_{10} and $PM_{2.5}$) because these smaller particles are associated with negative health effects, including respiratory and cardiovascular problems, and because they can become more deeply imbedded into the lungs (BLM 2021a) but does not regulate particles larger than 10 micrometers in diameter (such as sand and larger dust particles). PM_{10} are not currently monitored in the tri-county analysis area, and there are no areas of high concentrations that would warrant monitoring by the NMED. Like O_3, most particulate matter is formed by reactions between other chemicals, specifically between SO_2 and NO_x, which are emitted from vehicles, power plants, and other industrial processes (EPA 2021e). Particulate matter emissions often result from activities like construction, traffic on unpaved roads, fields, and wildfires (EPA 2021e). Particulate matter is of heightened concern when emissions are near sensitive receptors, such as residences, because particulate matter can be present in higher concentrations in a localized area prior to settling or dispersion.

CRITERIA POLLUTANT EMISSIONS

Along with criteria pollutant concentrations as measured by air monitors, the EPA provides data on criteria pollutant emissions, expressed in tons per year or total volume of pollutant released into the atmosphere. Emissions data point to which industries and/or practices are contributing the most to the general level of pollution (BLM 2021a). Total emissions within the tri-county analysis area are reported in Table 3.12, based on 2017 National Emissions Inventory (NEI) in tons per year (EPA 2020c).

The primary sources of air pollution in the PDO are dust from blowing wind on disturbed or exposed soil, exhaust emissions from motorized equipment, oil and gas development, agriculture, and industrial sources. Table 3.12 shows annual emissions, including fire and biogenic substances, for each of the counties in the CFO based on EPA's 2017 emissions inventory in tons/year (EPA 2020c). The Western States Air Resources Council-Western Regional Air Partnership (WESTAR-WRAP) conducted an oil and gas emissions inventory report for base year 2014 to further clarify the contributions of oil and gas activities to emissions within the Permian and San Juan Basins (BLM 2021a). The results indicate there are non-point sources, including fugitive components, pneumatic devices, pumps, and well blowdown events, that may not be reported through the state and federal inventories. These nonpoint sources could represent greater criteria, HAPs, and GHG emissions within these basins, in particular VOC and NO_x

emissions that contribute to O_3 formation. It is therefore believed that the NEI data related to Petroleum and Related Industries is underreported in terms of VOC and NOx emissions. Table 3.12 provides the 2017 NEI and WESTAR-WRAP datasets. Because the inventories are not presenting the same base-year emissions, it is not possible to make a meaningful comparison as to the magnitude of potential underestimates of emissions; however, both datasets are provided below for reference.

Table 3.12. Emissions in the New Mexico Portion of the Permian Basin, in Tons per Year

County (Chaves, Eddy, Lea, and Roosevelt)	NO_X	CO	VOC	PM_{10}	$PM_{2.5}$	SO_2
2017 NEI—all sources	33,217	78,938	172,241	39,761	7,086	7,577
2017 NEI Chaves County all sources	4,791	18,024	33,767	8,966	1,452	80
2017 NEI Eddy County all sources	10,083	31,592	64,734	13,957	2,803	1,288
2017 NEI Lea County all sources	15,514	23,582	65,207	12,309	2,048	6,185
2017 NEI Roosevelt County all sources	2,830	5,741	8,533	4,528	783	23
2017 NEI—petroleum and related industries	13,001	–	82,793	–	–	–
WESTAR-WRAP 2014 oil and gas sources[§†]	30,351	–	121,644	–	–	–

Note: BLM reports both biogenic and human-caused emissions in the table above. The table above shows emissions by county including biogenic sources. Biogenic emissions include natural emissions from vegetation and soil and contributed 4,790 tons of NO_x, 19,679 tons of CO, and 79,137 tons of VOCs in 2017. Emissions of PM_{10}, $PM_{2.5}$, and SO_2 result solely from human-caused sources. The portion of Human-caused emissions contributing to the 2017 NEI totals are 28,426tons, 59,260 tons, and 93,104 tons for NO_x, CO, and VOCs, respectively.

[§]Only precursor pollutants to ozone formation are compared in this analysis (NO_x and VOC).

Source: EPA (2020c); Data pulled from NEI as of June 2021. Values may not always sum correctly if queried on demand as the NEI database updates its emissions periodically with newer emission information. Values include Tier 1 summaries for each county, including combustion, industrial, on-road/nonroad, and miscellaneous sectors.

[†] Source: Ramboll Environ (2017). WESTAR-WRAP data includes Roosevelt County emissions; 133 tons per year of NO_x emissions and 374 tons per year VOCs.

AIR QUALITY INDEX

Air quality in a given region can also be measured by its Air Quality Index (AQI) value. The AQI is used to report daily air quality information in an easy-to-understand way by explaining how local air quality relates to human health. Calculated by the EPA, the AQI considers the following: O_3, particulate matter ($PM_{2.5}$ and PM_{10}), NO_2, SO_2, and CO (all except Pb) (EPA 2014).

The AQI translates daily air quality data into a tiered, color-coded system that helps people understand how clean outdoor air is, who may be affected if pollutant levels are higher than desired, and when individuals may want to take measures to protect their own health. The higher the AQI value, the greater the level of air pollution and the greater the concern for public health. An AQI value of 100 typically corresponds to the NAAQS set for that pollutant, and values below 100 are considered satisfactory for public health. Table 3.13 presents the AQI values (with associated color category) and levels of health concern.

Table 3.13. Air Quality Index

AQI Values	Levels of Health Concern	Meaning
0 to 50 (green)	Good	Air quality is considered satisfactory, and air pollution poses little or no risk.
51 to 100 (yellow)	Moderate	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.

AQI Values	Levels of Health Concern	Meaning
101 to 150 (orange)	Unhealthy for sensitive groups	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
151 to 200 (red)	Unhealthy	Everyone may begin to experience health effects, and members of sensitive groups may experience more than serious health effects.
201 to 300 (purple)	Very unhealthy	Health alert: everyone may experience more serious health effects.
301 to 500 (maroon)	Hazardous	Health warnings of emergency conditions. The entire population is more likely to be affected.

Source: EPA (2021f).

Note: AQI values above 500 are considered beyond the AQI and represent extreme levels of particle pollution.

The AQI summary report provides annual summary information, including maximum AQI values and count of days in each AQI category (EPA 2021g). Table 3.14 lists the number of days in which the AQI was "unhealthy for sensitive groups" or worse for the past 11 years. Over the past 10 years, Eddy County shows an upward trend in maximum AQI while Lea County shows no significant trends in maximum AQI.

Table 3.14. AQI Summary Data for Number of Days Classified above 100 for the Analysis Area (2009–2020)

Location	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Eddy County	2	2	7	10	2	4	0	0	10	20	19	11
Lea County	3	0	7	1	2	3	1	0	4	6	4	0

Source: EPA (2021g).

Note: Data from Chaves County are available for less than one-third of the year, and therefore, the data from this site are not included to avoid providing misleading information due to incomplete data. However, based on the Chaves County data that are available, the number of days with AQI over 100 is one or fewer for each of the years represented.

HAZARDOUS AIR POLLUTANTS

The CAA requires control measures for HAPs. A pollutant is classified as a HAP if it has been identified by the EPA as a compound that is known or suspected to cause cancer or other serious health effects and/or adverse environmental effects. There are currently 187 compounds listed as HAPs by the EPA. National Emission Standards for Hazardous Air Pollutants (NESHAPs), established by the EPA, limit the release of specified HAPs from specific industries (BLM2021b). NESHAPs for oil and gas development include control of benzene, toluene, ethyl benzene, mixed xylenes, and n-hexane from major sources, and benzene emissions from triethylene glycol dehydration units as area sources (BLM 2021a). The CAA defines a major source for HAPs as being one that emits 10 tons per year of any single HAP or 25 tons per year of any combination of HAPs. Under state regulations, a construction or operating permit may be required for a major source, and for New Mexico, determining a major source requires consideration of each oil and gas exploration and production well individually (BLM 2021a). In New Mexico, regulations for major sources are found under NMAC 20.2.70 and 20.2.71.

The Air Resources Technical Report discusses the relevance of HAPs to oil and gas development and the particular HAPs that are regulated in relation to these activities (BLM 2021a). The NATA, published by the EPA, provides a tool by which to help focus emissions reductions strategies. The most recent NATA was completed for 2014 and was released in August 2018 (EPA 2018). The 2014 NATA models ambient concentrations and estimates exposures and risk of cancer and/or other health impacts from HAPs,

represented as risk hazard indices for cancer, neurological problems, and respiratory problems for each county and census tract (BLM 2021a). NATA cannot give precise exposures and risks for a specific individual; therefore, NATA data are best applied to larger areas. NATA derives concentration and risk estimates from emissions data from a single year and assumes a person breathes these emissions each year over a lifetime (approximately 70 years). Lastly, NATA only considers health impacts from breathing air toxics and does not take into account indoor hazards, contacting or ingesting these air toxics, or other ways in which people may be exposed (BLM 2021a). A review of the results of the 2014 NATA shows that cancer, neurological risks, and respiratory risks in the analysis area are generally lower than national levels of 31.7 cases per 1 million people. The 2014 NATA map application reveals that the cancer risk index (defined as the probability of contracting cancer over the course of a lifetime [70 years], assuming continuous exposure) from human-caused emissions of HAPs in most of the analysis area is approximately 25 to 28 (that is 25 to 28 cases per 1 million people). The total cancer risk is 24.7, 25.9, and 28.0 for Lea, Chaves, and Eddy Counties, respectively (BLM 2021a).

REASONABLY FORESEEABLE ENVIRONMENTAL TRENDS AND PLANNED ACTIONS

Current estimated emissions across the tri-county analysis area (Chaves, Eddy, and Lea Counties) and air quality across the tri-county analysis area is generally good based on AQI ratings over the last decade (see Table 3.13). Current estimated emissions and AQI ratings are reflective of the effects of past and present actions. While there are other sources of emissions in the 20 million-acre PDO, oil and gas development is one of the most prominent sources of emissions. There are 41,006 active oil and gas wells in the New Mexico Permian Basin. Of this total, 18,690 wells are federal, with the remainder falling in other jurisdictions (BLM 2021a). Over the last 5 years, there have been 1,068 federal well completions in the Pecos District (Table 3.15).

Table 3.15. Past and Present Federal Well Completions

Number of Federal Well Completions	2016	2017	2018	2019	2020
Pecos District	150	199	261	284	174

As with past and present actions, continued oil and gas development is the most prominent reasonably foreseeable future action (RFFA) affecting air quality in the PDO. The 2012 and 2014 RFD scenario estimates that there could be an additional 16,000 wells drilled by 2035, of which 6,400 would be federal (Engler and Cather 2012, 2014). The BLM Air Resources Technical Report (BLM 2021a) provides information related to the reasonably foreseeable development for the PDO planning area. Reasonably foreseeable development projected for a 20-year time period shows well development with an average of 800 wells per year (of which 320 would be federal). Annual well averages are multiplied by the one oil-well pollutant emission factor (Table 3.16) to calculate RFFA annual emissions for both federal well development and federal and non-federal well development associated with the RFD scenario in Year 2020 (see Table 3.16).

Emissions are anticipated to be at the most acute level during the construction and completion phases of implementation (estimated to be 30–60 days). Localized and short-term effects on air quality for nearby residences from emissions of particulate matter, NO_x, VOCs, and HAPs are expected; however, because well development varies (i.e., permit approval, well pad construction, spudding, and completion), the phases of development may not occur in succession but may be spread out in development over time as a result of the varying development plans and approaches of lessees in the context of overall oil and gas development throughout the analysis area. The parcels may not be developed at all. As such, the incremental addition of criteria pollutants and VOCs over a period of 20 years would not be expected to

result in any direct exceedances of the NAAQS or NMAAQS for any criteria pollutants in the analysis area. These areas have not been formally declared non-attainment by the EPA through the State's recommendation. The BLM will continue to monitor these areas and participate in any ozone initiative meetings and strategies recommended by the State.

Table 3.16. Air Emissions from Annual Oil and Gas Well Development Associated with the RFD Scenario

Air Emissions	Lease Sale Emissions (tons per year)					
	PM_{10}	**$PM_{2.5}$**	**NO_x**	**SO_2**	**CO**	**VOC**
Current emissions (Chaves, Eddy, Lea, and Roosevelt Counties)	39,761	7,086	33,217	7,577	78,938	172,241
One oil-well emission factors*	0.58	0.27	4.53	0.12	2.06	4.46†
One gas-well emission factors	0.67	0.33	5.53	0.11	1.87	0.77
Total annual emissions for annual reasonably foreseeable federal well development (320 wells)	**185.60**	**86.40**	**1,449.60**	**38.40**	**659.20**	**1,427.20**
Percent increase	0.47%	1.22%	4.36%	0.51%	0.84%	0.83%
Total annual emissions for annual reasonably foreseeable federal and non-federal well development (800 wells)	464	216	3,624	96	1,648	3,568
Percent increase	1.17%	3.05%	10.91%	1.27%	2.09%	2.07%

Note: The analysis contained in this table provides percentage contribution rounded to two decimal points.

* The representative well used to calculate emissions is a horizontal oil well. Emissions for vertical wells were not used from this analysis due to current predominance in horizontal technological drilling methods and because presenting horizontal well emissions estimates represents a more conservative summary of emissions, compared with emissions from a vertical well, with the exception of SO_2, which could be four to five times greater in a vertical well scenario. However, sulfur dioxide emissions are still estimated to be within the same magnitude and less than 1 ton per year of SO_2 emissions per well. Oil wells are used for this analysis because they are the more prevalent well type in the PDO area. However, note that emissions of some compounds (NO_x, SO_2, PM_{10}, and $PM_{2.5}$) tend to be higher for gas well development in the area, but gas wells emit lower amounts of VOCs, CO, and HAPs.

† VOC emissions at the operational phase represent uncontrolled emissions and estimate potential emissions representing the contribution for "one oil well" from the emissions at storage tanks, gathering facilities, etc. However, federally enforceable regulations such as New Source Performance Standards (NSPS) OOOO and OOOOa both require emission reduction of VOC from well completions following hydraulic fracturing or refracturing and storage tanks with emissions greater than 6 tons per year after federally enforceable controls. Therefore, actual emissions from the one well scenario are likely be lower than represented.

An ARTSD (URS 2013) was prepared to analyze potential air quality effects resulting from the RFD scenario. This effort included atmospheric dispersion and photochemical grid modeling to predict concentrations of specific pollutants in and around the BLM CFO (in which most of the Pecos District oil and gas activity occurs). The results of ARTSD analysis indicate that air quality effects from the RFD scenario, while noticeable, are generally acceptable. Most predicted criteria pollutant concentrations are well below the NAAQS throughout the extensive modeling domains included in this analysis. While no exceedances of NAAQS were predicted from the modeling of federal wells associated with the RFD scenario (6,400 wells), consideration of the entire RFD scenario (16,000 wells) and other reasonably foreseeable trends and planned actions RFFAs (in the ARTSD included predictions of pollutant concentrations approaching or exceeding the NAAQS (for O_3, $PM_{2.5}$, and potentially SO_2) and indicate the need for additional ambient monitoring data, refined modeling, and consideration of additional mitigation measures. Most of the areas where NAAQS were projected to be exceeded are out of the BLM CFO region (URS 2013), including potential exceedances at CCNP. The State of New Mexico is working on a plan to address O_3 and air quality exceedances (NMED 2021b), including currently requiring operators to reduce NO_x emissions.

3.6.1.2 *Environmental Effects*

METHODOLOGY AND ASSUMPTIONS

Methodology and assumptions for calculating air pollutant emissions and developing inputs for the calculators are described in the Air Resources Technical Report (BLM 2021a). Emissions calculators were developed by air quality specialists at the BLM National Operations Center in Denver, Colorado, and account for a number of variables, including access and construction requirements, equipment, and other infrastructure needs, as well as expected production volumes. Because these calculators quantify emissions based on averages and several assumptions (e.g., construction methods, all wells would be hydraulically fractured), these estimates provide approximations of emissions of criteria pollutants, VOCs, and HAPs relative to regional and national levels. Additionally, the BLM in New Mexico has modified the calculators and assumptions for use in analyzing a single well to more closely represent oil and gas wells in the state and to address emissions from development and production for one horizontal well (BLM 2021a). Emissions estimates per well are included in Table 3.17.

Table 3.17. Percent Increase from Future Potential Development of the Lease Parcels

Future Potential Development	Lease Sale Emissions (tons per year)					
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	CO	VOC
Current emissions (Chaves, Eddy, Lea, and Roosevelt Counties)	39,761	7,086	33,217	7,577	78,938	172,241
One oil-well emission factors*	0.58	0.27	4.53	0.12	2.06	4.46†
One gas-well emission factors*	0.67	0.33	5.53	0.11	1.87	0.77
Total emissions from lease sale (five wells)	2.9	1.35	22.65	0.6	10.3	22.3
Percent increase	0.01%	0.02%	0.07%	0.01%	0.01%	0.01%

Note: The analysis contained in this table provides percentage contribution rounded to two decimal points.

Note: HAPs from the 2017 NEI Inventory are not included for comparison at the county level as a large portion of the inventory includes only facility level emissions emitted after controls are accounted for and only includes facility level or sources as required to be reported by the NMED. HAP emissions could include 0.31 and 0.06 tons per well/year for an oil well and a gas well respectively.

* The emission estimates for a one-well (oil well) scenario include construction, operations, maintenance, and reclamation activities. Construction emissions include well pad construction (fugitive dust), heavy equipment combustive emissions, commuting vehicles, and wind erosion. Emissions from operations include well workover operations (exhaust and fugitive dust), well site visits for inspection and repair, recompletion traffic, water and oil tank traffic, venting, compression and well pumps, dehydrators, and compression station fugitives. Maintenance emissions for both oil and gas wells are for road travel, and reclamation emission activities are for interim and final activities and include truck traffic, a dozer, a blade, and track hoe equipment. The representative well used to calculate emissions is a horizontal oil well. Emissions for vertical wells were not used from this analysis due to current predominance in horizontal technological drilling methods and because presenting horizontal oil well emissions estimates represent a more conservative summary of emissions, compared with emissions from a vertical well, with the exception of SO_2, which could be four to five times greater in a vertical well scenario. However, sulfur dioxide emissions are still estimated to be within the same magnitude and less than 1 ton per year of SO_2 emissions per well. Oil wells are used for this analysis because they are the more prevalent well type in the PDO area. However, note that emissions of some compounds (NO_x, SO_2, PM_{10}, and $PM_{2.5}$) tend to be higher for gas well development in the area, but gas wells emit lower amounts of VOCs, CO, and HAPs.

† VOC emissions at the operational phase represent uncontrolled emissions and estimate potential emissions representing the contribution for “one oil well” from the emissions at storage tanks, gathering facilities, etc. However, federally enforceable regulations such as New Source Performance Standards (NSPS) OOOO and OOOOa both require emission reduction of VOC from well completions following hydraulic fracturing or refracturing and storage tanks with emissions greater than 6 tons per year after federally enforceable controls. Therefore, actual emissions from the one well scenario are likely be lower than represented.

EFFECTS ANALYSIS

Future potential development of the nominated lease parcels would include increased criteria pollutant emissions, including increased particulate matter released from new well pads or roads, exhaust emissions from drilling equipment, compressor engines, vehicles, flares, dehydration and separation facilities, and VOCs during drilling and production activities. As stated above, the most substantial criteria pollutants

and O_3 precursors emitted by oil and gas development and production are VOCs, particulate matter, and NO_2.

Future potential development on the nominated lease parcels is estimated at five horizontal wells (1 well per parcel) (see Table 3.1). The future potential development of the nominated lease parcels associated with the Proposed Action comprises 0.03% of the RFD scenario (16,000 wells) and would be 0.63% of annual reasonably foreseeable development (800 wells). Reasonably foreseeable trends and planned actions would incrementally contribute to increases in in criteria pollutants between 1.17% to 10.91% of existing annual emissions of all well development, federal and non-federal (see Table 3.15).

VOCs and NO_2 contribute to the formation of O_3, which is the pollutant of most concern in the Permian Basin, and because O_3 is not a direct emission, emissions of NO_x and VOCs are used as proxies for estimating O_3 levels. Under the Proposed Action, the additional NO_x and VOC emissions (quantified in Table 3.16) from the well would incrementally add to O_3 levels within the analysis area, which recently exceeded NAAQS in Eddy and Lea Counties. Given that only five wells are expected to be developed as part of the Proposed Action, it is not expected that the Proposed Action would lead directly to additional NAAQS exceedances of O_3 in Eddy and Lea Counties. HAP emissions could include 0.31 and 0.06 ton per well per year for an oil well and a gas well, respectively. The CAA defines a major source for HAPs to be one emitting 10 tons per year of any single HAP or 25 tons per year of any combination of HAPs (BLM 2021a). Emissions presented in this analysis conservatively represent uncontrolled emission rates prior to implementation of applicable federally enforceable controls. Therefore, it is not expected that the Proposed Action would be a major source of HAP emissions.

Under the Proposed Action, particulate matter emissions (PM_{10} and $PM_{2.5}$) would increase by 0.01% and 0.02%, respectively. Construction activities would be one of the primary sources of particulate matter emissions as a result of dust and fine particles generated from on-site equipment use and related groundwork, as well as on- and off-site vehicles (Araújo et al. 2014; Reid et al. 2010). How particulate matter interacts with the environment is dependent on a variety of factors, with the size and chemical composition of the airborne particles being the most important in terms of dispersion (distance from the source) and deposition from the atmosphere. Effects of particulate matter emissions would not be confined to the construction site because $PM_{2.5}$ (fine particles) can travel farther in terms of distance than PM_{10} (dust) and other total suspended particulates (particles of sizes up to 50 micrometers) and therefore can affect local residents in the surrounding area (Araújo et al. 2014). The nominated lease parcels do not contain any residences. The nearest residence to any of the nominated lease parcels is approximately 0.33 miles northwest and is approximately 0.95 miles southwest of the Lea county-Jal Airport (See AIB-25). However, the use of best management practices (BMPs) as described in Section 3.6.1.3 can reduce off-site effects from fugitive dust.

The Proposed Action may also result in localized effects to air quality at nearby residences due to O_3 precursors and HAP emissions. A significant portion of the criteria pollutants, VOCs, and HAP emissions would be from construction and completion from future potential development of the nominated lease parcels; therefore, the Proposed Action would result in short-term increases in these emissions, lasting an average of 30 to 60 days. As stated above, air quality is dependent not only on the quantity of air pollutants, but also environmental conditions (humidity, wind direction and speed, temperature) that influence concentration and/or dispersion of pollutants. Ongoing operations of the well site would be subject to state and federal permitting (unless emissions are so minimal the site qualifies as de minimis), recordkeeping, monitoring, and reporting requirements, which ensure compliance with air quality emission standards.

Levels of HAPs would also temporarily increase during construction and completion activities under the Proposed Action, particularly in the form of diesel particulate matter from the on- and off-road construction equipment. However, concentrations of mobile source emissions of diesel particulate matter are typically reduced by 60% at a distance of approximately 300 feet (Zhu et al. 2002). The relatively steep drop-off with distance of diesel particulate matter concentrations as well as the short duration of the activity make the effects from exposure to HAP emissions minimal during construction. HAP emissions could include 0.31 and 0.06 ton per well per year for an oil well and a gas well, respectively.

Ongoing operations of the well site would be subject to state and federal permitting (unless emissions are so minimal the site qualifies as *de minimis*), recordkeeping, monitoring, and reporting requirements, which ensure compliance with air quality emission standards. Compliance with state and federal permitting requirements are designed to ensure that a proposed source will not cause or contribute to a violation of NAAQS standards.

3.6.1.3 *Mitigation Measures and Residual Effects*

Emissions associated with the RFD, including future potential development of leases, would be offset by substantial decreases in emissions from fossil-fired EGUs in the area (BLM 2021a). New Mexico will have to comply with the Federal Regional Haze Rule requirements as it develops its SIP for the second planning period. New Mexico is currently in the 2021 Regional Haze Planning Process and is in the process of updating its Regional Haze SIP. The submittal of the Proposed SIP to EPA Region 6 is expected in early 2022 (NMED 2021d). The EPA has promulgated air quality regulations for completion of hydraulically fractured gas wells. These rules require air pollution mitigation measures that reduce the emissions of VOCs during gas well completions. Based on its authority under the standard terms and conditions, the BLM requires industry to incorporate and implement best management practices, which are designed to reduce effects on air quality by reducing emissions, surface disturbances, and dust from field production and operations. Typical measures include requirements for watering dirt roads or applying magnesium chloride dust suppressants on dirt roads during periods of high use to reduce fugitive dust emissions of PM_{10} (Intermountain Oil and Gas BMP Project 2013); colocation of wells and production facilities to reduce new surface disturbance; implementation of directional and horizontal drilling and completion technologies whereby one well provides access to petroleum resources that would normally require the drilling of several vertical wellbores; suggestions that vapor recovery systems be maintained and functional in areas where petroleum liquids are stored; and interim reclamation to revegetate areas not required for production facilities and reduce the amount of fugitive dust.

In addition, the BLM encourages industry to participate in the Natural Gas STAR program, administered by the EPA (BLM 2021a). The Natural Gas STAR program is a flexible, voluntary partnership that encourages oil and natural gas companies to adopt proven, cost-effective technologies and practices that improve operational efficiency and reduce natural gas emissions (BLM 2021a).

Further, the EPA provides control measures for emission mitigation of various pollutants in the Menu of Control Measures (MCM). The MCM provides state, local, and tribal air agencies with information on existing emissions reduction measures, as well as relevant information concerning the efficiency and cost effectiveness of the measures. The MCM includes information on measures for large point sources of emissions, as well as some information on measures for nonpoint sources of emissions. State, local, and tribal agencies will be able to use this information in developing emissions reduction strategies, plans, and programs to assure they attain and maintain the NAAQS (EPA 2021h).

NO_x reductions can include several control measures from oil and gas–related point sources. One such measure is selective catalytic reduction (SCR) for natural gas compressors. This control is the reduction of NO_x through add-on controls. SCR controls are post-combustion control technologies based on the

chemical reduction of NO_x into molecular nitrogen (N_2) and water vapor (H_2O). The SCR utilizes a catalyst to increase the NO_x removal efficiency, which allows the process to occur at lower temperatures. This control applies to compressors used in natural gas production operations, natural gas–fired and process gas–fired heaters with NO_x emissions greater than 10 tons per year. This method generally offers an 80% control efficiency for NO_x (EPA 2021h).

Another NO_x control measure for non-point sources is for process heaters using natural gas or process gas. This control is the use of low-NO_x burner (LNB) technology to reduce NO_x emissions. LNBs reduce the amount of NO_x created from reaction between fuel nitrogen and oxygen by lowering the temperature of one combustion zone and reducing the amount of oxygen available in another. This control is applicable to natural gas–fired and process gas–fired process heaters with uncontrolled NO_x emissions greater than 10 tons per year (EPA 2021h).

VOC control measures from oil and gas–related non-point sources include reducing emissions at storage tanks, use of flares, and a leak detection and repair program to capture fugitive emissions (leaks). The EPA has New Source Performance Standards (NSPS) in place, NSPS OOOO, to reduce VOCs from well completion operations and storage tanks constructed after August 23, 2011. NSPS OOOOa requires reduction of VOCs from well completion operations and storage tanks and imposes semiannual monitoring requirements for the collection of fugitive emission components at well sites constructed after September 18, 2015. Following the 2020 amendment to OOOO and OOOOa, fugitive emissions monitoring is only required for those wells producing greater than 15 bbl per day. Other emission controls of VOCs include vapor recovery units, enclosed combustors (vapor combustion unit), and open-tipped (candlestick flares). The most desirable control method is a vapor recovery unit since this recovers the natural gas production and sends the gas to the sales line or back to the process for facility use. In lieu of vapor recovery, flaring of waste gas generally reduces 98% of VOC emissions at oil and gas sites (EPA 2021h).

On March 2021, in accordance with Governor Michelle Lujan Grisham's Executive Order 2019-003, the Energy, Minerals and Natural Resources Department (EMNRD) announced the release of the NMOCD proposed Natural Gas Waste Reduction Rule as part of New Mexico's statewide, enforceable regulatory framework to secure reductions in oil and gas sector emissions and to prevent natural gas waste from new and existing sources. Key provisions include prohibition of unnecessary venting and flaring of waste natural gas where it is technically feasible to route the gas to pipeline or to use this gas for some other beneficial purpose (such as on-site fuel consumption). In all cases, operators must flare rather than vent natural gas except where this is technically infeasible or would pose a safety risk. These provisions will reduce VOC emissions due to stringent limitations on natural gas venting which results in un-combusted VOC emissions. Additionally, it proposes that natural gas be recovered and reused rather than flared, which would result in reductions of VOC, NO_x, CO, SO_2, and Particulate matter emissions.

Phase I of the Rule beginning October 1, 2021, will focuses on natural gas loss reporting, collection of baseline gas capture data and natural gas waste targets. Phase II (which will begin in 2022), will require monthly reporting, monitoring, and recordkeeping and requires operators to reduce their natural gas waste by a fixed amount each year to achieve a gas capture rate of 98% by December 31, 2026.

The specified emission control techniques have varying degrees of effectiveness as discussed above. Therefore, the mitigation measures applied to future potential development of the nominated lease parcels would reduce emissions of particulate matter and VOCs but would not completely eliminate these emissions. Emission control techniques would be further evaluated when specific lease development projects are proposed.

3.6.2 Issue 2: Greenhouse Gases and Climate Change

How would future potential development of nominated lease parcels contribute to greenhouse gas (GHG) emissions and climate change?

The proposed leasing action could lead to emissions of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), the three most common greenhouse gases associated with oil and gas development. These GHG emissions would be emitted from leased parcels if developed, and from the consumption of any fluid minerals that may be produced. However, the BLM cannot reasonably determine at the leasing stage whether, when, and in what manner a lease would be explored or developed. The uncertainty that exists at the time the BLM offers a lease for sale includes crucial factors that would affect actual GHG emissions and associated impacts, including but not limited to the future feasibility of developing the lease, well density, geological conditions, development type (vertical, directional, or horizontal), hydrocarbon characteristics, specific equipment used during construction, drilling, production, abandonment operations, production and transportation, and potential regulatory changes over the 10-year primary lease term.

For the purposes of this analysis, the BLM has evaluated the potential effects of the proposed leasing action on climate change by estimating and analyzing potential GHG emissions from projected oil and gas development on the parcels proposed for leasing using estimates based on past oil and gas development and available information from existing development within the State.

Additional discussion of climate change science and predicted impacts, as well as the reasonably foreseeable and cumulative GHG emissions associated with BLM's oil and gas leasing actions are included in the BLM Specialist Report on Annual Greenhouse Gas Emissions and Climate Trends (2020) (hereinafter referred to as the Annual GHG Report) (BLM 2021c). This report presents the estimated emissions of greenhouse gases attributable to fossil fuels produced on lands and mineral estate managed by the BLM. The Annual GHG Report is incorporated by reference as an integral part of the analysis for this proposed lease sale and is available at https://www.co.blm.gov/AirResourcesReport/ghg/.

3.6.2.1 *Affected Environment*

CLIMATE CHANGE AND GREENHOUSE GASES

Climate change is a global process that is affected by the sum total of GHGs in the Earth's atmosphere. The incremental contribution to global GHGs from a single proposed land management action cannot be accurately translated into its potential effect on global climate change or any localized effects in the area specific to the action. Currently, global climate models are unable to forecast local or regional effects on resources. However, there are general projections regarding potential impacts on natural resources and plant and animal species that may be attributed to climate change from GHG emissions over time. GHGs influence the global climate by increasing the amount of solar energy retained by land, water bodies, and the atmosphere. GHGs can have long atmospheric lifetimes, which allows them to become well mixed and uniformly distributed over the entirety of the Earth's surface no matter their point of origin. Therefore, potential emissions from the Proposed Action can be compared with state, national, and global GHG emission totals to provide context of their significance and potential contribution to climate change impacts.

Table 3.18 shows the total estimated GHG emissions from fossil fuels at the global and national scales over the last five years. Emissions are shown in megatonnes (Mt) per year of carbon dioxide equivalent (CO_2e). Chapter 3 of the Annual GHG Report contains additional information regarding GHGs and an explanation of CO_2e. Table 3.19 shows GHG emissions data from the largest GHG-emitting facilities as

reported to the EPA through its Greenhouse Gas Reporting Program (GHGRP) for those states associated with this potential leasing action. Table 3.19 also shows energy-related CO_2 emissions reported by the U.S. Energy Information Administration (EIA) in its annual State Energy-Related Carbon Dioxide Emissions Tables (EIA 2021a). State energy-related CO_2 emissions include emissions from fossil fuel use across all sectors (residential, commercial, industrial, transportation, and electricity generation) and are released at the location where the fossil fuels are consumed.

Additional information on current state, national, and global GHG emissions, as well as the methodology and parameters for estimating emissions from BLM fossil fuel authorizations and cumulative GHG emissions is included in the Annual GHG Report (see Chapters 4, 5, and 6).

Table 3.18. Global and U.S. GHG Emissions from 2015 through 2019

	GHG Emissions (Mt CO_2/yr)				
Scale	**2015**	**2016**	**2017**	**2018**	**2019**
Global	52,700	52,800	53,500	55,300	59,100
U.S.	5,249	5,153	5,083	5,244	5,107

Sources: Annual GHG Report, Chapter 6, Table 6-1 (BLM 2021c);
Note: units are in Mt CO_2e/yr; 1 megatonne = 1 million metric tons.

Table 3.19. State GHG Emissions

State	**EPA – GHGRP Large Emitters (Mt CO_2/yr)**			**EIA Energy-related CO_2 Emissions (Mt/yr)**
	Total Reported	**Power Plants**	**Petroleum and Natural Gas Systems**	
New Mexico	29.7	21.4	5.0	45.4

Sources: Annual GHG Report, Chap. 6, Table 6-3 (BLM 2021c); EIA (2021a)

The continued increase of anthropogenic GHG emissions over the past 60 years has contributed to global climate change impacts. A discussion of past, current, and projected future climate change impacts is described in Chapters 8 and 9 of the Annual GHG Report (BLM 2021c). These chapters describe currently observed climate impacts globally, nationally, and in each state, and present a range of projected impact scenarios depending on future GHG emission levels. These chapters are incorporated by reference in this analysis.

3.6.2.2 *Environmental Consequences*

PROPOSED ACTION ALTERNATIVE

While the leasing action itself does not directly generate GHG emissions, such emissions are a reasonably foreseeable consequences of oil and gas development. There are three general phases of post-lease development that would generate GHG emissions that include 1) well development (well site construction, well drilling, and well completion), 2) production operations (processing, storage, and transport/distribution), and 3) end-use (combustion) of the fuels produced.

The BLM cannot develop a precise emissions inventory at the leasing stage due to uncertainties including the type (oil, gas, or both), scale, and duration of potential development; the types of related equipment (drill rig engine tier rating, horsepower, fuel type); and the mitigation measures that future lessees may

propose in their development plan. In order to estimate reasonably foreseeable on-lease emissions at the leasing stage, the BLM uses estimated well numbers based on state data for past lease development combined with per-well drilling, development, and operating emissions data from representative wells in the area. The amount of oil or gas that may be produced if the offered parcels are developed is unknown. For purposes of estimating production and end-use emissions, reasonably foreseeable wells are assumed to produce oil and gas in similar amounts as existing nearby wells. While the BLM has no authority to direct or regulate the end use of the products, for this analysis, the BLM assumes all produced oil or gas will be combusted (such as for domestic heating or energy production). The BLM acknowledges that there may be additional sources of GHG emissions along the distribution, storage, and processing chains (commonly referred to as midstream operations) associated with production from the lease parcels. These sources may include emissions of CH_4 (a more potent GHG than CO_2 in the short term) from pipeline and equipment leaks, storage, and maintenance activities. At the leasing stage, these sources of emissions are highly speculative, and the BLM has therefore chosen to assume, for the purposes of this analysis, that all produced oil or gas will be combusted. We note, however, that the potential emissions from these sources have been estimated and are accounted for in the cumulative assessment of GHGs from the BLM's fossil fuel leasing program.

The emissions used in this analysis are estimated as described above using the BLM Lease Sale Emissions Tool. Emissions are presented for each of the three phases described above.

- Well development emissions occur over a short period and include emissions from heavy equipment and vehicle exhaust, drill rig engines, completion equipment, pipe venting, and any well treatments such as hydraulic fracturing that may be used.
- Production operations and end-use emissions occur over the entire production life of a well, which is assumed to be 30 years for this analysis based on the productive life of a typical oil/gas field. Production emissions may result from storage tank breathing and flashing, truck loading, pump engines, heaters and dehydrators, pneumatic instruments or controls, flaring, fugitives, and vehicle exhaust.
- End-use emissions occur from the downstream combustion of produced oil or gas. End-use emissions are estimated by multiplying the EUR of produced oil and gas with emissions factors for combustion established by the EPA (Appendix Tables C-1 and C-2 of 40 CFR Part 98, Subpart C). Additional information on emission factors and EUR factors are provided in the Annual GHG Report (Chapter 4) (BLM 2021c).

Tables 3.20 and 3.21 list the estimated direct and indirect GHG emissions in metric tons (tonnes) for the proposed lease sale over the average 20-year production life of the lease.

Table 3.20. Estimated Life of Lease Emissions (On-Site) from Well Development and Production Operations (tonnes)

Activity	CO_2 (tonnes)	CH_4 (tonnes)	N_2O (tonnes)	CO_2e (100-yr GWP) (tonnes)	CO_2e (20-yr GWP) (tonnes)
Well development	2,851	131.80	0.03	7,341	14,062
Production operations	4,036	299.05	0.020	14,210	29,461

GWP = global warming potential

Table 3.21. Estimated Life of Lease Indirect Emissions from the End-Use Combustion of Produced Oil and Gas (tonnes)

Emissions	EUR (bbl or mcf)	CO_2 (tonnes)	CH_4 (tonnes)	N_2O (tonnes)	CO_2e (100-year GWP) (tonnes)	CO_2e (20-year GWP) (tonnes)
Oil	840,000	362,908	14.61	2.92	364,273	364,930
Gas	4,898,000	266,645	5.03	0.50	266,965	267,206
Total end use	**-**	**629,553**	**19.63**	**3.42**	**631,238**	**632,136**

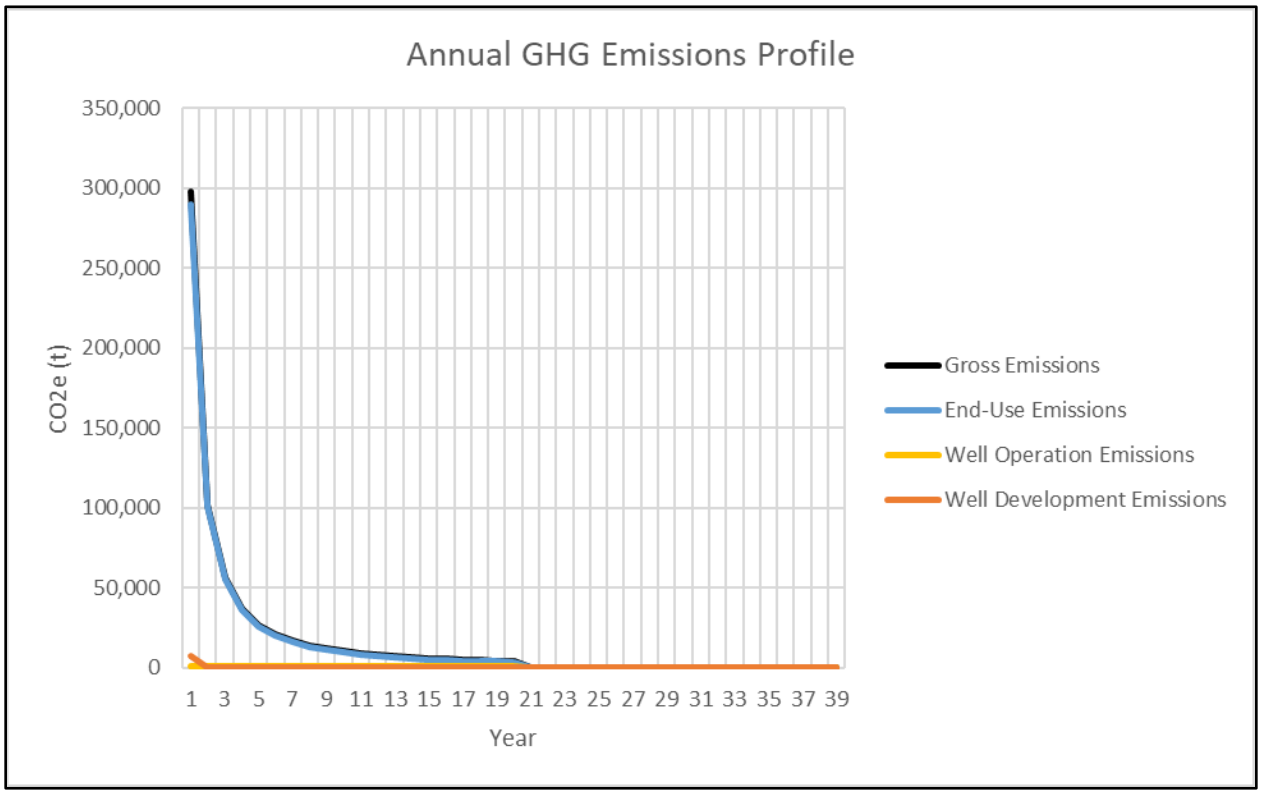
Source: BLM Lease Sale Emissions Tool (BLM 2021c)
GWP = global warming potential

GHG emissions vary annually over the production life of a well due to declining production over time. Table 3.22 provides maximum year and average year emissions over the life of the lease. Figure 3.1 shows the estimated annual GHG emissions profile over the production life of a typical lease including well development, well operation, end-use, and gross (total of well development, well production, and end-use) emissions.

Table 3.22. Estimated Direct and Indirect Emissions from Lease Parcels on an Annual and Life-of-Lease Basis (tonnes)

Emissions	CO_2 (tonnes)	CH_4 (tonnes)	N_2O (tonnes)	CO_2e (100-year GWP)	CO_2e (20-year GWP)
Max year	291,853	156.26	1.746	297,684	305,601
Average year	31,822	22.52	0.174	32,639	33,783
Life of lease	636,441	450.48	3.474	652,789	675,659

Source: BLM Lease Sale Emissions Tool (BLM 2021c)



Source: BLM Lease Sale Emissions Tool

Figure 3.1. Estimated Annual GHG Emissions Profile over the Life of a Lease

In order to put the estimated GHG emissions for this lease sale in context, potential emissions that could result from development of the lease parcels for this sale can be compared with other common activities that generate GHG emissions, as well as emissions at state and national scales. The EPA GHG equivalency calculator can be used (https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator) to express the potential average year GHG emissions on a scale relatable to everyday life (EPA 2021i). For instance, the projected average annual GHG emissions from expected development following the proposed lease sale are equivalent to 7,096 gasoline-fueled passenger vehicles driven for 1 year, or the emissions that could be avoided by operating seven wind turbines as an alternative energy source or offset by the carbon sequestration of 39,804 acres of forest land.

Table 3.23 compares estimated maximum and average annual lease-sale emissions with existing state GHG emissions, federal BLM fossil fuel (oil, gas, and coal) emissions, and U.S. fossil fuel and total GHG emissions reported in the EPA Inventory of U.S. GHG Emissions and Sinks: 1990-2019 (EPA 2021j).

Table 3.23. Comparison of Lease Sale Annual Emissions with Emissions from Other Sources (megatonnes)

Reference	Annual Emissions (Mt CO_2e)*	Average Year (% of reference)	Max Year (% of reference)
Max year	0.298	-	-
Average year	0.033	-	-
New Mexico federal (oil and gas)†	198.8	0.016	0.150
New Mexico federal (oil, gas, and coal)†	203.7	0.016	0.146

Reference	Annual Emissions (Mt CO_2e)*	Average Year (% of reference)	Max Year (% of reference)
U.S. federal (oil and gas)†	427.7	0.008	0.070
U.S. federal (oil, gas, and coal)†	918.6	0.004	0.032
U.S. total (all sectors)‡	6,576.1	0.000	0.005

* Estimates are based on 100-year GWP values provided by AR-5 (IPCC 2013).

† Federal values come from the BLM Specialist Report on Annual Greenhouse Gas Emissions Table ES-1 (BLM 2021c).

‡ U.S. Values comes from the EPA Inventory of U.S. GHG Emissions and Sinks: 1990–2019 (EPA 2021j).

Table 3.24 compares emission estimates over the 20-year life of the lease compared to the 30-year projected federal emissions in the state and nation from existing wells, the development of approved APDs, and emissions related to reasonably foreseeable lease actions.

Table 3.24. Comparison of Life-of-Lease Emissions with other Federal Oil and Gas Emissions from Existing Wells, Development of Approved APDs, and Other Leasing Actions in New Mexico and the Nation

Reference	Mt CO_2e (100-year GWP)	Life of Lease (% of reference)
Life of lease	0.653	100.000
Reasonably foreseeable short-term federal (oil and gas)	1,846.000	0.036
EIA projected long-term federal (oil and gas)	3,862.186	0.017
U.S. short-term federal (oil and gas)	4,307.51	0.015
U.S. long-term federal (oil and gas)	13,960.99	0.006

Source: U.S. and federal emissions from BLM Lease Sale Emissions Tool and Annual GHG Report Tables 5-17 and 5-18 (BLM 2021c)

Compared with emissions from other existing and foreseeable federal oil and gas development, the life of lease emissions for the Proposed Action is between 0.017% and 0.035% of federal fossil fuel authorization emissions in the state and between 0.006% and 0.015% of federal fossil fuel authorization emission in the United States.

In summary, potential GHG emissions from the Proposed Action could result in GHG emissions of 0.653 Mt CO_2e over the life of the lease.

MONETIZED IMPACTS FROM GHG EMISSIONS

The social cost of carbon, social cost of nitrous oxide (SC-N_2O), and social cost of methane (SC-CH_4)—together, the social cost of greenhouse gas (SC-GHG)—are estimates of the monetized damages associated with incremental increases in GHG emissions in a given year.

On January 20, 2021, President Biden issued Executive Order 13990, *Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis* (Federal Register 86:7307). Section 1 of Executive Order 13990 establishes an administrative policy to, among other things, listen to the science, improve public health and protect our environment, ensure access to clean air and water, reduce GHG emissions, and bolster resilience to the impacts of climate change. Section 2 of the Executive Order calls for federal agencies to review existing regulations and policies issued between January 20, 2017, and January 20, 2021, for consistency with the policy articulated in the order and to take appropriate action.

Consistent with Executive Order 13990, the CEQ rescinded its 2019 "Draft National Environmental Policy Act Guidance on Considering Greenhouse Gas Emissions" and has begun the review process for updating its "Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews" issued on August 5, 2016 (2016 GHG Guidance) (Federal Register 86:10252). While CEQ works on updated guidance, it has instructed agencies to consider and use all available tools and resources in assessing GHG emissions and climate change effects, including the 2016 GHG Guidance.

Regarding the use of the social cost of carbon or other monetized costs and benefits of GHGs, the 2016 GHG Guidance noted that NEPA does not require monetizing costs and benefits (CEQ 2016). It also noted that "the weighing of the merits and drawbacks of the various alternatives need not be displayed using a monetary cost-benefit analysis and should not be when there are important qualitative considerations" (CEQ 2016).

Section 5 of Executive Order 13990 emphasized the importance for federal agencies to "capture the full costs of greenhouse gas emissions as accurately as possible, including by taking global damages into account" and established an Interagency Working Group on the Social Cost of Greenhouse Gases (IWG). In February 2021, the IWG published *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide: Interim Estimates under Executive Order 13990* (IWG 2021). This is an interim report that updated previous guidance from 2016. The final report is expected in January 2022.

In accordance with this direction, this subsection provides estimates of the monetary value of changes in GHG emissions that could result from selecting each alternative. Such analysis should not be construed to mean a cost determination is necessary to address potential impacts of GHGs associated with specific alternatives. These numbers were monetized; however, they do not constitute a complete cost-benefit analysis, nor do the SC-GHG numbers present a direct comparison with other impacts analyzed in this document. For instance, the BLM's overall economic analysis for this lease sale does not monetize most of the major costs or benefits and does not include all revenue streams from the Proposed Action. SC-GHG is provided only as a useful measure of the benefits of GHG emissions reductions to inform agency decision-making.

For federal agencies, the best currently available estimates of the SC-GHG are the interim estimates of the social cost of carbon dioxide (SC-CO_2), SC-CH_4, and SC-N_2O developed by the IWG) on the SC-GHG. Select estimates are published in the Technical Support Document (IWG 2021) and the complete set of annual estimates are available on the Office of Management and Budget's website (Office of Management and Budget 2021).

The IWG's SC-GHG estimates are based on complex models describing how GHG emissions affect global temperatures, sea level rise, and other biophysical processes; how these changes affect society through, for example, agricultural, health, or other effects; and monetary estimates of the market and nonmarket values of these effects. One key parameter in the models is the discount rate, which is used to estimate the present value of the stream of future damages associated with emissions in a particular year. A higher discount rate assumes that future benefits or costs are more heavily discounted than benefits or costs occurring in the present (i.e., future benefits or costs are a less significant factor in present-day decisions). The current set of interim estimates of SC-GHG has been developed using three annual discount rates: 2.5%, 3%, and 5% (IWG 2021).

As expected with such a complex model, there are multiple sources of uncertainty inherent in the SC-GHG estimates. Some sources of uncertainty relate to physical effects of GHG emissions, human behavior, future population growth and economic changes, and potential adaptation (IWG 2021). To better understand and communicate the quantifiable uncertainty, the IWG method generates several thousand estimates of the social cost for a specific gas, emitted in a specific year, with a specific discount

rate. These estimates create a frequency distribution based on different values for key uncertain climate model parameters. The shape and characteristics of that frequency distribution demonstrate the magnitude of uncertainty relative to the average or expected outcome.

To further address uncertainty, the IWG recommends reporting four SC-GHG estimates in any analysis. Three of the SC-GHG estimates reflect the average damages from the multiple simulations at each of the three discount rates. The fourth value represents higher-than-expected economic impacts from climate change. Specifically, it represents the 95th percentile of damages estimated, applying a 3% annual discount rate for future economic effects. This is a low-probability but high-damage scenario representing an upper bound of damages within the 3% discount rate model. The estimates below follow the IWG recommendations.

The SC-GHGs associated with estimated emissions from future potential development of the lease parcels are reported in Table 3.25. These estimates represent the present value (from the perspective of 2021) of future market and nonmarket costs associated with CO_2, CH_4, and N_2O emissions from potential well development and operations, and potential end use, as described in Subsection 3.6.2.2. Estimates are calculated based on IWG estimates of social cost per metric ton of emissions for a given emissions year and BLM's estimates of emissions in each year. They are rounded to the nearest $1,000. The estimates assume development will start in 2022 and end-use emissions will be complete in 2041, based on experience with previous lease sales.

Table 3.25. SC-GHGs Associated with Future Potential Development

	SC-GHG (2020$)			
	Average Value, 5% discount rate	**Average Value, 3% discount rate**	**Average Value, 2.5% discount rate**	**95th Percentile Value, 3% discount rate**
Development and Operations	$359,000	$983,000	$1,370,000	$2,728,000
End-Use	$8,863,000	$31,757,000	$47,578,000	$95,040,000
Total	$9,222,000	$32,740,000	$48,948,000	$97,768,000

ESTIMATED GHG EMISSIONS FOR REASONABLY FORESEEABLE ENVIRONMENTAL TRENDS AND PLANNED ACTIONS

The analysis of GHGs contained in this EA includes estimated emissions from those parcels being offered in this lease sale as described above. In addition to this lease sale, the BLM is offering parcels in six other BLM administrative units within the first quarter of 2022. The estimated GHG emissions from parcels being offered in each of those individual sales is contained in the associated EA for each sale. When analyzing the potential impacts from multiple lease sales, it is important to note that it is the actual production of fossil fuel commodities on leased parcels that generates GHG emissions and not the offering of acres or parcels for lease in a particular grouping of lease sales. Parcels offered in a lease sale may or may not be sold, and sold parcels may or may not go into production for several years, if at all. Typically, lease sales in different BLM administrative units are not offered on the same date and each administrative unit has discretion to defer its sale or defer or add parcels as a result of scoping and protests. The dynamic nature of the lease sale process and independence of each administrative unit for constructing its lease sales, precludes an analysis of potential GHG emissions that could occur from other lease sales that might occur in the same quarter. In addition, combining all of the offered parcels from multiple lease sales that may occur over a 3-month period, assuming all acres will be sold and produce immediately, and estimating GHG emissions from development on the offered acreage based on these

assumptions would result in an inflated, unrealistic, quantity of estimated emissions that would not be useful to the decision maker and would not accurately inform the public of the magnitude of probable cumulative emissions and impacts.

An assessment of GHG emissions from BLM's fossil fuel authorizations including coal leasing and oil and gas development is included in the BLM Specialist Report on Annual GHG Emissions (referred to as Annual Report, see Chapter 5 (BLM 2021c). The Annual Report includes estimates of reasonably foreseeable GHG emissions related to BLM lease sales anticipated during the calendar year, as well as the best estimate of emissions from ongoing production, and development of parcels sold in previous lease sales. It is, therefore, an estimate of cumulative GHG emissions from the BLM fossil fuel leasing program based on actual production and statistical trends.

The Annual Report provides an estimate of short-term and long-term GHG emissions from lease sale activity across the BLM. The short-term methodology presented in the Annual Report includes a trends analysis of 1) leased federal lands that are held by production, 2) approved applications for APDs, and 3) leased lands from competitive lease sales occurring over the next annual reporting cycle (12 months), to provide a 30-year projection of potential emissions from federal lease actions over the next 12 months. The long-term methodology uses oil and gas production forecasts from the EIA to estimate GHG emissions out to 2050 that could occur from past, present, and future oil and gas development. These analyses are the basis for projecting GHG emissions from lease parcels that are likely to go into production during the analysis period of the Annual Report and represent both a hard look at GHG emissions from fossil fuel leasing and the best available estimate of reasonably foreseeable cumulative emissions related to any one lease sale or set of quarterly lease sales. Table 3.26 shows the cumulative estimated GHG emissions from the development of the projected lease sale acres in 2021 using the methodology described above. The 5-year lease averages include all types of oil and gas development related leases, including leases granted under the Mineral Leasing Act as well as other authorities, that have been issued over the last 5 years. As such, the projections made from the 5-year averages represent the potential for all types of future potential oil and gas leasing activity. However, they may also overestimate the potential emissions from the 12-month cycle of competitive oil and gas leasing activities if the projected lease sale activity does not actually occur.

Table 3.26. Reasonably Foreseeable Projected Emissions

State (BLM Administrative Unit)	**Annual Report Table 4-8 Projected Lease Acres 2021 Projected Lease Acres 2021**	**Annual Report Figure 5-1 GHG Emissions from Projected Lease Acres 2021 (Mt CO_2e per year)**
Alabama (ES)	1	0.00
Alaska	356,021	9.33
Arkansas (ES)	536	0.04
California	184	0.02
Colorado	67,268	10.21
Idaho	1,881	0.03
Kansas (ES)	287	0.02
Kentucky (ES)	37	0.01
Louisiana (ES)	9,334	2.59
Michigan (ES)	5,006	0.17
Mississippi (ES)	2,609	0.06

State (BLM Administrative Unit)	**Annual Report Table 4-8 Projected Lease Acres 2021 Projected Lease Acres 2021**	**Annual Report Figure 5-1 GHG Emissions from Projected Lease Acres 2021 (Mt CO_2e per year)**
Montana	60,807	2.48
Nebraska (WY)	19	0.01
Nevada	155,583	0.29
New Mexico	38,926	22.90
North Dakota (MT)	2,477	0.07
Ohio (ES)	681	0.18
Oklahoma (NM)	2,052	0.05
South Dakota (MT)	1,543	0.02
Texas (NM)	1,602	0.09
Utah	141,832	9.13
West Virginia (ES)	42	0.01
Wyoming	562,985	88.87
Total	**1,411,713**	**146.56**

NO ACTION ALTERNATIVE

Under the No Action Alternative, the parcel(s) would not be leased, and no new foreseeable oil and gas development would occur on the subject lease parcels. As a result, no new GHG emissions from the development of these lease parcels would occur and no emissions from development activities on the parcels would contribute to national and global GHG emissions that influence climate change.

EIA studies regarding short-term "supply disruptions" suggest that reducing domestic supply (in the near-term under the current supply / demand scenario) would lead to the import of more oil and natural gas from other countries, including countries with lower environmental and emission control standards than the United States. The 2021 Annual Energy Outlook (EIA 2021b) long-term energy outlook for the high U.S. domestic natural gas supply scenario describes a potential 1.2% growth in natural gas–related GHG emissions for the power sector through year 2050 and an almost 3% decline in coal-related emissions over the 30-year period. For the EIA projected low oil and gas supply scenario, power sector related GHG emissions are reduced for both natural gas and coal through the period, though at a smaller relative percentage for coal, resulting in coal-related emissions remaining higher than those associated with natural gas at year 2050 (EIA 2021c).

3.6.2.3 *Mitigation Strategies*

GHG emissions contribute to changes in atmospheric radiative forcing resulting in climate change impacts. GHGs act to contain solar energy loss by trapping longer-wave radiation emitted from the Earth's surface and act as a positive radiative forcing component. The buildup of these gases has contributed to the current changing state of the climate equilibrium toward warming. Chapters 8 and 9 of the Annual Report provide a detailed discussion of climate change science, trends, and impacts.
The relationship between GHG emissions and climate impacts is complex, but a project's potential to contribute to climate change is reduced as its net emissions are reduced. When net emissions approach zero, the project has little or no contribution to climate change. Net-zero emissions can be achieved through a combination of controlling and offsetting emissions. Emission controls (e.g., vapor recovery

devices, no-bleed pneumatics, leak detection and repair, etc.) can substantially limit the amount of GHGs emitted to the atmosphere, while offsets (e.g., sequestration, low carbon energy substitution, plugging abandoned or uneconomical wells, etc.) can remove GHGs from the atmosphere or reduce emissions in other areas. Chapter 10 of the Annual Report provides a more detailed discussion of GHG mitigation strategies.

The Federal government has issued regulations that will reduce GHG emissions from any development related to the proposed leasing action. These regulations include the New Source Performance Standard for Crude Oil and Natural Gas Facilities (49 CFR 60, subpart OOOOa) which imposes emission limits, equipment design standards, and monitoring requirements on oil and gas facilities.

NMED has developed the "Oil and Natural Gas Regulation for Ozone Precursors" (20.2.50.1 NMAC), which is anticipated to go into effect March 2022. Approximately 50,000 wells and associated equipment will be subject to this regulation. It is anticipated that the regulation will annually reduce CH_4 emissions by 200,000 to 425,000 tons.

The BLM's regulatory authority is limited to those activities authorized under the terms of the lease and are primarily included in the upstream portions of natural gas and petroleum systems. This decision authority is applicable when development is proposed on public lands and BLM assesses its specific location, design, and proposed operation. In carrying out its responsibilities under NEPA, the BLM has developed BMPs designed to reduce emissions from field production and operations. BMPs may include limiting emissions on stationary combustion sources, mobile combustion sources, fugitive sources, and process emissions occurring on a lease parcel. Analysis and approval of future development may include application of BMPs within BLM's authority, as COAs, to reduce or mitigate GHG emissions. Additional measures developed at the project development stage also may be incorporated as applicant-committed measures by the project proponent or added to necessary air quality permits. Additional information on mitigation strategies, including emissions controls and offset options, are provided in the Annual GHG Report (BLM 2021c).

3.6.3 Issue 3: Water Use and Quantity

How would future potential development of the nominated lease parcels affect surface and groundwater quantity?

The analysis area for this issue is the total area of Chaves, Eddy, and Lea Counties, which collectively make up the New Mexico portion of the Permian Basin. This analysis area is used because water sources used to support future potential development of the nominated lease parcels would likely be sourced from these three counties.

Water uses associated with development of the nominated lease parcels would occur during the 30- to 60-day well construction and completion period (such as hydraulic fracturing) and during the 20-year operation period (e.g., water use associated with dust control). While much of the water use associated with oil and gas development is expected to occur within a 30-to-60-day construction period, the effect of this use on groundwater aquifers is expected to last until recharge occurs. Due uncertainty about water sources and recharge rates, it is assumed that all water use associated with oil and gas development is likely to be a long-term effect. Additionally, the ability for aquifer recharge may be affected by drought conditions associated with climate change.

The following analysis summarizes information contained in the *2020 BLM Water Support Document for Oil and Gas Development in New Mexico;* hereafter referred to as the Water Support Document (BLM 2020a) and incorporated by reference. Water use for development of the nominated lease parcels is

assumed to primarily come from groundwater sources based on previous oil and gas development in the area.

3.6.3.1 *Affected Environment*

CURRENT TOTAL WATER USE IN THE ANALYSIS AREA

The USGS report, *Estimated Use of Water in the United States in 2015* (Dieter et al. 2018), lists total water withdrawals across eight water use categories: aquaculture, domestic, industrial, irrigation, livestock, mining, public water supply, and thermoelectric power. Water use for 2015 is summarized in Table 3.27for the eight water use categories in each of the three counties within the analysis area. Industrial is the largest category of water use in all counties, accounting for an average of 75% (466,784 acre-feet [AF]) of the total water withdrawal for the analysis area (620,416 AF). Approximately 88% (546,194 AF) of the total water use is from groundwater. Mining (which includes oil and gas development) comprises approximately 15% of water withdrawals. All mining-related water use (95,800 AF) is from groundwater. Of that total, 99% of withdrawals are from saline sources.

Table 3.27. Tri-County Analysis Area 2015 Water Use by Category

Category	Surface Water			Groundwater			Total Withdrawals			
	Fresh (AF)	Saline (AF)	Total (AF)	Fresh (AF)	Saline (AF)	Total (AF)	Fresh (AF)	Saline (AF)	Total (AF)	Percent Total Use
Aquaculture	-	-	-	39,470	-	39,470	39,470	0	39,470	6%
Domestic	-	-	-	1,121	-	1,121	1,121	0	1,121	0%
Industrial	73,908	-	73,908	392,877	-	392,877	466,784	0	466,784	75%
Irrigation	314	-	314	10,537	-	10,537	10,851	0	10,851	2%
Livestock	-	-	-	1,782	-	1,782	1,782	0	1,782	0%
Mining	-	-	-	1,573	94,227	95,800	1,573	94,227	95,800	15%
Public Water Supply	-	-	-	1,827	-	1,827	1,827	0	1,827	0%
Thermoelectric Power	-	-	-	2,780	-	2,780	2,780	0	2,780	0%
Total	**74,221**	**-**	**74,221**	**451,967**	**94,227**	**546,194**	**526,188**	**94,227**	**620,416**	**100%**

Source: Dieter et al. (2018). The Mining category (highlighted in dark gray) represents the category into which the Proposed Action falls.

Note: See the Water Support Document (BLM 2020a) for graphical representation of these data, as well as comparisons with water use across the state of New Mexico.

CURRENT WATER USE ASSOCIATED WITH OIL AND GAS DEVELOPMENT

As part of oil and gas development, water is used for drilling fluid preparation and makeup water for completion fluids, in well stimulation (of which the most common method is hydraulic fracturing), as rig wash water, as coolant for internal combustion engines, for dust suppression on roads or well pads, and for equipment testing. Water uses for oil and gas development in the Pecos District tri-county area are typically sourced from groundwater. Of these uses, hydraulic fracturing activities comprise the vast majority of water use. The amount of water used for hydraulic fracturing is dependent on many factors, including the geologic formation. In the PDO, most wells use water for completion, rather than nitrogen gel or slickwater completion technologies (Herrell 2020).

Oil and gas operators are required by the State of New Mexico to disclose water use to FracFocus (per NMAC 19.15.16), a national hydraulic fracturing chemical registry managed by the Ground Water Protection Council and Interstate Oil and Gas Compact Commission to provide objective information on hydraulic fracturing. The BLM examined FracFocus data reported for the calendar years of 2014 to 2019 to ascertain actual water use in the analysis area (Table 3.28).

Table 3.28. Actual Water Use in the Tri-County Analysis Area for Calendar Years 2014 to 2019

Year	Federal Water Use (AF)	Non-Federal Water Use (AF)	Total Water Use (AF)	Federal Water Use (%)	Average Water Use per Well (AF)	Total Number of Wells Reported to Frac Focus
2014	1,303	2,438	3,741	34.9	7.0	537
2015	3,996	4,219	8,215	48.6	16.4	502
2016	836	5,932	6,768	12.3	22.6	300
2017	3,157	11,078	14,235	22.2	26.8	531
2018	8,913	22,147	31,060	28.7	32.0	972
2019	7,847	26,986	34,833	22.5	40.9	852
Total	**26,052**	**72,800**	**98,852**	**26.3**	**26.8**	**3,694**

Source: BLM (2020a). The analysis contained in this table provides percentage contribution rounded to two decimal points.
Note: Tri-county analysis area is Lea, Chaves, and Eddy Counties.

Water use has increased from 3,741 AF in 2014 to 34,833 AF in 2019, with a corresponding basin-wide average water use per well increase from 6.82 AF per well to 40.9 AF per well (BLM 2020a). Although the average water use per well for hydraulic fracturing increased to 40.9 AF in 2019, the 6-year average is 26.8 AF per well. This increase in water use per well is likely due to the higher volume of wells, the likelihood that horizontal wells are being drilled to longer lengths, and the continued use of hydraulic fracturing technologies in well drilling and completion (BLM 2020a).

While much of the water use associated with oil and gas development is expected to occur within a 30- to 60-day construction period, the effect of this use on groundwater aquifers is expected to last until recharge occurs. The Water Support Document (BLM 2020a) indicates there are four potential sources of groundwater in the Tri-County Analysis Area: the Pecos valley alluvium aquifer; the Dewey Lake and Santa Rosa aquifer; the Rustler Formation aquifer; and the Captain Reef aquifer (BLM 2020a). A recent study of within the analysis area to identify sources waters indicated most water wells contained a mix of source waters; however, in general, the main water source for water wells Dewey Lake and Santa Rosa aquifer and the Rustler Formation. Some wells near the community of Carlsbad access the Capitan Reef aquifer (BLM 2020a). Recharge for the Dewey Lake and Santa Rosa aquifer and the Rustler Formation aquifer is driven by precipitation (BLM 2020a). No additional information is available about recharge rates. In light of this uncertainty about water sources and recharge rates, the BLM therefore assumes that water use associated with oil and gas development is likely to be a long-term effect and the ability for aquifer recharge may be affected by drought conditions associated with climate change.

REASONABLY FORESEEABLE ENVIRONMENTAL TRENDS AND PLANNED ACTIONS

Between 2012 and 2014, the BLM developed an RFD scenario for the PDO that projected approximately 800 new wells per year, for a total of 16,000 wells over a 20-year period. With consideration of the revised water use estimates discussed in the Water Support Document (31.2 AF per well), development of the RFD scenario would require 499,200 AF water, or 24,960 AF of water in any given year if all wells

were drilled horizontally (BLM 2020a). Note that this includes both federal and non-federal wells. Well development projected as a result of ongoing BLM and state lease sales is included in this RFD scenario. Well development associated with recent or reasonably foreseeable APDs or master development plans is also included in the RFD scenario. If more water-intensive stimulation methods (e.g., slick water fracturing) are implemented or if laterals become longer, aggregate water use could increase from estimates provided in the Water Support Document (BLM 2020a). Alternatively, water use estimates could be lower if produced water is reused or recycled for use in hydraulic fracturing or if methods such as nitrogen completions are implemented.

The projected annual use associated with the RFD scenario comprises about 4% of tri-county analysis area 2015 total water withdrawals (620,416 AF, which already includes past and present water use). Irrigation would remain by far the largest water use within the analysis area (currently 75% of all water use within the tri-county analysis area and 82% of all water use within the state).

There are no reasonably foreseeable mining projects that would contribute to water withdrawals within the tri-county analysis area. Some water use would be required during construction and operation of reasonably foreseeable transmission lines and pipelines; these uses are addressed in the Water Support Document (BLM 2020a).

As noted in Section 3.6.2.1, predicted effects from climate change for the analysis area include intensified droughts. A Bureau of Reclamation report (Bureau of Reclamation 2013) predicts decreases in overall water availability by one-quarter to one-third through the end of the twenty-first century for the Upper Rio Grande Basin (southern Colorado to central southern New Mexico).

3.6.3.2 *Environmental Effects*

Drilling and completion of five horizontal wells on the nominated lease parcels is estimated to use approximately 156 AF of groundwater. This calculation is based on a factor of 31.2 AF per horizontal well, which the BLM continues to consider a reasonable current estimate of water use associated with drilling and completion of a single horizontal well within the analysis area (BLM 2020a); this value falls between the aforementioned average per-well estimate in 2019 (40.9 AF) and the 6-year average (26.8 AF). If more water-intensive stimulation methods (e.g., slick water fracturing) are implemented or if laterals become longer, water use could increase from estimates provided in the Water Support Document (BLM 2020a). Alternatively, water use estimates could be lower if produced water is reused or recycled, or if less water-intensive stimulation methods are used (e.g., nitrogen) in hydraulic fracturing.

Water use associated with drilling and completion of the well is expected to occur within a 30- to 60-day period. Assuming that all wells are developed in the same year, groundwater water use associated with future potential development of the lease would result in a 0.01% increase of the tri-county analysis area 2015 total water use (620,416 AF), 0.01% of the tri-county area 2015 total groundwater use (546,194 AF), and would result in an 0.07% increase over 2015 water use in the mining category for the tri-county analysis area (95,800 AF). The total estimated water use for drilling and completion of the five horizontal wells in the nominated lease parcels (7.8 AF) in a single year represents approximately 0.4% of the 2019 oil and gas water use reported to FracFocus (34,833 AF) (BLM 2020a).

Annual water use associated with future potential development of the proposed lease parcels (5 wells, resulting in 156 AF of water) would comprise 0.6% of annual RFD water use and 0.03% of total water use associated with the RFD. Long term water requirements during operation would depend on the project but could include coolant for internal combustion engines and dust suppression on roads or well pads.

Water used for the purpose of oil and gas drilling, completion, and operations would be purchased legally from those who hold water rights in or around the Permian Basin. The transaction would be handled by the NMOCD, as well as the NMOSE. All water uses would be evaluated at the time of proposed lease development in site-specific NEPA analysis and subject to standard lease terms and conditions. Table 2-9 of the Water Support Document (BLM 2020a) identifies the potential sources of groundwater in the analysis area.

Produced water associated with development of the lease parcels is estimated at approximately 2,907,000 bbl of water. Produced water would be disposed of at regulated and permitted commercial facilities (such as SWD wells). Water sourced from outside of the geological formation that is used in hydraulic fracturing, which remains in the geological formation after hydraulic fracturing is complete, is likely lost to the hydrological water cycle (Kondash et al. 2018).

3.6.3.3 *Mitigation Measures and Residual Effects*

Public concern about water use from hydraulic fracturing is especially high in semiarid regions such as the tri-county analysis area, where water withdrawals associated with hydraulic fracturing comprise the majority of oil and gas–related water use. Overall, there have been calls to increase the use of alternative water sources such as brackish water or recycling produced water, minimizing the extent to which oil and gas–related consumptive water uses contribute to the strain on local freshwater resources (Kondash et al. 2018). The BLM encourages the use of recycled water in hydraulic fracturing techniques, and in 2019, the State of New Mexico passed the Produced Water Act, which encourages oil and gas producers to reuse produced water when possible, rather than relying on freshwater sources for oil and gas extraction. Additionally, the State of New Mexico has promulgated new rules on produced water stemming from passage of the 2019 Produced Water Act (NMED 2021c)[10]. The rules were developed to encourage the recycling, re-use or disposition of produced water while also affording reasonable protection against contamination of fresh water and establish procedures by which persons may transport and dispose of produced water, drilling fluids and other liquid oil field waste. Such rules do not change the requirement that development of a Federal lease must comply with all applicable Federal and State laws and regulations.

Recent studies indicate that the water used for hydraulic fracturing may be retained within the shale formation, with only a small fraction of the fresh water injected into the ground returning as flowback water; water returning to the surface is highly saline, is difficult to treat, and is often disposed through deep-injection wells (Kondash et al. 2018). NMED recently signed a memorandum of understanding with New Mexico State University to develop new technologies for treating produced water to inform future policies for produced water reuse.

3.6.4 Issue 4: Dunes Sagebrush Lizard and Lesser Prairie-Chicken

How would future potential development of the nominated lease parcels affect dunes sagebrush lizard (DSL) and lesser prairie-chicken (LPC)?

The analysis area established to analyze effects on LPC and DSL is the 20 million-acre BLM PDO, comprising the CFO and RFO, in which habitat for these species is located. For the purposes of this analysis, short-term effects to LPC and DSL are defined as those that cease after well construction and completion (30–60 days); long-term effects are defined as those associated with operation, which would cease after well operation or until habitat is successfully reclaimed.

[10] The State of New Mexico House Bill 546, which included the Produced Water Act, went into effect July 1, 2019. Amendments to NMAC 19.15.34, Produced Water, Drilling Fluids and Liquid Oil Field Waste, became effective on October 13, 2020.

3.6.4.1 *Affected Environment*

Species proposed for listing under the ESA as threatened or endangered are managed with the same level of protection as listed species. BLM policy for candidate species is contained in BLM Manual 6840 (BLM 2008b). The BLM carries out management consistent with the principles of multiple use for the conservation of special status species and candidate species and their habitat. 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, and that BLM actions would not adversely affect the likelihood of recovery of any threatened or endangered species (BLM 2008b). Under the ESA, DSL was petitioned for listing in 2018 (USFWS 2021c), and LPC was petitioned for relisting in 2016 (USFWS 2021d). Both DSL and LPC petitioned listings are under review under the ESA.

DUNES SAGEBRUSH LIZARD

The DSL is a habitat specialist native to the shinnery oak sand dune habitats within the RFO and CFO. These habitats extend from the San Juan Mesa in northeastern Chaves County, Roosevelt County, and through eastern Eddy and southern Lea Counties. Approximately 65% to 75% of DSL the habitat distribution area occurs within New Mexico, with the majority of this portion occurring within the planning area (Smolensky and Fitzgerald 2011; USFWS 2021c). This species has an extremely strong affinity for bowl-shaped depressions in active dune complexes referred to as sand dune blowouts, with a preference for relatively large blowouts and select microhabitat within a given blowout (BLM 2007, 2008a). Within their geographic range, the presence of this species is also associated with composition of the sand; they only occur at sites with relatively coarse sand.

Currently, the species is listed as sensitive by the BLM NMSO and endangered by the State of New Mexico. This species was petitioned for federal listing in 2018 and is under review under the ESA. This species' current management within the State of New Mexico is currently being driven by the state listing status and protections afforded under the CCA (USFWS et al. 2008) and Candidate Conservation Agreement with Assurances (CCAA) prescriptions (USFWS et al. 2014; USFWS and Texas Comptroller of Public Accounts [CPA] 2019), as well as the Special Status Species Resource Management Plan Amendment (RMPA) of 2008 (BLM 2008a). The CCA and CCAA are voluntary agreements limited to existing participants.

Texas A&M University developed a mapped DSL habitat distribution area in New Mexico based on known occupied, suitable, and interconnecting unsuitable DSL habitat and its connectivity (Laurencio and Fitzgerald 2010). Based on this model, a total of 543,527 acres are within the New Mexico DSL mapped habitat distribution area. The portions of the species' habitat distribution area that contain suitable and/or occupied DSL habitat are a spatially dynamic system of patches of shinnery oak and sand dune complexes with interspersed flat areas without dunes. Based on habitat suitability analysis and occupancy data, the BLM estimates approximately 66% (358,727 acres) of the species' mapped habitat distribution area contains suitable dune complexes and vegetation that meet the species' habitat requirements (Allen 2020; Laurencio and Fitzgerald 2010).

The connectivity of dune complexes and the ability of DSL to locally migrate between occupied dunes is essential to reproductive success (Smolensky and Fitzgerald 2011). The utilization of microhabitats within a greater system, in conjunction with the species' small size and restricted ability to travel long distances, places this species at risk of adverse effects from surface occupancy development that directly disturbs dunal habitat or results in fragmentation of habitat (Smolensky and Fitzgerald 2011). This species is most sensitive to long-term surface disturbances (e.g., well pads, access roads, facility sites, etc.); that may deter movement between suitable dunal complexes, which are inherently dispersed.

LESSER PRAIRIE-CHICKEN

The LPC is currently listed as sensitive by the BLM NMSO. The BLM CFO management of the LPC is determined by the 2008 Special Status Species RMPA (BLM 2008a), which designates five LPC management areas totaling 1,499,746 acres. BLM management of LPC includes protection of the species' sensitive breeding system in which males form display groups on arenas called leks and make vocalizations to attract females (BLM 2008a).

LPC was proposed for listing as threatened in December 2012 (*Federal Register* 77:73828–73888), and the USFWS announced the final listing of the species as threatened under the ESA in April 2014 (*Federal Register* 79:19974–20071). In July 2016, the LPC was removed from the Federal List of Endangered Species and Threatened Wildlife (*Federal Register* 81:47047–47048). The listing decision was vacated by the U.S. District Court for the Western District of Texas on September 1, 2015 and was not due to the successful recovery of populations and/or habitat. The LPC was then petitioned for relisting to the Federal List of Endangered Species and Threatened Wildlife in November 2016 (Federal Register 81:86315–86318). The relisting of this species is still under review.

In addition, in the state of New Mexico, management is currently being driven by listing status and protections afforded under the LPC/DSL CCA (USFWS et al. 2008) and CCAA prescriptions (USFWS et al. 2014; USFWS and Texas CPA 2019). The CCA and CCAA are voluntary agreements limited to existing participants.

In New Mexico, the LPC formerly occupied a range that encompassed the easternmost third of the state, extending from the Pecos River to 30 miles west near Fort Sumner. This occupied area covered about 14,672 square miles in nine eastern counties: Union, Harding, Chaves, De Baca, Quay, Curry, Roosevelt, Lea, and Eddy, at the beginning of the twentieth century. Remnant populations are known to exist only in parts of Lea, Eddy, Chaves, and Roosevelt Counties. The currently occupied area comprises approximately 20% of the species' historical range.

LPC are found throughout dry grasslands that contain shinnery oak (Quercus havardii) or sand sagebrush (Artemisia filifolia). Currently, they are most commonly found in mixed-grass vegetation, sometimes in short-grass prairie habitat. They are occasionally found in farmland and smaller fields, especially in winter. Shinnery oak shoots are used as cover and produce acorns, which are an important food source for the species. The current geographic range of shinnery oak is nearly congruent with that of the LPC, and these species sometimes are considered ecological partners. Population densities of LPC are greater in shinnery oak habitat than in sand sagebrush habitat (BLM 2007, 2008a).

LPC use a breeding system in which males form display groups on arenas called leks. During mating displays, male vocalizations, called booming, attract females to the lek. Leks are often on knolls, ridges, or other raised areas; however, leks are just as likely to be on flat areas in New Mexico due to topography constraints. Leks may be completely bare, covered with short grass, or have scattered clumps of grass or short tufts of plants. The visibility of surroundings and the ability of the females to hear the male vocalizations are important characteristics of occupied leks. Due to their breeding system and obligate vegetation requirements, LPC are particularly sensitive to anthropomorphic development (including oil and gas development) and habitat fragmentation. Lek use and nesting activity in Eddy and Lea Counties substantially decreased (and in many areas ceased to exist) during increased oil and gas development periods accompanied by severe droughts, affecting the same LPC habitat components. A number of active leks (33) were documented well into the 1990s by BLM biologists, who conducted the primary lek surveys during that era within both the BLM CFO (Eddy and Lea Counties) and BLM RFO (Chaves and Roosevelt Counties) (Sherman 2020). There are currently no known active leks within the BLM CFO. Within the BLM RFO planning area, where there is a greater density of LPC, there were 297 known

active leks, 179 of which were surveyed for LPC in 2019 (Baggao 2020). Of the 179 leks surveyed, 57 were found to be active (Baggao 2020). Adult LPC are known to stay within approximately 3 km (1.9 miles) of their lek and nesting site, with the exception of juveniles traveling upwards of 12 km (7.5 miles) once fledged to establish territory (Hunt 2004).

As a species that inhabits expansive grasslands lacking in tall canopy vegetation, the species has been theorized to be inherently fearful of anthropomorphic aboveground structures. Linear infrastructure such as roads and overhead transmission lines, as well as noise produced by oil and gas infrastructure, have been determined to be the more impactful disturbance types for LPC; however, effects of overgrazing within suitable grassland habitat has also been determined to contribute to the decrease in New Mexico populations (Hunt 2004). Analysis of LPC tolerance for development disturbance within their habitat has shown that the species is susceptible to noise, activity, and visual alterations within their habitat (Hunt 2004; Pruett et al. 2009; Thompson et al. 2015). It was also found that LPC avoid crossing roads and have a strong avoidance of overhead power lines. The primary predators of LPC are avian raptor species that perch on tall objects (natural and industrial alike) to survey for prey, thus increased tall structure density within habitat may increase predation pressure and avoidance of these areas by existing populations (Pruett et al. 2009; Thompson et al. 2015).

The analysis area contains five designations of LPC management areas totaling 1,499,746 acres: the Core Management Area (CMA), totaling 221,402 acres; the Primary Population Area (PPA), totaling 265,730 acres; the Sparse and Scattered Population Area (SSPA), totaling 218,126 acres and found only in the RFO, and the Isolated Population Area (IPA), totaling 794,487 acres, and which include 17 Habitat Areas [HAs]; totaling 112,989 acres). Management practices, including areas open and closed to leasing, are outlined in the 2008 Special Status Species RMPA (BLM 2008a). In the future, new leasing in occupied LPC habitat would be linked to the status of the species or habitat in New Mexico, as identified in the annual USFWS candidate notice of review or other periodic agency review.

REASONABLY FORESEEABLE ENVIRONMENTAL TRENDS AND PLANNED ACTIONS

The BLM PDO, which is composed of the CFO and RFO, encompasses over 20 million acres within the planning area boundary. This includes 3.6 million acres of BLM surface and 7.6 million acres of federally managed minerals. Reasonably foreseeable environmental trends and planned actions within the PDO that would affect DSL and LPC include land use authorizations, livestock grazing, recreational uses (including off-highway vehicles, non-motorized recreation, etc.), mineral exploration and development, fire and fuels treatments, and other vegetation treatments, including noxious weeds management.

Additionally, reasonably foreseeable environmental trends and planned actions within the PDO would result in a 110,740 acres of new surface disturbance for a total of 427,740 acres of total landscape-level surface disturbance, of which the future potential development of the nominated lease parcels would comprise approximately 22.5 acres (0.005% of total landscape-level surface disturbance; see Table 3.2). The estimated surface disturbance from future potential development of the nominated lease parcels is approximately 0.00001% of the 20 million-acre PDO (see Table 3.2). Additionally, the RFD scenario projected approximately 800 new wells per year, for a total of 16,000 new wells over a 20-year period. Roads, pads, and other associated infrastructure of oil and gas development may further contribute to additional fragmentation of habitat depending on the site-specific conditions. Oil- and gas-related traffic may also result in direct mortalities. Habitat fragmentation can reduce the overall fitness of a species by isolating populations from one another, making it more difficult for intra- and inter-population movement between patches of suitable habitat. This can lead to less resilience to stochastic events and lead to reduced genetic diversity of this species (genetic bottlenecks).

Prior to the application of species-specific protections for LPC and DSL by BLM management decisions (RMPA 2008), voluntary conservation agreements, and implementation of USFWS and NMDGF protection measures designed to conserve and avoid effects to species habitat, historic high-density oil and gas development was known to have reduced the amount of suitable and occupied habitat of these species. Additionally, BLM management decisions have a continued focus on conserving lands (habitat) for special status species, including LPC and DSL, as disclosed in the 2008 RMPA and those managed by candidate conservation agreements (BLM 2007, 2008a, 2008c; USFWS et al. 2008; USFWS et al. 2014; USFWS and Texas CPA 2019) (see Section 3.3.2).

For DSL, the development of the RFD scenario would be subject to management per the LPC/DSL 2008 RMPA as well as standard terms and conditions if development is to occur within the species' distribution range and surrounding areas (BLM 2008a). However, surface development may incrementally contribute to barriers between suitable dune complexes within the DSL habitat distribution area in New Mexico (habitat fragmentation). Habitat fragmentation may decrease habitat connectivity and reduce opportunity for expansion of occupied habitat into discontinuous suitable habitat. Note that the standard terms and conditions have the ability to minimize effects of surface occupancy, including habitat fragmentation through site selection, and are dependent on location and ecological conditions. Future potential development associated with the Proposed Action (an estimated five wells, or one well per parcel) is approximately 0.0009% of the RFD (16,000 wells) and would occur outside of the areas of greatest conservation concern for this species.

For LPC, habitat fragmentation and increased surface use associated with the RFD scenario risk reducing available habitat. The BLM's land management decisions include closure to leasing or leasing with NSO stipulations within IPA-HAs (depending on individual HA conditions). The BLM also has the ability to close leasing to suitable and occupied habitat within the PPA on a site-specific basis (BLM 2008a). These management decisions allow the BLM to prevent surface occupancy related to energy development (BLM 2008a) in order to protect habitat occupied by this species and help prioritize these areas for reclamation efforts to increase the availability of non-fragmented and suitable LPC habitat. In addition, the BLM has previously and plan to continue working with a multi-stakeholder group to restore and improve habitat conditions (e.g., revegetation, reclamation of historic surface development, water access, and species surveys and monitoring) across the LPC range, including efforts related to the LPC and DSL CCA/CCAA and Restore New Mexico. Future potential development associated with the Proposed Action (an estimated five wells, or one well per parcel) is approximately 0.009% of the RFD (16,000 wells) and would occur outside of the areas of greatest concern for this species.

3.6.4.2 *Environmental Impacts*

Due to application of lease stipulations and standard terms and conditions, surface disturbance from future potential development of the nominated lease parcels is not likely to result in a decrease in available suitable or occupied habitat for DSL and LPC. Potential effects to LPC and DSL and their habitats related to surface-disturbing activities from future potential development of the nominated lease parcels is analyzed in detail below. Effects related to surface disturbance would be long-term, continuing until well operations cease and habitat is successfully reclaimed.

DUNES SAGEBRUSH LIZARD

None of the nominated lease parcel are within the DSL habitat distribution area (analysis area). During internal scoping, PDO biologists reviewed aerial imagery and identified active dunes within the boundaries of nominated lease parcel 396 (BLM 2020b); however, this parcel is 31.86 miles south of the DSL habitat distribution area. Therefore, no impacts to DSL or its habitat are expected to result from the future potential development of the nominated lease parcels.

LESSER PRAIRIE-CHICKEN

Approximately 320.80 acres, or 100% of nominated lease parcel 408, are located within the 218,126-acre LPC SSPA (Table 3.29) and is approximately 3.07 miles northwest of the LPC SSPA and 33.68 miles southwest of the LPC PPA (BLM 2021b). None of the remaining nominated lease parcels are located within an LPC management area and are therefore not anticipated to result in adverse impacts to the species or its' habitat. Depending on the selected location of surface disturbance, development of nominated lease parcel 408 could result in up to 4.5 acres of surface disturbance within the LPC SSPA, and a potential decrease in LPC habitat quality from human presence and loss of vegetation (see Table 3.29). Both effects would be considered long-term because they would result in a loss of habitat and increased fragmentation until operations cease and habitat is successfully reclaimed. Within the SSPA, occupied LPC habitat (defined as areas within 1.5 miles of a lek site) is generally closed to new leasing. There are no known leks within 2 miles of parcel 408 (BLM 2020e).

Table 3.29. Potential Effects to LPC Management Areas from Future Potential Development of the Nominated Lease Parcels

LPC Management Areas (acres)	Lease Parcel (acres)	Description of Overlap	Total Surface Disturbance (acres)	Applicable Stipulations and Lease Notices
SSPA (218,126)	4,084 (333.34)	Parcel 408 is 100% within the LPC SSPA.	4.5 acres (0.002% of the LPC SSPA)	SENM-S-39-CSU POD

Note: SSPA = Sparse and Scattered Population Area. See Section 3.6.4.1 for description.

Stipulation SENM-S-39-CSU is applied to parcel 408, which requires a plan of development (POD) for the entire lease to be submitted for review and approval prior to development actions, which may provide protections to LPC (see Appendix B). Additionally, parcel 408 would be subject to LPC Timing Restriction Zone COAs to restrict the timing of construction activities to reduce potential noise impacts during LPC breeding season. As no leks are located within the boundaries of or within 2 miles of the nominated lease parcels, current LPC breeding efforts are not expected to be impacted.

Together, the applied CSU stipulation applied to nominated lease parcel 408 and COAs determined at the time of proposed development would minimize impacts to LPC and LPC habitat within this parcel. Site-specific analysis, including review of the required POD and pre-disturbance biological surveys at the lease development stage, would contribute to avoidance, minimization, and reduction of impacts to suitable habitat.

The stipulation applied to the nominated lease parcel 408 would minimize impacts to LPC and LPC habitat within the nominated lease parcel listed in Table 3.29. Site-specific analysis and pre-disturbance biological surveys at the lease development stage would contribute to avoidance, minimization, and reduction of impacts to suitable habitat.

3.6.4.3 *Mitigation Measures and Residual Effects*

Under the authority granted in standard terms and conditions attached to each lease, measures to reduce impacts on or avoid resource values, land uses, or users would be attached as COAs to the APD. Potential mitigation would reduce the risk of impacts on species; however, residual impacts may still include habitat fragmentation especially from roads and associated infrastructure outside of key habitat areas avoided through lease stipulations.

CHAPTER 4. CONSULTATION AND COORDINATION

The following consultation and coordination efforts with tribes, individuals, organizations, and agencies were conducted for the proposed leasing actions.

4.1 ENDANGERED SPECIES ACT CONSULTATION

BLM PDO biologists have reviewed the proposed leasing and determined the Proposed Action would comply with threatened and endangered species management guidelines outlined in the 1988 CFO RMP as amended in 1997 (Consultation #2-22-96-F-128), as amended in 1997 (Consultation #2-22-96-F-128), and in the Roswell RMP (BLM 1997b), as well as the September 2006 (Consultation #22420-2007-TA-0033) Biological Assessments (BAs) and in accordance with the requirements of the FLPMA and NEPA. In April 2008, the BLM PDO Special Status Species RMPA amended both of these land use plans in portions of Chaves, Roosevelt, Eddy, and Lea Counties to ensure continued habitat protection of two BLM special status species: LPC and the DSL. This action is also in compliance with threatened and endangered species management outlined in the September 2006 (Cons. #22420-2007-TA-0033) Biological Assessments and in accordance with the requirements of the FLPMA and NEPA.

Additionally, in August 2021, the BLM also completed a review of the current species listings within the vicinity of the nominated lease parcels using the USFWS IPaC system (Consultation Code:02ENNM00-2021-SLI-1582 Chaves County, and Consultation Code: 02ENNM00-2021-SLI-1583 for Lea County; USFWS 2021b). No federally listed fish species were found to have potential to be present on the nominated lease parcels. Based on the understanding that water use for drilling and operations would be properly permitted from existing legal sources (i.e., no new water depletions), no federally listed fish species would be impacted by future potential development of the lease parcels. Therefore, no further consultation with the USFWS is required at this stage.

BLM would initiate Section 7 consultation with the USFWS in compliance with the ESA for species not previously analyzed in the 1997 RMP Biological Assessment (BLM 1997a) if during site selection federally listed species are found to have a potential to be present or effected during lease development. If during site selection federally listed species are found to have a potential to be effected during lease development, the BLM would initiate Section 7 consultation with the USFWS in compliance with the ESA.

While federal regulation and policies require the BLM to make its public land and resources available on the basis of the principle of multiple uses, it is BLM policy to conserve special status species and their habitats, and to ensure that actions authorized by the BLM do not contribute to the need for the species to become listed as Threatened or Endangered by the USFWS. Official species lists, whether obtained via IPaC or local USFWS offices, are valid for 90 days. After 90 days, project proponents should confirm their results on IPaC by requesting an updated official species list for their project.

4.2 TRIBAL CONSULTATION

Tribal consultation for the leasing actions is done on a government-to-government basis. The five nominated lease parcels were originally nominated for auction in the BLM PDO April 2021 Competitive Oil and Gas Lease Sale.

The CFO initiated government-to-government consultation for the April 2021 Competitive Oil and Gas Lease Sale under NEPA and NHPA on September 16, 2020, with the Apache Tribe of Oklahoma, Comanche Nation, Hopi Tribe, Kiowa Tribe of Oklahoma, Mescalero Apache Tribe, Pueblo of Isleta,

and Ysleta del Sur Pueblo. The CFO re-initiated government-to-government consultation under NEPA and NHPA for the same leases as part of the BLM PDO Quarter 1 2022 Competitive Oil and Gas Lease Sale planning process on September 8, 2021, with the same tribes.

The Comanche Nation responded to CFO on September 23, 2020, stating that "No Properties" have been identified. The Ysleta del Sur Pueblo responded on September 29, 2020, stating that they "believe that this proposed undertaking will not affect traditional, religious, or culturally significant sites of [the] Pueblo and have no opposition to it," but that they wish to be consulted if any human remains or artifacts are discovered that fall under the guidelines of the Native American Graves Protection and Repatriation Act.

The BLM RFO initiated government-to-government consultation under NEPA and NHPA on October 13, 2020, with the Apache Tribe of Oklahoma, Comanche Nation, Kiowa Tribe of Oklahoma, Mescalero Apache Tribe, and Ysleta del Sur Pueblo. No consultation responses have been received to date.

Tribal consultation is ongoing, and the BLM PDO will remain available to engage with Tribes and Pueblos and respond to any consultation requests. If the nominated parcels are leased, future potential development would go through separate NEPA and NHPA processes as directed by regulation and current policy.

4.3 STATE HISTORIC PRESERVATION OFFICE AND TRIBAL HISTORIC PRESERVATION OFFICE CONSULTATION

Section 106 of the NHPA and its implementing regulations (36 CFR 800) require federal agencies to consider what effect their licensing, permitting, funding, or otherwise authorizing an undertaking, such as an APD or right-of-way, may have on properties listed in or eligible for listing in the NRHP. 36 CFR 800.16 gives specific definitions for key cultural resource management concepts such as undertakings, effects, and areas of potential effects.

The New Mexico BLM has a two-party agreement with the SHPO that implements an authorized alternative to 36 CFR 800 for most undertakings (BLM and SHPO 2014). This agreement, called the State Protocol, offers a streamlined process for reporting and review that expedites consultation with the SHPO. However, certain circumstances, including intense public controversy over an undertaking, may result in the SHPO or BLM requiring use of the standard Section 106 consultation procedures outlined in 36 CFR 800 rather than the State Protocol.

The State Protocol details how the New Mexico BLM and SHPO consult and regulate their relationship. The State Protocol also outlines when case-by-case SHPO consultation is or is not required for specific undertakings, the procedures for evaluating the effects of common types of undertakings, and details how to resolve adverse effects on historic properties. These common types of undertakings regularly include actions undertaken by the BLM.

The BLM PDO cultural heritage resources specialists determined that there would be *no effect* to historic properties as a result of the undertaking. The use of State Protocol Appendix C.I.a for this undertaking is appropriate because the lease sale itself does not directly authorize surface disturbance. Rather, leaseholders are granted future right of development to the leased mineral estate that is subject to site-specific analysis under NEPA and Section 106 of the NHPA at the stage of lease development. Such lease development activities are considered undertakings separate from the lease sale. These undertakings would be subject to additional detailed analysis under NEPA and Section 106. Any adverse effects identified for development of the lease parcels would be subject to mitigation or avoidance, as appropriate.

The BLM PDO also entered the PBPA as an option for compliance with Section 106 of the NHPA for energy-related projects in the PBPA project area. None of the five nominated lease parcels available for lease are within the PBPA area; therefore, development on these parcels would not be eligible for enrollment to the PBPA. See the Programmatic Agreement fact sheet for further information (BLM 2019b). The PDO sent a letter notifying the SHPO of their intent to use the State Protocol Appendix C.I.a. on October 21, 2020 and November 11, 2021, respectively, and again on September 8, 2021 and MONTH DAY, 2021. Consultation is considered on going. Please refer to section 4.2 for information regarding Tribal consultation.

CHAPTER 5. LIST OF PREPARERS

Table 5.1 contains a list of individuals that contributed to preparation of this EA.

Table 5.1. List of EA Preparers

Name	Area of Expertise	Organization
Jim Stovall	District Manager	BLM PDO
Amanda Evanson	Hydrologist	BLM CFO
Bob Ballard	Supervisor Natural Resource Specialist	BLM CFO
Cassandra Brooks	Wildlife Biologist	BLM CFO
James Rutley	Solid Minerals Geologist (Potash)	BLM CFO
Rolando Hernandez	Cartographic Technician	BLM CFO
Tracie Hughes	Outdoor Recreation Planner	BLM CFO
Ty Allen	Assistant Field Manager – Resources	BLM CFO
Blake Ingram	Outdoor Recreation Planner	BLM RFO
Christopher Bolen	Geologist	BLM RFO
Chuck Schmidt	Field Manager	BLM RFO
Daniel Baggao	Wildlife Biologist, Former	BLM RFO
Glen Garnard	Planning and Environmental Coordinator	BLM RFO
Harley Davis	Natural Resource Specialist	BLM RFO
Helen Miller	Range Specialist	BLM RFO
Knutt Peterson	Outdoor Recreation Planner (Caves and Karsts)	BLM RFO
Michael McGee	Hydrologist	BLM RFO
Ricky Flores	Natural Resource Specialist	BLM RFO
Vanessa Bussel	Realty Specialist	BLM RFO
Catherine Brewster	Natural Resource Specialist - Planning and NEPA	BLM NMSO
Clara Meier	Natural Resource Assistant	BLM NMSO
Erin Knolles	Archeologist – Acting	BLM NMSO
John Sherman	Wildlife Biologist	BLM NMSO
Kim Ryan	Archeologist	BLM NMSO
Marikay Ramsey	Threatened and Endangered Species	BLM NMSO
Nathan Combs	Rangeland Management Specialist	BLM NMSO
Phil Gensler	Paleontologist	BLM NMSO

Name	Area of Expertise	Organization
Rebecca Hunt	Natural Resource Specialist – Minerals	BLM NMSO
Sharllyn Pimentel	Natural Resource Assistant	BLM NMSO
Anne Russell	GIS Specialist	SWCA Environmental Consultants
Brianna Zurita	Project Coordinator, Lead Author, and NEPA Specialist	SWCA Environmental Consultants
Georgia Knauss	Paleontology Specialist	SWCA Environmental Consultants
Janet Guinn	Project Lead and NEPA Specialist	SWCA Environmental Consultants
Jennifer Clayton	Assistant Project Lead and NEPA Specialist	SWCA Environmental Consultants
Jen Summers	NEPA Specialist - Environmental Justice; Cultural Resources Specialist	SWCA Environmental Consultants
Jeremy Eyre	Water Resources Specialist	SWCA Environmental Consultants
Michele Rowe	Air Quality Specialist	SWCA Environmental Consultants
Paige Marchus	NEPA Subject Matter Expert	SWCA Environmental Consultants
Max Wiegmann	NEPA Specialist – Induced Seismicity	SWCA Environmental Consultants

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APPENDIX A. MAPS

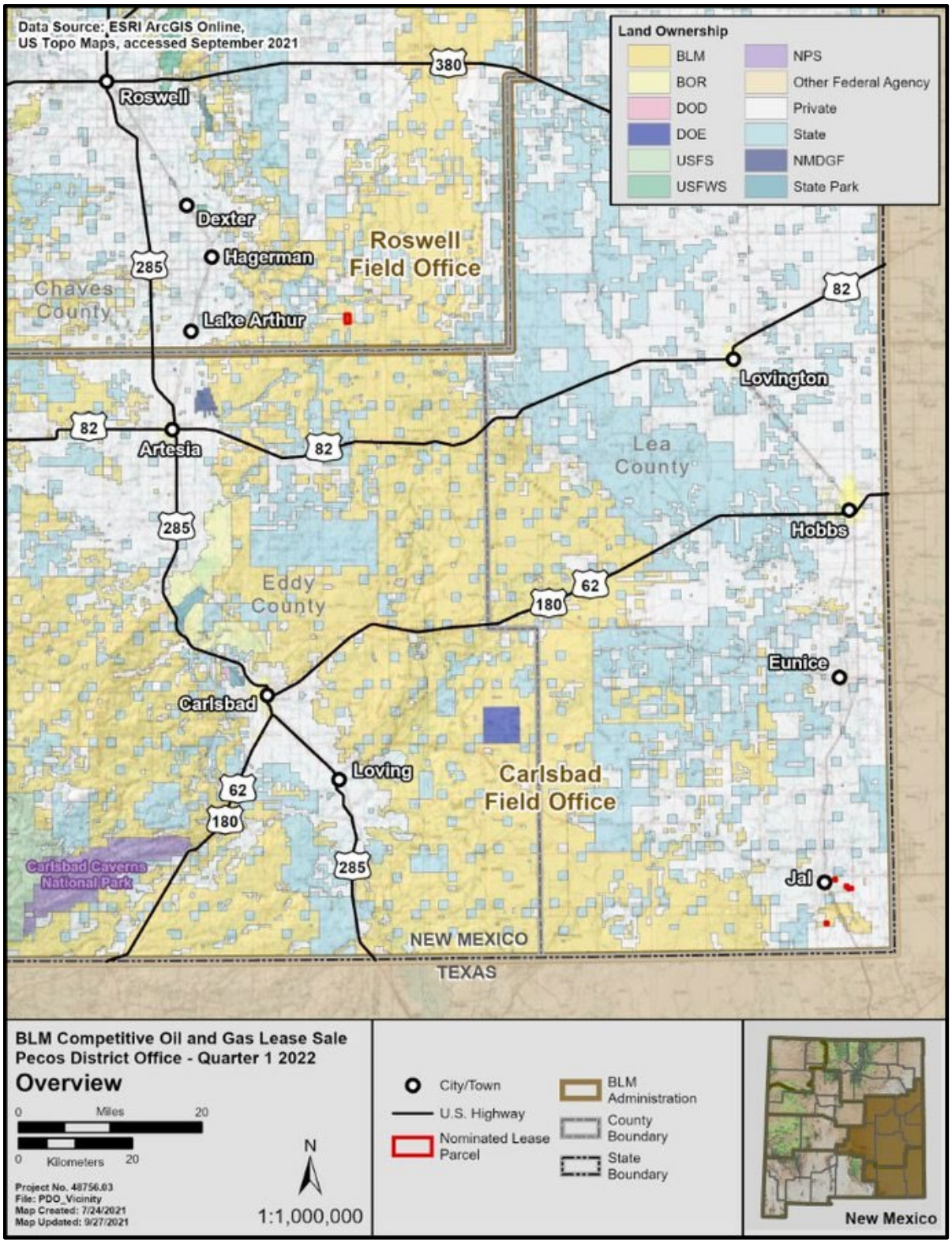

Figure A.1. Location of the nominated lease parcels analyzed within this EA, within the BLM PDO.

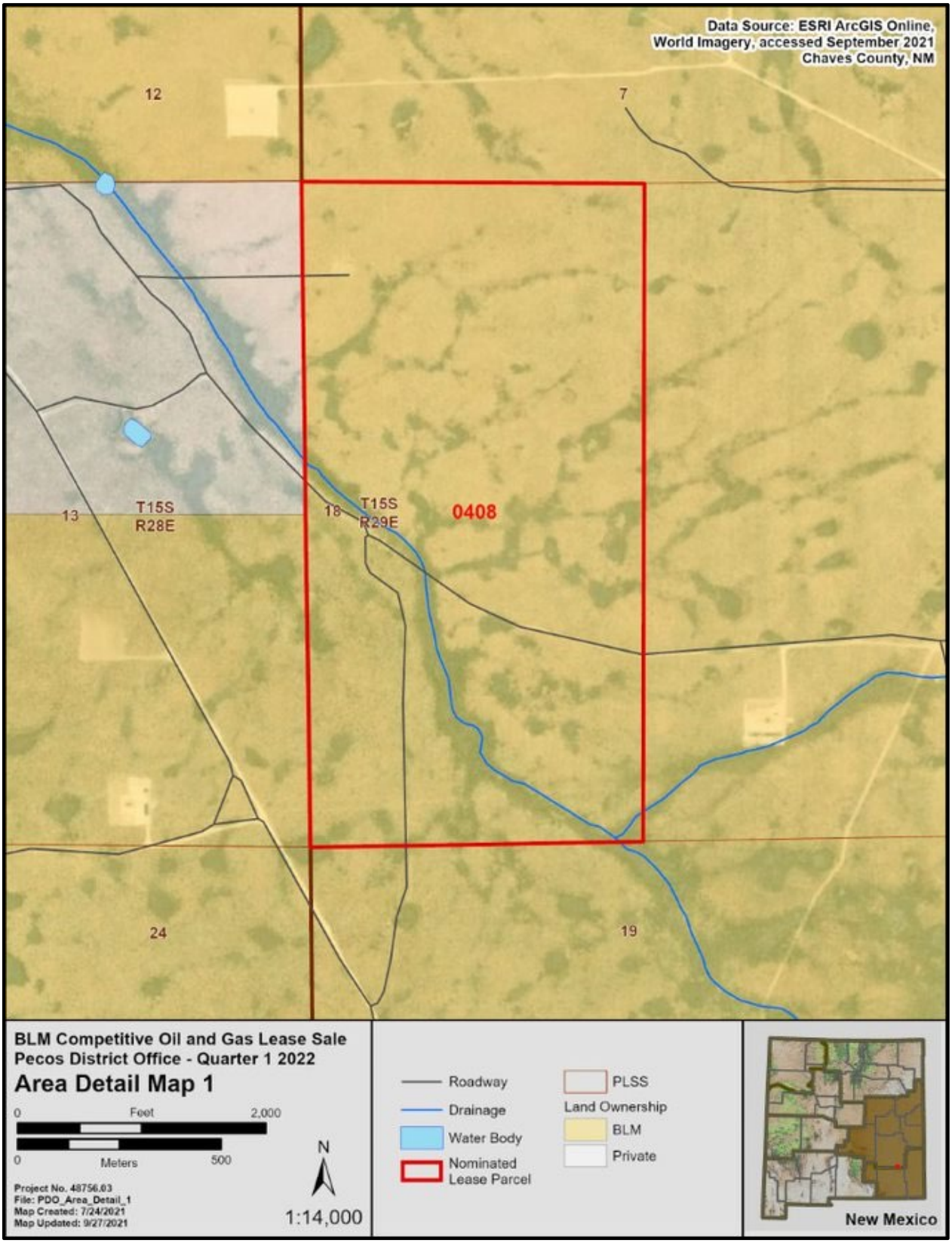

Figure A.2. Detail map of nominated lease parcel 408 analyzed in this EA, within the BLM PDO.

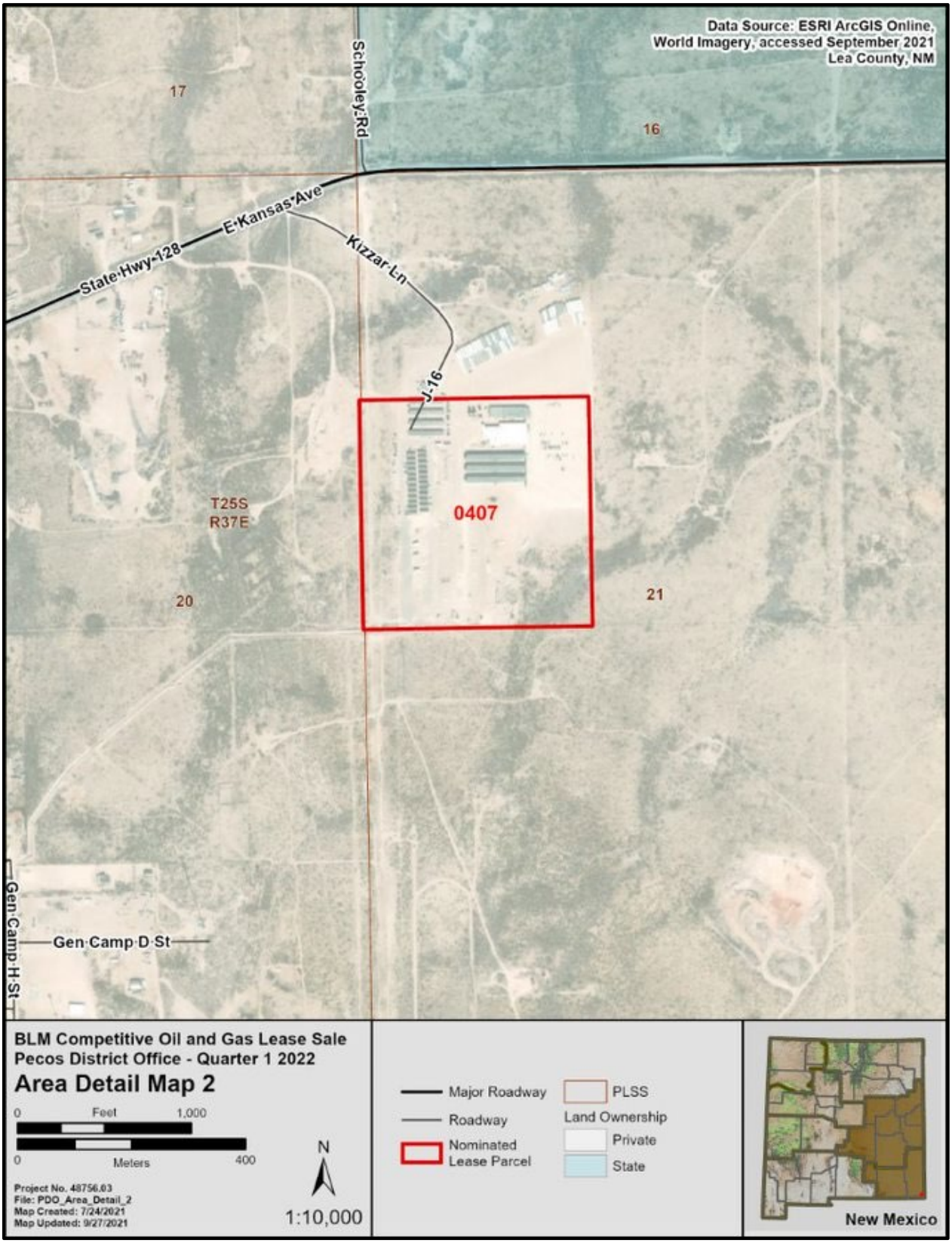

Figure A.3. Detail map of nominated lease parcel 407 analyzed in this EA, within the BLM PDO.

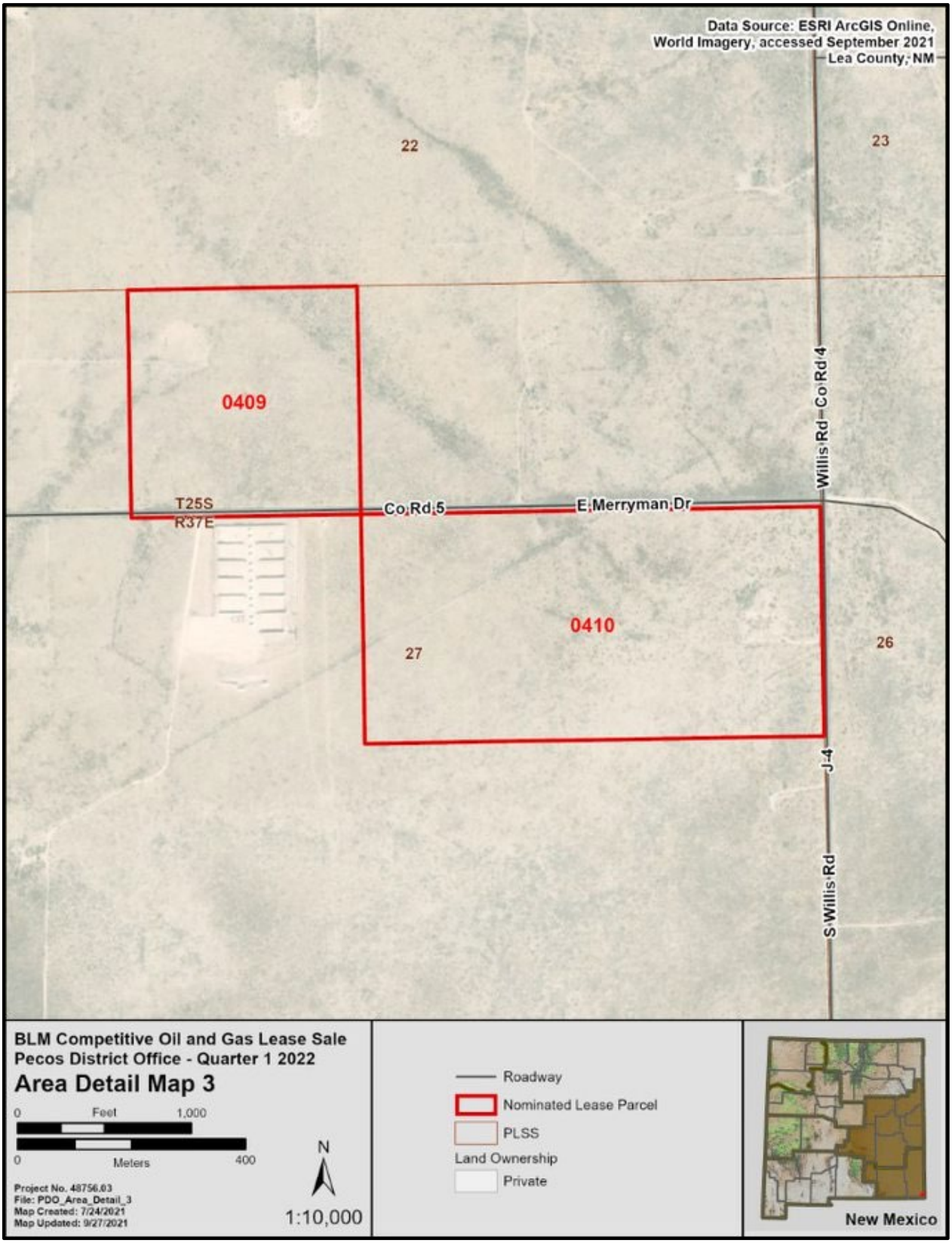

Figure A.4. Detail map of nominated lease parcels 409 and 410 analyzed in this EA, within the BLM PDO.

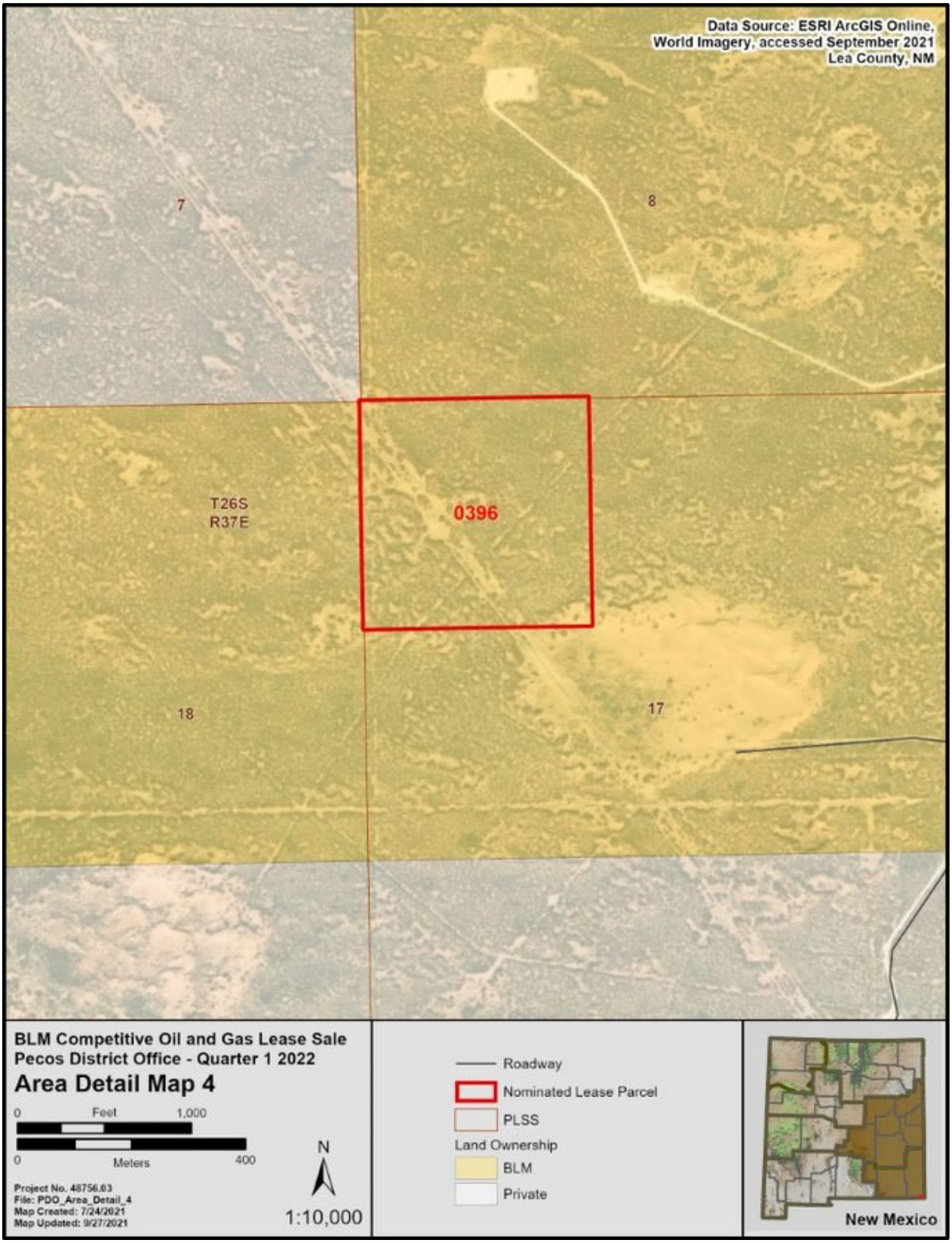

Figure A.5. Detail map of nominated lease parcel 396 analyzed in this EA, within the BLM PDO.

APPENDIX B. PECOS DISTRICT OFFICE LEASE STIPULATION AND LEASE NOTICE SUMMARY

Table B.1. Lease Stipulations and Lease Notices

Stipulation	Description/Purpose
NM-1-LN	**LEASE NOTICE – SPECIAL STATUS PLANT SPECIES** The lease contains potential, suitable, and/or occupied habitat for special status plant species; therefore, special status plant species clearance surveys may be required prior to approving any surface-disturbing activities within or adjacent to BLM Special Status Plant Species' potential, suitable, and occupied habitats. Based on the results of the survey, COAs may be applied to land use authorizations and permits that fall within the area of direct/indirect impacts or affected habitat, as appropriate. Possible mitigation strategies may include, but are not limited to avoidance/restriction of development, minimizing the area of disturbance, dust abatement measures, deterrents to reduce human disturbance, construction outside of the blooming season, specialized reclamation procedures, long-term monitoring of impacts, general oversight by qualified and independent third-party contractors, non-native or invasive species monitoring and control in occupied and suitable habitat, or any other on-site habitat protection or improvements.
NM-11-LN	**LEASE NOTICE – SPECIAL CULTURAL RESOURCE** All development activities proposed under the authority of this lease are subject to compliance with Section 106 of the NHPA and Executive Order 13007. The lease area may contain historic properties, traditional cultural properties (TCPs), and/or sacred sites currently unknown to the BLM that were not identified in the Resource Management Plan or during the lease parcel review process. Depending on the nature of the lease developments being proposed and the cultural resources potentially affected, compliance with Section 106 of the NHPA and Executive Order 13007 could require intensive cultural resource inventories, Native American consultation, and mitigation measures to avoid adverse effects—the costs for which will be borne by the lessee. The BLM may require modifications to or disapprove proposed activities that are likely to adversely affect TCPs or sacred sites for which no mitigation measures are possible. This could result in extended time frames for processing authorizations for development activities, as well as changes in the ways in which developments are implemented.
NM-13-CSU	**CONTROLLED SURFACE USE – PROTECTION OF PALEONTOLOGICAL RESOURCES** All development in this lease will be subject to compliance with the Paleontological Resources Preservation Act (PRPA), the National Environmental Policy Act (NEPA), and the Federal Land Policy and Management Act (FLPMA). Surface occupancy or use is subject to special operating constraints.
NM-14-LN	**LEASE NOTICE – PALEONTOLOGICAL RESOURCES** All development in this lease will be subject to compliance with the Paleontological Resources Preservation Act (PRPA), the National Environmental Policy Act (NEPA), and the Federal Land Policy and Management Act (FLPMA). The lessee shall immediately notify the BLM Authorized Officer (AO) of any paleontological resources discovered as a result of approved surface disturbing operations. The lessee shall suspend all activities in the vicinity of such discovery until notified to proceed by the AO and shall protect the discovery from damage or looting. The AO will evaluate, or will have evaluated, such discoveries after being notified and determine after consulting with the operator and the BLM Regional Paleontologist, the appropriate measures to mitigate adverse effect to significant paleontological resources. Upon approval of the AO, the operator will be allowed to continue construction through the site, or will be given the choice of either following the AO's instructions for stabilizing the fossil resource in place and avoiding further disturbance to the fossil resource, or following the AO's instructions for mitigating impacts on the fossil resource prior to continuing construction through the project area. The lessee is responsible for any cost associated for mitigating paleontology resources discovered as a result of their activities. In addition, surface occupancy or use may be subject to, but not limited to the special operating constraints:
SENM-LN-1	**LEASE NOTICE – POTENTIAL CAVE OR KARST OCCURRENCE AREA** All or a portion of the lease is located in a potential cave or karst occurrence area. Due to the sensitive nature of the cave or karst systems of this area, special protective measures may be developed during environmental analyses and be required as part of approvals for drilling or other operations on this lease. These measures could include: changes in drilling operations; special casing and cementing programs; modifications in surface activities; or other reasonable measures to mitigate impacts on cave or karst values.

Stipulation	Description/Purpose
SENM-S-16-CSU	**CONTROLLED SURFACE USE – PROTECTION OF RAPTOR NESTS AND HERONRIES** Surface disturbance will not be allowed within up to 200 meters of active heronries or by delaying activity for up to 120 days, or a combination of both. Raptor nests on special, natural habitat features, such as trees, large brush, cliff faces and escarpments, will be protected by not allowing surface disturbance within up to 200 meters of nests or by delaying activity for up to 90 days, or a combination of both. Exceptions to this requirement for raptor nests will be considered if the nests expected to be disturbed are inactive, the proposed activity is of short duration (e.g., habitat enhancement projects, fences, pipelines), and will not result in continuing activity in proximity to the nest.
SENM-S-17-CSU	**CONTROLLED SURFACE USE – PROTECTION OF SLOPES OR FRAGILE SOILS** Surface disturbance will not be allowed on slopes over 30%. Occupancy or use of fragile soils will be considered on a case-by-case basis.
SENM-S-19-CSU	**CONTROLLED SURFACE USE – PROTECTION OF PLAYAS AND ALKALI LAKES** Surface disturbance will not be allowed within up to 200 meters from the edge of playas or alkali lakes.
SENM-S-39-CSU	**CONTROLLED SURFACE OCCUPANCY – PLAN OF DEVELOPMENT (POD)** A plan of development (POD) for the entire lease must be submitted for review and approval, including NEPA analysis, by the BLM Authorized Officer, prior to approval of development (APD, Sundry Notices) actions. The POD must indicate planned access to well facilities (roads, pipelines, power lines), and the approximate location of well sites.
WO-ESA-7	**ENDANGERED SPECIES ACT SECTION 7 CONSULTATION** The lease area may now or hereafter contain plants, animals, or their habitats determined to be threatened, endangered, or other special status species. BLM may recommend modifications to exploration and development proposals to further its conservation and management objective to avoid BLM-approved activity that will contribute to a need to list such a species or their habitat. BLM may require modifications to or disapprove proposed activity that is likely to result in jeopardy to the continued existence of a proposed or listed threatened or endangered species or result in the destruction or adverse modification of a designated or proposed critical habitat. BLM will not approve any ground-disturbing activity that may affect any such species or critical habitat until it completes its obligations under applicable requirements of the Endangered Species Act as amended, 16 U.S.C. § 1531 et seq., including completion of any required procedure for conference or consultation.
WO-NHPA	**CULTURAL RESOURCES AND TRIBAL CONSULTATION** This lease may be found to contain historic properties and/or resources protected under the National Historic Preservation Act (NHPA), American Indian Religious Freedom Act, Native American Graves Protection and Repatriation Act, Executive Order 13007, or other statutes and executive orders. The BLM will not approve any ground-disturbing activities that may affect any such properties or resources until it completes its obligations (e.g., State Historic Preservation Officer (SHPO) and tribal consultation) under applicable requirements of the NHPA and other authorities. The BLM may require modification to exploration or development proposals to protect such properties or disapprove any activity that is likely to result in adverse effects that cannot be successfully avoided, minimized, or mitigated.

APPENDIX C. SUMMARY OF THE TYPICAL PHASES OF OIL AND GAS DEVELOPMENT

INTRODUCTION

The phases of oil and gas development include construction, drilling operations, completion operations, hydraulic fracturing, and production. During the construction activity phase, the area is cleared of vegetation and the pad is constructed. Throughout the drilling operation phase, equipment is moved on site and used to install the drill rig and other associated infrastructure. At this stage, the well is drilled. Well completion follows well drilling. Well completion includes setting the casing to depth, cementing the casing,[11] and perforating the casing in target zones. If a well is going to be drilled directionally,[12] horizontally,[13] or vertically[14] this phase may be followed by hydraulic fracturing which involves pumping fracturing fluid into a formation at a calculated, predetermined rate and pressure to generate fractures or cracks in the target formation. The production phase begins when the well starts producing. The well abandonment and reclamation phases occur after the productive life of the well has concluded. Well abandonment and reclamation involve plugging wells and reclaiming the surface according to BLM guidelines and requirements.

Construction Activities

First, new construction areas need to be cleared of all vegetation. Clearing of the proposed well pad and access road are typically limited to the smallest area possible to provide safe and efficient work areas for all phases of construction. All clearing activities are accomplished by cutting, mowing, and/or grading vegetation, as necessary. Cut vegetation may be mulched and spread on site or hauled to a commercial waste disposal facility.

Next, heavy equipment, including but not limited to, bulldozers, graders, front-end loaders, and/or track hoes are used to construct the pad, along with other features, as needed for development. Other features may include, but are not limited to, an access road, reserve pit, pipeline, and/or fracturing pond. Cut and fills may be required to level the pad or road surfaces. Reserve pits, if authorized, are lined using an impermeable liner or other lining mechanism (i.e., bentonite or clay) to prevent fluids from leaching into the soil. Access roads may have cattle guards, gates, drainage control, or pull-outs installed, among a host of other features that may be necessary based on the site-specific situation. Long-term surface

[11] According to BLM regulations from 43 CFR 3160: Onshore Order No. 2, casing and cementing programs are conducted to protect and/or isolate all usable water zones, lost circulation zones, abnormally pressured zones, and any prospectively valuable deposits of minerals. The casing setting depth is calculated to position the casing seat opposite a competent formation which will contain the maximum pressure to which it will be exposed during normal drilling operations. Determination of casing setting depth is based on all relevant factors, including presence/absence of hydrocarbons; fracture gradients; usable water zones; formation pressures; lost circulation zones; other minerals; or other unusual characteristics. Any isolating medium other than cement shall receive approval prior to use. The deepest casing may not be cemented and may remain open hole depending on the type of formation it is located in.

[12] Vertical drilling is the process of drilling a well from the surface vertically to a subsurface location where the target oil or gas reservoir is located (U.S. Department of Energy 2015).

[13] Horizontal drilling is the process of drilling a well from the surface to a subsurface location just above the target oil or gas reservoir called the “kickoff point,” then deviating the well bore from the vertical plane around a curve to intersect the reservoir at the “entry point” with a near-horizontal inclination, and remaining within the reservoir until the desired bottom hole location is reached (North Dakota Department of Mineral Resources 2008).

[14] Directional drilling is the process of controlling the direction and deviation of drilling a well from the surface to a subsurface location without disturbing the land directly above the target oil or gas reservoir (U.S. Department of Energy 2015).

disturbances such as pads and roads are typically surfaced with a layer of crushed rock. Areas not needed for long-term development are reclaimed by recontouring the surface and re-establishing vegetation.

A pipeline, if needed, is laid within a right-of-way that is first cleared of vegetation. A backhoe, or similar piece of equipment, digs a trench to a depth at least 36 inches below ground surface. After the trench is dug, the pipeline is assembled by welding pieces of pipe together to fit the contour of the pipeline's path. Once inspected, the pipe can be lowered into the trench and covered with stockpiled subsoil originally removed from the trench. Each pipeline undergoes hydrostatic testing prior to natural gas being pumped through the pipeline. This ensures the pipeline is strong enough and absent any leaks. Table C.1 includes some of the common wastes (hazardous and nonhazardous) that are produced during construction.

Drilling Operations

When construction of the well-pad is complete, the drilling rig and associated equipment are moved on site and erected. Usually, a conventional rotary drill rig is used. The drill rig must be capable of withstanding all the anticipated conditions that may be encountered while drilling. Wells may be drilled directionally, horizontally, or vertically based on the target formation. The depth of the well is entirely dependent on the target formation depth and may be several hundred feet deep to over 20,000 feet deep.

When a conventional reserve pit [15]system is used, drilling fluid or mud is circulated through the drill pipe to the bottom of the hole, through the bit, up the bore of the well, and finally to the surface. When drilling mud emerges from the hole, it enters the reserve pit where it remains until all fluids are evaporated and the solids can be buried.

A closed-loop system operates in a similar fashion except that when the drilling mud emerges from the hole, it passes through equipment used to screen and remove drill cuttings (rock chips) and sand-sized solids rather than going into a pit. When the solids have been removed, the drilling mud is placed into holding tanks, and from the tank, used again.

In either situation the drilling mud is maintained at a specific weight and viscosity to cool the bit, seal off any porous zones (thereby protecting aquifers and preventing damage to producing zone productivity), control subsurface pressure, lubricate the drill string, clean the bottom of the hole, and bring the drill cuttings to the surface. Water-based or oil-based muds can be used. This choice is dependent on the site-specific conditions.

Once a well has been drilled, completion operations begin. Well completion involves setting casing to depth and perforating the casing in target zones.

Wells are often treated during completion to improve the recovery of hydrocarbons by increasing the rate and volume of hydrocarbons moving from the natural oil and gas reservoir into the wellbore. These processes are known as well-stimulation treatments, which create new fluid passageways in the producing formation or remove blockages within existing passageways. They include fracturing, acidizing, and other mechanical and chemical treatments often used in combination. The results from different treatments are additive and complement each other.

Hydraulic Fracturing

Hydraulic fracturing is a formation stimulation practice used to create additional permeability in a producing formation, thus allowing oil and/or gas to flow more readily toward and into the wellbore.

[15] A conventional reserve pit is a lined earthen pit excavated adjacent to a well pad and is commonly used for the disposal of drilling muds and fluids in gas or oil fields (USFWS 2009).

Hydraulic fracturing can be used to overcome natural barriers, such as naturally low permeability or reduced permeability resulting from near wellbore damage to the flow of fluids (gas or water) to the wellbore (Groundwater Protection Council 2017). The process has been a method for additional oil and gas recovery since the 1900s; however, with the advancement of technology, in both hydraulic fracturing and horizontal drilling, it is more commonly used than previous hydraulic fracturing and horizontal drilling technologies.

Hydraulic fracturing uses high pressure pumps to pump fracturing fluid into a formation at a calculated, predetermined rate and pressure to generate fractures or cracks in the target formation. For shale developments (within Mancos shale geologic formations, for example), fracture fluids are primarily water-based fluids mixed with additives that help the water to carry "proppants" into the fractures. Proppants, which may be made up of sand, walnut hulls, or other small particles, are needed to "prop" open the fractures once the pumping of fluids has stopped. Once the fracture has initiated, additional fluids are pumped into the wellbore to continue the development of the fracture and to carry the proppant deeper into the formation. The additional fluids are needed to maintain the downhole pressure necessary to accommodate the increasing length of opened fracture in the formation.

Hydraulic fracturing increases the flow rate and volume of reservoir fluids that move from the producing formation into the wellbore. The fracturing fluid is typically more than 99% water and sand, with small amounts of readily available chemical additives used to control the chemical and mechanical properties of the water and sand mixture. Because the fluid is composed mostly of water, large volumes of water are usually needed to perform hydraulic fracturing (estimates of water usage for hydraulic fracturing are provided in the BLM New Mexico Water Support Document [BLM 2020a]). However, in some cases, water is recycled or produced water is used.

The predominant fluids currently being used for fracture treatments in the shale gas plays are water-based fracturing fluids mixed with friction-reducing additives, also known as slick water (Groundwater Protection Council 2017). The number of chemical additives used in a typical fracture treatment varies depending on the conditions of the specific well that is to be fractured. A typical fracture treatment uses very low concentrations of between three and 12 additive chemicals, depending on the characteristics of the water and the shale formation being fractured. Each component serves a specific, engineered purpose, from limiting the growth of bacteria to preventing corrosion of the well casing. The makeup of fracturing fluid varies from one geologic basin or formation to another. Because the makeup of each fracturing fluid varies to meet the specific needs of each area, there is no one-size-fits-all formula for the volumes for each additive. In classifying fracture fluids and their additives, it is important to realize that service companies that provide these additives have developed a number of compounds with similar functional properties to be used for the same purpose in different well environments. The difference between additive formulations may be as small as a change in concentration of a specific compound (Groundwater Protection Council 2017).

Before operators or service companies perform a hydraulic fracturing treatment, a series of tests are performed. These tests are designed to ensure that the well, including casing and cement, well equipment, and fracturing equipment are in proper working order and would safely withstand the application of the fracture treatment pressures and pump flow rates.

Hydraulic fracturing of horizontal shale gas wells is most commonly performed in stages. Lateral lengths in horizontal wells for development may range from 1,000 feet to more than 5,000 feet. Depending on the lengths of the laterals, treatment of wells may be performed by isolating smaller portions of the lateral. The fracturing of each portion of the lateral wellbore is called a stage. Stages are fractured sequentially beginning with the section at the farthest end of the wellbore, moving up hole as each stage of the treatment is completed until the entire lateral well has been stimulated. During drilling, the BLM is on

location during the casing and cementing of the surface casing, which is often the string of casing that protects groundwater, along with other critical casing and cementing intervals. Before hydraulic fracturing takes place, all surface casing and some deeper, intermediate zones are required to be cemented from the bottom of the cased hole to the surface. The cemented well is pressure tested to ensure there are no leaks and in some cases a cement bond log is run to ensure the cement has bonded to the casing and the formation. If the fracturing of the well is considered to be a "non-routine" fracturing job for the area, the BLM would always be on-site during those operations as well as when abnormal conditions develop during the drilling or completion of a well.

Some soils and geologic formations contain low levels of radioactive material. This naturally occurring radioactive material (NORM) emits low levels of radiation, to which everyone is exposed on a daily basis. When NORM is associated with oil and natural gas production, it begins as small amounts of uranium and thorium within the rock. These elements, along with some of their decay elements, notably Radium-226 and Radium-228, can be brought to the surface in drill cuttings and produced water. Radon-222, a gaseous decay element of radium, can come to the surface along with the shale gas. When NORM is brought to the surface, it remains in the rock pieces of the drill cuttings, remains in solution with produced water, or, under certain conditions, precipitates out in scales or sludges. The radiation is weak and cannot penetrate dense materials such as the steel used in pipes and tanks. Testing is required prior to disposal of pipes, tanks, and pipe deposits per Section 19.15.35.8 of the New Mexico Administrative Code (NMAC). Radiation levels used to define "regulated NORM" in oil-field soils, equipment, sludges, or other materials related to oilfield operations or processes are defined at 20.3.14.1403 NMAC. Disposal of NORM (including in produced water) is regulated per 19.15.35.9 through 19.15.35.14 NMAC and the New Mexico environmental improvement board rule, 20.3.14 NMAC. Per 20.3.14.1403 NMAC, produced water is exempt from the requirements of these regulations if it is reinjected into a Class I or Class II Underground Injection Control (UIC) well permitted by the New Mexico Oil Conservation Division (NMOCD) and/or stored or disposed of in a double, synthetically lined surface impoundment permitted by the NMOCD.

Production Operations

Production equipment used during the life of the well may include a three-phase separator-dehydrator, flowlines, a meter run, tanks for condensate, produced oil and water, and heater treater. A pumpjack may be required if the back pressure of the well is too high. Production facilities are arranged to facilitate safety and maximize reclamation opportunities. All permanent aboveground structures not subject to safety considerations are painted a standard BLM environmental color or as landowner specified.

Workovers may be performed multiple times over the life of the well. Because oil and gas production usually declines over the years, operators perform workover operations, which involve cleaning, repairing, and maintaining the well for the purposes of increasing or restoring production.

Abandonment and Reclamation

Well abandonment (whether dry hole or depleted producer) and reclamation of location, access road, and other facilities requires BLM approval. After approval, wellbores are plugged with cement as necessary to prevent fluid or pressure mitigation and to protect and isolate mineral and water resources. Wellheads are removed, and both the surface casing and the production casing are cut off below ground in compliance with federal and state regulations. The well pad, reserve pit and access are reclaimed according to BLM guidelines. This may include backfilling the pit, recontouring the surface to blend with natural surroundings and redistributing topsoil. All surfaces are then reseeded per BLM and State requirements specified in the Application for Permit to Drill (APD) approval.

Common Wastes

Table C.1 includes some of the common wastes (hazardous and nonhazardous) that are produced during oil and gas development.

Table C.1. Common Wastes Produced during Oil and Gas Development

Phase	Waste	
Construction, Well Drilling and Completion (including hydraulic fracturing)	Domestic wastes (i.e., food scraps, paper, etc.)	
	Excess construction materials	Woody debris
	Used lubricating oils	Paints
	Solvents	Sewage
	Drilling muds, including additives (i.e., chromate and barite) and cuttings; Well drilling, completion, workover, and stimulation fluids (i.e., oil derivatives such as polycyclic aromatic hydrocarbons (PAHs), spilled chemicals, suspended and dissolved solids, phenols, cadmium, chromium, copper, lead, mercury, nickel)	
	Equipment, power unit and transport maintenance wastes (i.e., batteries; used filters, lubricants, oil, tires, hoses, hydraulic fluids; paints; solvents)	
	Fuel and chemical storage drums and containers	
	Cementing wastes	Rig wash
	Production testing wastes	Excess drilling chemicals
	Excess construction materials	Processed water
	Scrap metal	Contaminated soil including hazardous and non-hazardous materials (potential)
	Sewage	Domestic wastes
Production	Power unit and transport maintenance wastes (i.e., batteries; used filters, lubricants, filters, tires, hoses, coolants, antifreeze; paints; solvents, used parts)	
	Discharged produced water	
	Production chemicals	
	Workover wastes (e.g., brines)	
Abandonment / Reclamation	Construction materials	
	Decommissioned equipment	
	Contaminated soil (potential)	
	Equipment or wastes that could contain hazardous and nonhazardous materials	

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